AD NUMBER
AD852659
CLASSIFICATION CHANGES
TO: unclassified
FROM: confidential
LIMITATION CHANGES
TO: Approved for public release, distribution unlimited
FROM: Distribution authorized to U.S. Gov't. agencies and their contractors; Critical Technology; APR 1962. Other requests shall be referred to Headquarters, Space and Missile Systems Organization, Attn: SMSD, Los Angeles, CA 90045.
AUTHORITY
30 Apr 1974, DoDD 5200.10; SAMSO ltr, 28 Feb 1972

AD NUMBER
AD852659
CLASSIFICATION CHANGES
TO confidential
FROM secret
AUTHORITY
30 Apr 1965, DoDD 5200.10

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CONVAIR (ASTRONAUTICS) DIVISION
GENERAL DYNAMICS CORPORATION

AA 62-0048
30 April 1962

UNCLASSIFIED

WS 107A-1 FLIGHT TEST WORKING GROUP

FLIGHT TEST REPORT

ATLAS MISSILE 11F

GENERAL DYNAMICS | ASTRONAUTICS

Classification 9 April 1962
UNCLASSIFIED

Log No. T 62-828 Copy No. 143

AMR RANGE TEST NUMBER 71

ASTRONAUTICS TEST NUMBER P1-601-00-11

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FOREWORD

This report has been prepared to present preliminary information relative to the flight of Atlas Missile No. 11F. The information presented is based on visual observation and data evaluation to the extent permitted by time limitations. It should be considered as preliminary only, and the final reports on this flight referenced for further information. The technical content has been prepared and jointly agreed upon by members of the WS107A-1 Flight Test Working Group.

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SUMMARY

Atlas Missile 11F was launched from AMR, Complex 11 at 1607 EST on 9 April 1962. The flight was unsuccessful and the missile destroyed itself after slightly more than one second of flight. The cause of the flight failure has not been determined. Several areas are suspect and are presently under investigation; however, no conclusions can be made at this time.

The first indication of an unusual situation was a momentary temperature decrease in the thrust section at minus 58 seconds, as monitored by two thermistor circuits located on the Quad 2 A Frame. This was immediately after completion of the LO2 slug. Examination of the B2 slug check valve has revealed a bad seal which could leak under low pressure conditions and which could account for this indication. However, a sequence of events has not been determined whereby such a leak could have been the initiating factor which ultimately would lead to missile destruction.

No other abnormal indications were observed until after liftoff. Booster and sustainer ignition and transition to mainstage operation appeared completely normal. About 0.87 seconds after liftoff the sustainer engine began to shut down. All fuel system pressures started to decrease and the pump speed and some of the LO2 system pressures showed momentary increases and then decreases. All sustainer engine data was lost at about 0.97 seconds. The engine had essentially shut down by that time.

A LO2 rich explosion was seen in the thrust section at about 0.90 seconds. All telemetry data were lost at 1.19 seconds when propellants in the tanks exploded. Booster engine operation was still normal at that time. Examination of telemetry data has not revealed the initiating cause for loss of the missile. Preliminary hardware examination revealed evidences of a detonation in the LO2 pump inlet or inlet ducting; however, it is not known whether this was the initiating cause or a result. Further tear down of the sustainer engine is being accomplished.

Refurbishment of the complex is proceeding.

All times in this report are referenced to One Inch Motion which occurred at 1607:39.88 EST.

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FLIGHT TEST OBJECTIVES

The primary objectives for the flight of Missile 11F were to obtain data for the statistical determination of CEP, evaluate ARMA Inertial Guidance System performance, determine the performance of the arming and fuzing system, and to obtain data on missile systems at staging. Also included was the evaluation of the Mark 4 Mod IB Re-entry Vehicle performance.

These objectives, as well as others, were not satisfied due to self-destruction of the missile at approximately 1.2 seconds after liftoff. The target for this flight was located at the center of the Ascension (MILS) Splash Net 4400 nautical miles downrange.

FAILURE ANALYSIS

PROPULSION SYSTEM

Operation of the engines was satisfactory until at least 0.87 seconds after One Inch Motion. The booster and sustainer engines had satisfactorily progressed through ignition stage and transition to mainstage. All primary parameters had attained proper operating levels. The first significant occurrence was noted when the measurement of the Sustainer Head Suppression Valve position was sampled at 0.884 seconds. The instrumentation wiring for this measurement was apparently shorted at this time. When the measurement was next sampled at 0.902 seconds, the measurement wiring appeared open. The wiring remained open after that time. After 0.87 seconds, at which time all sustainer engine pressure parameters appeared normal, an increase and subsequent decay in the gas generator and main chamber LO2 injection pressures occurred. The remaining sustainer engine parameters showed decays during this period. At 0.892 and 0.898 seconds respectively, the main chamber and gas generator LO2 injection pressures showed increases for the data samples at those times. (Sustainer engine measurements were sampled 60 times per second.) These pressures then showed decays until loss of data on engine operation at about 0.97 seconds. Sustainer pump speed data showed an increase at approximately the same time as the increases in LO2 injection pressures; however, the time delay inherent in pump speed data leaves some question as to when the increase occurred. The best playback available shows a very slight increase (less than 100 rpm) between 0.870 and 0.895 seconds and a sharp increase between 0.895 and 0.907 seconds, when it reached a peak of at least 10,900 rpm. This increase may have occurred as much as 15 milliseconds earlier since there is a delay in the data. Pump speed then decayed to 9,810 rpm by 0.98 seconds. The data after that time is questionable. After 0.89 seconds downward trends occurred on the gas generator fuel injection pressure, the main chamber fuel injection pressure, the fuel pump discharge pressure, the LO2 regulator discharge pressure and the chamber pressure. These pressures showed decays until loss of data. At loss of data all system pressures were below 300 psi.

Possible explanations for these events include:

1. A detonation in the LO2 pump inlet or inlet ducting. If a detonation did occur, a hammer would take place and could cause the observed rise in the gas generator and thrust chamber LO2 injection pressures and subsequently on pump speed. However, it is expected that the increase on pump speed would also cause increases in the LO2 regulator outlet pressure, the fuel pump discharge pressure, the gas generator fuel injection and main chamber fuel injection pressures. No such increases were observed.

2. An undetermined malfunction in the fuel feed system or the fuel pump. If there were an interruption or restriction of fuel flow to the gas generator, such as would be caused by a fuel restriction in the low pressure system, the gas generator power output would increase due to the change in mixture ratio, and the pump speed and LO2 discharge pressure would increase as seen. Also the fuel pump discharge pressures would decrease, as seen. However, it is expected that the increase in pump speed would cause an increase in the LO2 regulator outlet pressure and in the SGG combustor temperature. No such increase was observed. In addition, unloading of the pump can cause rubbing in the impeller area of the LO2 pump with subsequent detonation and rupturing of the LO2 inlet ducting.

No other failure methods which have been considered would fit the data and hardware condition as well as these two methods. In either case, the rupturing of the low pressure LO2 ducting could easily lead to further damage in the thrust section and the subsequent explosion in the thrust section which was seen at 0.90 seconds. There is also the possibility that LO2 from the B2 slug check valve, which was found to have a cracked seal, could have contributed to an initial failure other than these; however no hypothesis has yet been put forward to explain the failure sequence using this fact.

Booster Engines

Propulsion System Telemetered Data indicated booster engines operated satisfactorily until flight termination. The thrust rises on B1 and B2 appeared normal. Engine operating time was 3.04 seconds (ignition start to missile self-destruction). The following is a tabulation of telemetered booster engine measurements showing nominal values and values measured prior to degradation of telemetry quality at ∕0.9 seconds.

Measurement	Description	Nominal	Last
P 83 B	B2 Pump Speed	6085	6188
P 84 B	B1 Pump Speed	6085	6108
P 60 P	B1 Chamber Pressure	577	560
P 59 P	B2 Chamber Pressure	577	552
P 38 P	B2 Fuel Pump Disch	890	800

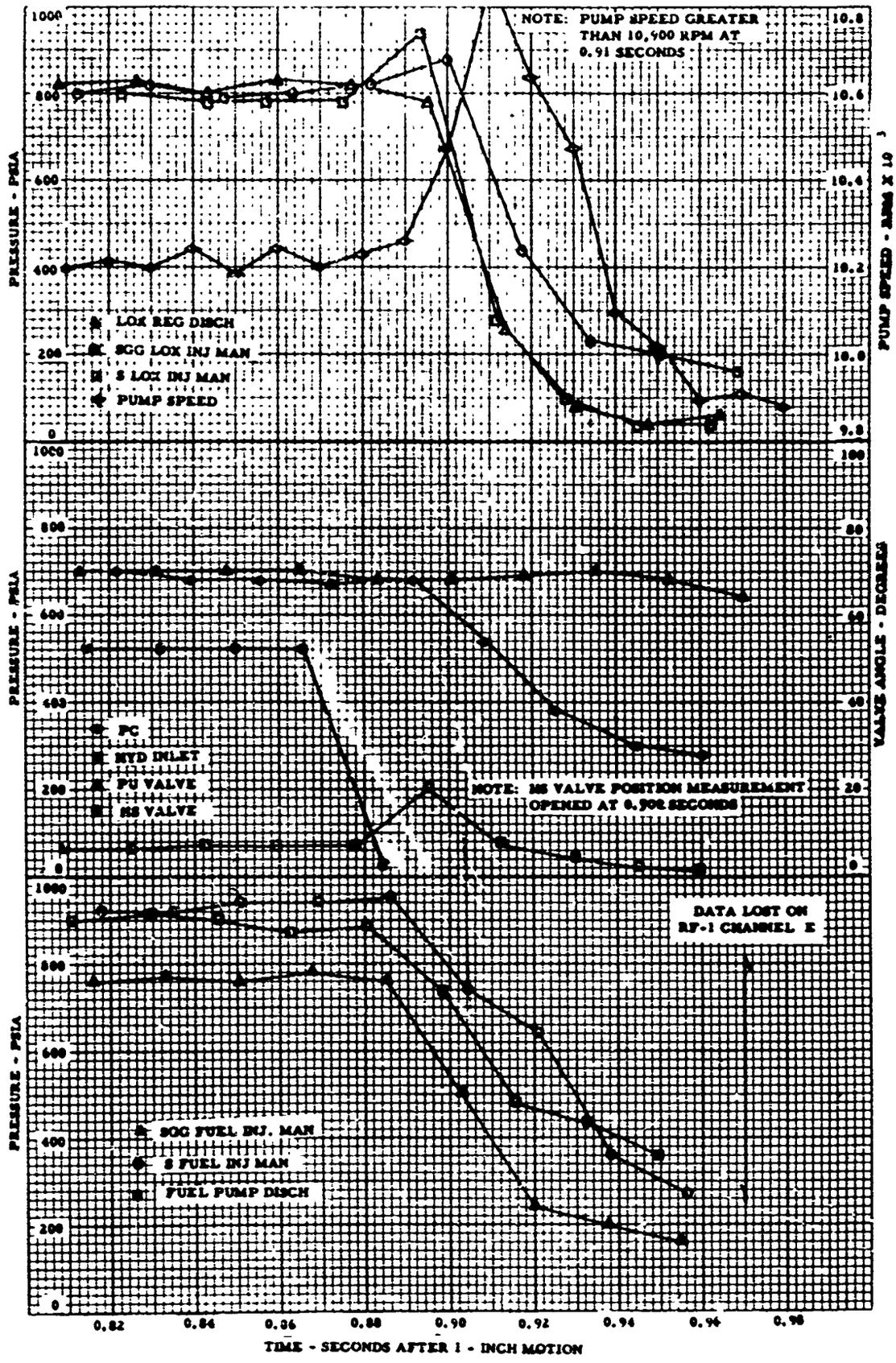
Measurement	Description	Nominal	Last
P 39 P	B1 Fuel Pump Disch	890	780
P 91 P	B1 LO2 Inj Man	-	660
P 92 P	B2 LO2 Inj Man	-	680
P 184 P	B2 GG Combustor	480	480
P 473 P	B1 Lo Pr Lub Oil Man	-	15
P 279 P	B2 Lo Pr Lub Oil Man	-	15
P 713 T	B1 GG Combustor	1276	1140
P 714 T	B2 GG Combustor	1293	1245

The above tabulation shows that the booster engines were in the process of transition from the start phase to steady state mainstage operation.

Vernier Engines

Vernier engine operation was not achieved due to flight termination at 1.19 seconds. Vernier engine thrust rise normally starts approximately 3 seconds after liftoff. At loss of telemetry data both vernier engine chamber pressures and both vernier tank pressures were normal. The vernier control pressure regulator outlet pressure was 580 psia (nominal 590) until termination of the flight. Both vernier engine LO2 bleeds operated properly until missile self-destruction.

A graph is presented on the following page showing the relationship between significant sustainer parameters during the period of engine shutdown.



HARDWARE REVIEW

Most of the Propulsion System was found in good condition. All damage to the booster engines appears to have been caused by either the missile explosion or from the impact of the parts with the surrounding area. The vernier engines appear to have been blown from the missile and received little damage. The sustainer engine was found intact with a section of the fuel tank apex attached.

A detailed discussion of the inspection of the booster and sustainer engines is presented below.

Boosters

Both booster thrust chambers were found together approximately 50 feet west of the launcher. The baffled injectors appeared in good condition. There was no apparent erosion on the injector face or on the baffles and no bending or distortion of the baffles was noted. The external surface of the LO2 domes indicated no cracks or other damage. The lube oil tank pressurizing valves were found intact with the thrust chambers. Both were badly sooted and burned from the fire, but showed no indication of cracks or deformation. Special attention was given to the area around the control port. Booster No. 1 lube tank was found adjacent to the thrust chamber and was badly burned. B2 lube tank was blown away from the thrust section and sustained only impact damage.

The booster main LO2 valves were both torn loose and were found in an open condition after impact. The booster main fuel valves were found intact with the thrust chambers.

The booster thrust chambers were subjected to extreme heat, as indicated by separation of the edge of the fiber glass wrapping at the throat area. Considerable braze wash was noted on both the external and internal surfaces of the chamber. The heaviest braze wash occurred from under the bands on the external surface of the chamber tubes. Booster No. 1 had a large dent on the "Y" axis between Quads II and III. Thirty-six (36) tubes were sheared radially approximately 14 inches above the exit. Eight (8) tubes were cut through, approximately 25 inches above the exit and a piece of metal was lodged in this hole. The piece of metal appeared to be a part of the launch tube for the sustainer thrust section camera package. It is suspected that the camera package ejected during disintegration of the missile, striking the thrust chamber, causing the damage. Several other small holes were noted in this area. Booster No. 2 received little physical damage.

Both turbopumps were found intact with gas generator and turbines mounted. There was no indication of an internal explosion in either turbopump. The accessory pads on both turbopumps were damaged, but this appeared to have been caused by impact. All turbopump volute support brackets remained with the turbopump except B2 fuel volute support bracket. The helicoils in the turbopump flange were pulled out on this bracket. There was no failure of the bolts, Part No. 401509. The nuts were in place and in each case a small section ot the boattail was torn away with the support assembly.

Sustainer

The complete sustainer engine assembly was found intact and attached to the missile fuel tank apex. It sustained very little fire damage except in the apex area. The engine had been blown through the flame bucket and across a concrete ramp into the sluiceway. The HS valve transducer was torn off and slightly burned, indicating the possibility of this occurring during the explosion. The sustainer lube tank and the thrust section area immediately aft of the lube tank were damaged during impact. The sustainer hydraulic pump was fractured at the mounting bolts which is believed to have occurred during impact. No impact marks were noted on this pump, indicating that failure was cue to inertial force. All other components appeared to have sustained no damage except the LO2 turbopump and the HS valve. All lines on the engine appear to be connected correctly. The HS valve and the PU valve were in the closed position after impact. The bolts for the inlet and outlet flanges of the HS valve were broken, separating the flanges from the valve. The downstream flange was separated approximately 1/2 inch. The area downstream of the valve was heavily blackened with soot which appears to have entered the duct through the separated flange. The LO2 volute section of the turbopump was heavily damaged. The volute parted approximately at the parting line with the bootstrap flange on the piece of the volute remaining with the pump. Several damaged areas were noted on the parted volute halves. Some of these appeared to have occurred prior to the parting of the volute. The diverter lip was burned approximately 180 degrees with the worst being between 7 and 10 o'clock. The inlet (inducer tunnel) was burned completely 360 degrees with the worst being between 8 and 9 o'clock; however, all wear ring steps were sharp on the corners but blackened by fire.* The eye of the impeller was burned on the inside diameter approximately 270 degrees and the impeller was torn back approximately .060 to .090 inches from the original dimension. The outside diameter of the impeller at the inlet was burned approximately 270 degrees. The areas of the slightest burning occurred at the same place on both the inside and outside diameters. The inducer was burned on the downstream side of the blades and had pieces broken off the outside diameter. The inside surface of the torus was clean along the entire periphery.

* The center-line of the fuel inlet flange is considered to be the 12 o'clock position.

Approximately 1" of the rayco seal retainer at the inlet adapter flange (customer connect point) was missing and at this point a section of the teflon seal was folded over. The retainer protruded into the flow stream of the duct. This was indicated by a splattering of eroded metal on the turbopump side of the seal. The rest of the retainer was clean. The missing area of the seal retainer was at approximately 9-10 o'clock. The bellows section of the LO2 inlet duct just upstream from the turbopump also shows indication of eroded metal. The elbow section of the inlet duct adjacent to the pump was missing entirely.

The fire damage in the turbopump LO2 volute appeared to have been isolated to the impeller inlet and inducer area. This was indicated by the large amount of erosion and burning in the inducer tunnel, the impeller inlet, the diverter lip, and on the inducer blades. The lack of damage to the wear ring steps, the impeller outlets, and the periphery of the volute torus indicated the fire did not reach this area. The eroded metal found upstream of the turbopump also tends to indicate an explosive force traveling in that direction.

Whether the force causing the volute fracture was due to external impact or to an internal pressure force (caused by combustion in the inducer tunnel) is not readily discernible. Several of the external marks on the volute appear to have occurred prior to the volute parting.

Vernier Engines

Both vernier engines were heavily burned as a result of the explosion. The only major damage to the components noted was that the V1 LO2 valve and fuel valves were separated. The separation occurred at the point where they are bolted together. Damage to the vernier engines is believed to be a result of the explosion and not related to the cause.

General

One (1) helium bottle was found to have exploded. Shrapnel from this bottle was found in many areas of the complex. No shrapnel damage was noted on the propulsion components, indicating that the bottle exploded after leaving the boattail. The Quad III aft nacelle sustained the only noted shrapnel damage. This bottle is located in Quad III, approximately level with the sustainer LO2 dome.

FILM REVIEW

Engineering sequential film were reviewed and several items were useful in establishing significant events during the launch and subsequent explosion of Missile 11F. However, the cause of the explosion could not be determined from the review of the films.

Significant events and times obtained from film were as follows.

Item 1.2-15, 35 mm Mitchell located at Camera Pad 11-3 viewing Quads II and III

-0.67	First sign of SPGG flash.
∕0.91	B2 Nacelle door starts to open.

Item 1.2-6, 16 mm Milliken, located at Camera Pad 11-10 viewing Quad IV

-0.67	First sign of SPGG flash.
∕0.898	V1 Clamshell begins to separate.
∕0.90	Indication of intense flame from Quad IV booster section holes and V1 Clamshell.
∕0.905	B1 Nacelle door begins to separate.
∕0.91	B2 Nacelle door begins to separate.

Item 1.2-7, 16 mm Milliken, located at the camera pad at the break of the ramp viewing Quads I and II.

-0.67	First sign of SPGG flash.
∕0.90	Fire showing from B2 door lower corner Quad II.
∕0.91	B2 Nacelle door begins to separate.

Item 1.2-5, 16 mm Milliken, located at Camera Pad 11-2 viewing Quad III

-0.67	First sign of SPGG flash.
∕0.905	Light issuing brilliant flame indications from holes in booster skin Quad IV and V1 Clamshell fairing seam.
∕0.91	B2 Nacelle door begins to separate.

SYSTEM PERFORMANCE

AIRFRAME

Telemetry data and engineering sequential film indicate that the airframe remained structurally intact until after failures occurred in the thrust section. The two engine compartment thermocouples, A 638 T in Quadrant II and P 671 T in Quadrant IV, gave normal temperature indications of 97°F and 76°F, respectively, until the data became invalid. Thermistor A 353 T High, mounted on the A-Frame in Quadrant II, showed a decrease from 108° F at 0.26 second to 86°F at 0.90 second. Thermistor A 350 T High, mounted on the A-Frame in Quadrant IV, indicated approximately 80°F until 0.9 seconds when the data indicated a rise to 175°F. The Pod 1 thermocouple reference junction temperature Measurement T 105 T remained at 48°F until loss of the data.

At approximately minus 58 seconds a decrease in temperature was noted on Measurement A 353 T, Aft A Frame Low-Quad II. Data indicated a decrease from 100°F to 25°F which lasted for approximately 1.5 seconds. This was also reflected by the A 353 T, Aft A Frame High-Quad II, measurement. Hardware investigation revealed a bad seal on the B2 LO2 slug check valve which might have produced a low pressure leak which might account for the above conditions. However, no decrease in temperature was noted on Measurement A 638 T, Aft Side A Frame-Quad II, which is very close to the above measurements and between these measurements and the suspected leak.

The two ambient pressure transducers, A 354 P in Quadrant II and A 355 P in Quadrant IV, were at the upper band limit of 6 psia during the recorded data period.

Measurement M 182 X, Recoverable Camera Package/Photo Light Intensity, dropped from 83 percent IBW to 40 percent IBW between 0.51 and 0.92 seconds and was invalid by the next commutation sample.

The two low frequency accelerometers mounted on the Quad II jettison rail provided valid data until at least 0.9 second. Accelerometer A 77 A, Jettison Rail End/Radial, displayed a 40 to 60 cps waveform at engine ignition until 0.9 second. Accelerometer A 78 A, Jettison Rail End/Tangential, displayed a 42 cps waveform between main engine ignition and 0.90 second at a maximum level of 4 G's peak. Increased oscillatory activity after 0.91 seconds was apparent on both accelerometer outputs, with peak accelerations to the band limit of 30 G's indicated. The data for both measurements were invalid after 1.20 seconds. Data prior to 0.9 seconds compared well with data attained on successful launches.

PROPELLANT UTILIZATION

There are no indications of abnormal operation of the Acoustica Propellant Utilization (PU) System. The PU and Head Suppression (HS) valves opened properly in response to the sustainer engine ignition sequence. The opening trends were normal and both valves began to enter control at approximately 0.20 seconds. PU valve movements appeared proper until loss of telemetry data. HS valve movements were proper until 0.866 seconds when data was lost apparently due to damage to the transducer and/or its wiring.

PNEUMATIC SYSTEM

System performance was satisfactory until at least plus 0.9 second when RF Number 1 telemetry data were lost. Missileborne LO2 and fuel tank pressures remained between 20.0 and 22.9 psig and 53.7 and 55.7 psig, respectively, until approximately 0.9 seconds. Although these levels are somewhat lower than expected, respective landline measurements indicated tank pressures to be between 23.1 and 25.3 psig and 58.8 and 60.7 psig. After 0.9 seconds, the telemetry tank pressure data became questionable due to a drop in the RF Number 1 transducer power supply. The regulator inlet temperature behavior was normal until loss of data. The sustainer controls helium bottle was satisfactorily pressurized to 3043 psia at liftoff.

HYDRAULIC SYSTEMS

Systems performance was satisfactory until at least plus 0.9 second when telemetry data were lost. Oil evacuation was indicated at minus 61 seconds. Normal transfer from ground to airborne pressures was indicated during the engine start sequence.

The Booster Hydraulic System pressure rose from 1860 psia to a normal peak pressure of 3260 psia at booster engines start. Missileborne system pressure was maintained between 2840 and 3040 psia until loss of data at plus 0.9 second. System return pressure was normal at 70 psia with the expected momentary drop to 48 psia at liftoff.

The sustainer/vernier system pressure rose normally from 1950 psia to a peak pressure of 3160 psia by plus 0.97 second as indicated by Measurement H 140 P, Sustainer/Vernier Hydraulic Pressure. Loss of data after this time was indicated. Measurement H 185 P, Sustainer Hydraulic Pump Inlet Pressure, exhibited a pressure spike at 0.91 second which reached a maximum value of 174 psia. This pressure spike is believed to have resulted from a return system pressure surge associated with the shuttle of valves within the sustainer engine control package during the shutdown sequence. The pressure then apparently decayed to ambient. Measurement H 212 P, Vernier Return, did not reflect this surge.

MISSILE ELECTRICAL SYSTEM

All parameters of the Missile Electrical System were within specification. At approximately One Inch Motion the missile inverter frequency began to increase from 400.6 cps. Inverter frequency reached 402.4 cps before loss of data. In addition, all three phases of the 115 volt power supply show decreases approximately 0.3 seconds after One Inch Motion. Phase A shifted from 114.0 to 113.8 vac. Phase C shifted from 115,1 to 114.3 vac. These shifts are considered to be incidental and not related to the Propulsion System failure.

RANGE SAFETY COMMAND SYSTEM

The Range Safety Command System operation was satisfactory. Data indicated adequate signal strength to ensure proper operation of the system. No signals were sent and none were received.

AZUSA SYSTEM

Azusa System operation was normal. A noisy, low strength signal was experienced at liftoff due to antenna location; this would normally improve during the roll program.

FLIGHT CONTROL SYSTEM

Operation of the Flight Control System was satisfactory until affected by abnormal conditions in the thrust section. The engine position null shifts during thrust buildup were normal and less than 0.6 degrees. A normal roll transient was experienced at liftoff and pitch and yaw transients were negligible. The programmer roll manuever was not entered and no programmer switching function activated.

INERTIAL GUIDANCE SYSTEM

Inertial Mode Start occurred at -5.81 seconds (1607:34.07 ST). From this time until loss of telemetry data the computer generated proper yaw steering and proper digital data. The only anomaly which occurred during this period was a 0.9 volt peak to peak fluctuation from 0.43 to 0.60 seconds in the -50.0 vdc computer power supply. This corresponded with a fluctuation in the missile 115 vac power supply. The reason for this anomaly has not been determined.

Alignment Countdown Set

This missile was launched using Lot III OGE. Operation of this equipment was normal up to step 6.15.3E of the precountdown. During this step the Z scale storage had an out-of-specification error of -0.0036 cps/g. At step 6.19.10B, it was found that X offset had set up to a positive out-of-specification error of /0.009 cps. This was considered to be too large to have been caused solely by the Z scale storage error. It was then decided to repeat the procedure starting with the accelerometer scaling. After this run, the X and Z scale storages were within specifications but X offset still contained a positive, out-of-specification error of /0.007 cps. At launch time, this parameter was on the specification limit of /0.006 cps.

Missile Guidance Set

The Missile Guidance Set installed on this missile included a Life Improvement Program Platform. This was to be the third flight test of this type platform. Performance of this platform was satisfactory during the various tests which included special accelerometer and temperature tests. Gyro drifts and accelerometer scaling measured during the precount were consistent with previous measurements.

Computer

Computer operation during the precount and countdown was proper as indicated by "All Go" runs and a satisfactory check of the GAP Test Tape with the data checker.

Analog Signal Converter

During the GAP Test, no T bar signal appeared on the azimuth resolver T bar ASC Channel 37 via telemetry. Checks performed confirmed that the proper channel was patched on the telemetry record. A check was made during the first hold countdown computer run and it was found that the Computer was generating T bar and that X accelerometer offset switching occurred. This was an instrumentation fault and T bar was not a mandatory telemetry signal.

MOD III RANGE SAFETY AND INSTRUMENTATION SYSTEM

The Mod III System performed satisfactorily throughout the test. A normal pulse and rate beacon signal was received by the Ground Radar. Good track and rate data were provided to the Computer for a brief period after liftoff. Loss of signal was abrupt. Computer performance was satisfactory.

PENETRATION SYSTEM

Missile self-destruction after liftoff precluded operation of the Penetration System. The few measurements activated at liftoff, which included environmental temperature, static pressures, and pod instrumentation power supplies, were satisfactory.

RE-ENTRY VEHICLE

The general condition of the Mark 4 Mod 1B Re-entry Vehicle after Missile self-destruction is considered relatively good. Usable telemetry data was received for approximately 140 minutes at Hangar N. This was during the period from liftoff until the Re-entry Vehicle Telemetry System was turned off. The only major damage suffered was to the nose cap which was sheared from the cylinder during impact.

TELEMETRY SYSTEM

Operation of the Telemetry System was satisfactory until approximately 0.92 seconds when a variation in the RF No. 1 five-volt power supply was noted. There were no unsatisfactory measurements prior to this time. The failure of all sustainer engine pressure instrumentation occurred at 0.97 seconds and was apparently due to conditions in the thrust section at this time. Valid telemetry signals were received until complete loss of telemetry at 1.19 seconds due to missile self-destruction.

Missile 11F contained three Bendix Mod 7 FM Telemetry Packages and one Time Transposition Telemetry Package which included a Speidel Corp. Mod 003 Recorder-Reproducer System. Basic Telemetry channel assignment is given in General Dynamics/Astronautics Report AE 61-0123-11.

LANDLINE INSTRUMENTATION

The Landline Instrumentation System provided satisfactory data prior to missile liftoff.

PROPELLANT TANKING

Fuel tanking was accomplished on 30 March 1962. Tanking was secured at the PLCU Overfill Probe Level. Pressurization leak checks opened the pressure-sensitive fuel prevalves. This allowed fuel to fill the engine plumbing, thus lowering the fuel level to just below the 100 Percent Probe. Flight level, just below the Overfill Probe, was maintained by making level adjustments between the initial tanking on 30 March and flight on 9 April. These level adjustments made it impractical to determine the fuel density at ignition. Therefore, the 30 March fuel density of 50.18 lbs/ft^3 was used in fuel weight computations.

Prior to LO2 tanking the fuel level was 2.84 ft^3 above the 100 Percent Probe. Based on tank volume and density there were 77,140 pounds of fuel aboard at ignition.

LO2 tanking was concluded with a satisfactory LO2 slug transfer of 41.8 seconds duration. The 100 Percent Slug Cutoff Probe deactivated 1 second after ignition or 0.45 seconds prior to 1 Inch Motion. This indicated that the LO2 level was 8.6 ft^3 or 600 pounds above the probe, or that the probe did not respond properly to the decrease in level associated with propellant consumption.

At ignition, the LO2 weight was approximately 174,942 pounds as computed from tank volume and an ignition LO2 density of 70.17 lbs/ft3.

Weather Data

	Fuel Tanking	Ignition
Ambient Temperature	70.0°F	73.0°F
Barometric Pressure	30.120 Inches of Hg	29.995 Inches of Hg
Relative Humidity	91 Percent	74 Percent
Wind Velocity and Direction	8 Knots, SE	8 Knots, E
Total Cloud Cover	Clear	10/10
Time	2200 EST	1607:38.43 EST

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

1. The flight was unsuccessful. The missile exploded approximately 1.2 seconds after One Inch Motion. Analysis of the hardware, data, and film has indicated that the initial explosion occurred in the sustainer LO2 turbo pump inlet although the cause of the explosion has not been determined.

2. The difficulties experienced with both the electrical and mechanical interface of the Mod II decoy pods and the missile suggest a lack of design coordination on this initial installation.

3. The missile was launched with both the lubricating oil and sustainer hydraulic oil reported out of specification by the fluid chemistry analysis. It appears the necessary control over use of acceptable fluids was not exercised by the responsible personnel.

Recommendations

1. Continue hardware analysis, metallurgical analysis and design review of the sustainer turbo pump and propellant ducting to try and determine the cause of the initial explosion.

2. Make a complete review of the Mod II decoy pod electrical and mechanical interface prior to the next flight of this pod.

3. Exercise strict control over fluid chemistry on future flights to insure all fluids are within their applicable specifications.

COUNTDOWN TIME VERSUS EVENTS

The countdown for Test P1-601-00-11, AMR Test No. 71, was scheduled for 150 minutes starting at 1130 EST, 9 April 1962. The countdown was started as scheduled and was completed 278 minutes later. The additional 128 minutes elapsed countdown time were required for three holds that occurred as follows:

1. At minus 90 minutes a hold of 45 minutes duration to investigate the ADF pod ground electrical control wiring.

2. At minus 45 minutes a 75 minute hold to replace a leaking LN2 line on the test stand.

3. At minus 25 minutes an 8 minute hold to tighten a leaking flange on LO2 Transfer Pumps LA and LB.

There were no further difficulties encountered.

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

EST	Countdown Time	Countdown Procedure	Event
1130	T-150	T-150	Countdown Started.
1130	T-150	T-150	Nose Cone Telemetry and Beacon on External Power.
1130	T-150	T-150	Acoustica Sensor Response Checks Started.
1133	T-148	T-148	AIG Telemetry Check Started.
1137	T-143		Acoustica Sensor Response Checks Completed.
1139	T-141		AIG Telemetry Check Completed.
1140	T-140	T-140	GAP Test Preparation Started.

EST	Countdown Time	Countdown Procedure	Event
1145	T-135	T-135	Nose Cone Beacon and Telemetry to Internal.
1146	T-134	T-134	Nose Cone Beacon and Telemetry Off.
1146	T-134	T-134	GAP Test Started.
1154	T-126		GAP Test Completed.
1208	T-112	T-120	RSC Tests Started.
1216	T-104	T-110	RSC Tests Completed.
1220	T-100	T-110	Electrical Connection of Red Destruct Boxes Started.
1225	T-95	T-105	AIG Accel Measurements Completed.
1230	T-90H		Holding to Investigate ADF Pod Electrical Control
1233			Retro-rocket Installation Completed.
1233	T-90H		Nose Cone Arming and Fusing Checks Started.
1243	T-90H		Nose Cone Arming and Fusing Checks Completed.
1300	T-90H		Hold Extended for an Additional 15 Minutes.
1309	T-90H		Main Missile Battery Activated and Telemetry Batteries Activated.
1312	T-90H		Telemetry Internal Checks Satisfactorily Completed.
1315	T-90		T-90 and Counting.

EST	Countdown Time	Countdown Procedure	Event
1315	T-90	T-90	Flight Control Systems Test Started.
1321	T-84		Flight Control Systems Test Completed.
1324	T-81		Service Tower Floors Coming Up.
1340	T-65	T-65	Landline Electrical Calibrations Started.
1340	T-65		Service Tower Removal Started.
1340	T-65	T-65	Mod III Beacon Checks Started.
1342	T-63	T-50	AIG Computer Check Started.
1347	T-58		Helium Storage Preparation Completed.
1349	T-56	T-70	Helium Storage Started.
1352	T-53		AIG Computer Check Completed.
1358	T-47		Landline Electrical Calibrations Completed.
1400	T-45H		T-45 and Holding to Check LN2 Leak on Stand.
1515	T-45	T-45	Countdown Resumed.
1515	T-45	T-45	LO2 Tanking Preparation Started.
1520	T-40	T-40	AIG Computer and Programmer Check Started.
1525	T-35	T-35	LO2 Tanking Started.
1527	T-33	T-35	Autopilot System Final Check Started.
1527	T-33		AIG Computer and Programmer Check Completed.

EST	Countdown Time	Countdown Procedure	Event
1535	T-25H		T-25 and Holding to Correct Leak in LO2 Transfer Pumps LA and LB Inlet Flanges.
1542	T-25		Countdown Resumed.
1547	T-20	T-22	RSC Final Test Started.
	T-18		RSC Final Checks Completed.
1549	T-18	T-20	Final Telemetry Warmup Started.
1552	T-15		Autopilot System Final Checks Completed.
1552	T-15		Holddown Hooks Retracted.
1555	T-12	T-12	Nose Cone Telemetry and Beacon On External.
1555	T-12		AIG Computer Check Completed.
1557	T-10	T-10	Acoustica Final Checks Started.
1557	T-10	T-10	Telemetry/RSC AGC Check Started.
1558	T-9		Acoustica Final Checks Completed.
1559	T-8		Final RSC Check Completed.
1600	T-7		Range Forecast All Clear For Launch.
1603	T-3:50	T-3:50	Status Check - All "Go".
1603	T-3:30	T-3:30	T-3:30 and Counting.
			Squibs Disarm Switch to Off.
			Telemetry to Internal.
1604	T-3:00	T 3:00	Timer Off - Ready Switch to Ready.

EST	Countdown Time	Countdown Procedure	Event
1604	T-2:45	T-2:45	Shut Down Power Switch to Arm.
1604	T-2:10	T-2:10	Nose Cone Beacon and Telemetry tc Internal.
1604	T-2:05	T-2:05	Commands to Internal.
1605	T-2:00	T-2:00	Nose Cone to Ready.
1605	T-1:55	T-1:55	Autopilot to Arm.
1605	T-1:50	T-1:50	Turning Water Systems "On".
1605	T-1:45	T-1:45	Commands to Arm.
1605	T-1.40	T-1:40	Range Ready Switch "On".
1605	T-1:35	T-1:35	All Prestart Lights Are Green.
			Slug Start.
			T-1 Minutes 35 Seconds and Counting.
			Starting Flight Pressurization.
1605	T-1:10	T-1:10	Missile to Internal Power.
1605	T-1:05	T-1:05	Missile Helium to Internal.
1606	T-0:55	T-0:55	Water Full Flow.
1606	T-0:50	T-0:50	Status Check - "Go".
1606	T-0:30	T-0:30	Close LO2 Ground Fill and Drain Valve.
			All Launch Commit Lights Are Green.
1606	T-0:05	T-0:05	Commit Armed Light On. All Recorders to Fast.
1607:39.88			1 Inch Motion.

MISSILE CONFIGURATION

Airframe

GD/Astronautics "F" Series Airframe. Thor Retro-rockets were installed in the modified vernier engine fairings.

Two ADF Mod II Penetration System Pods were attached to the propellant tanks for this flight.

Azusa System

A type B-1A coherent carrier transponder operated in conjunction with the Mark II Ground Station. An elliptical horn antenna was mounted on the tripod boom in Missile Quad IV.

Electrical System

Missile electrical power was supplied by a remotely-activated, primary-type, Eagle-Picher main missile battery and Bendix rotary inverter.

Flight Control System

The square canister configuration with forward rate gyro canister containing pitch and yaw rate gyros was flown on Missile 11F. The main gyro canister incorporated the Phase Rotation Detector System in addition to the Spin Motor Rotation Detector (SMRD) System.

Guidance System

An ARMA Lot IV Missile Guidance Set (MGS) was flown on Missile 11F. Lot III Ground Equipment was used for preflight checkout of the MGS. The MGS platform was of the LIP (Life Improvement Program) configuration in which the platform temperatures are maintained 20°C below previous settings.

Hydraulic System

The Hydraulic System is comprised of independent booster, sustainer/vernier, and vernier-solo subsystems. The booster and sustainer/vernier subsystems are comprised of a hydraulic pump, engine actuators, accumulators, fluid reservoir, relief valves, disconnects, and associated plumbing. The vernier-solo subsystem incorporates a precharged accumulator-type hydraulic power supply.

Impact Predictors

Azusa System and Mod III Range Safety and Instrumentation System were utilized for impact prediction purposes.

Pneumatic System

An additional propellant tanks pressurization LN2 shrouded helium storage sphere is carried aboard "F" Series Missiles. The additional sphere is required because of the short helium loading time in the "F" Series operational countdown. The 6 minute loading interval does not allow the helium to be chilled sufficiently by the liquid nitrogen shroud to store the required amount of helium in the five spheres used with "E" Series Missiles.

An AiResearch LO2 boiloff valve was flown. Modified Fluidgenics pneumatic regulators were used to control pressures in the LO2 and fuel tanks.

Propellant Utilization System

The Acoustica Propellant Utilization System was utilized on this missile and is essentially the same as the system flown on Missiles 26E and on. This system uses a 400 cps signal for excitation of the PU valve position feedback transducer and a 5-card computer.

Propulsion System

The Rocketdyne MA-3 Liquid Propulsion Engine System was used on this flight. The booster engines were modified by installation of copper baffles on the injectors and replacement of the stainless steel injector rings with copper rings. Engine weight was increased 36 pounds.

Range Safety Command System

The standard system employed two ARW-62 receivers, a power and signal control unit, arming switch, and destruct package. System electrical power was supplied by two manually-activated, secondary-type, Yardney batteries which were contained within a single canister.

Telemetry System

PAM/FM/FM System was comprised of four telemetry packages, three Bendix R and D telemetry packages and a one time transposition telemetry package which included a Speidel Corp. Recorder Reporducer System. One accessory package was carried to furnish transducer excitation and signal conditioning circuits, two diplexers, a ring coupler, and two cavity-type antennas.

Four airframe telemetry links were operational at 227.7, 229.9, 232.4 and 235.5 mc. System electrical power was supplied by three remotely-activated, primary-type, Yardney batteries.

Mod III Range Safety and Instrumentation System

The missileborne Mod III E Instrumentation Beacon System operated in conjunction with the Mod III Ground Station. The missileborne antenna was mounted on the tripod boom in missile Quad IV.

Propellant Tanking

Astronautics "E" Series Propellant Tanking System incorporated four ultrasonic fuel sensors, four LO2/GO2 detectors, a Propellant Loading Control Unit (PLCU) in the blockhouse, and 200-400 gallon LO2 slug.

Penetration System

Two Mod II Pods in Quads I and III were externally mounted on the surface of the missile. Each pod contained four re-entry decoys and six balloon decoys. An instrumentation interface was provided to transfer pod generated signals to the missile Telemetry System. Another electrical interface provided the T1 and T2 signals to the pods at Booster Cutoff and Re-entry Vehicle Separation.

Re-entry Vehicle

A Mark 4 Mod 1B Re-entry Vehicle was carried aboard Missile 11F, containing an ablation shielded self-stabilizing sphere-cone-cylinder flare structure, a C-band tracking beacon, a telemetry system and an ejectible, recoverable, data cassette.

Staging Studies

A photo-instrumentation package was installed near the aft end Quad IV booster rail, looking forward. The package consisted of a photo-optical package and recovery package combined to make up the recoverable capsule, an ejection canister, auxiliary lighting, and instrumentation measurements relative to ejection sequence, camera start, and lighting functions.

HISTORY OF SM-65F MISSILE NO. 11F

Atlas Missile 11F arrived at AMR on 13 March 1962. Transfer from the IOC trailer to the R and D trailer was accomplished in Hangar J. Receiving inspection was completed and certain component testing of the Flight Control System was performed in the gyro and battery labs in Hangar J. On 15 March Missile 11F was weighed and transported to Complex 11 for erection. Pre-launch operations were accomplished in accordance with planning documented in Report AA 62-0028, Flight Test Directive, Atlas Missile 11F.

Significant events concerning Missile 11F from arrival at AMR to launch are delineated chronologically below.

Date	Event
13 March 1962	Arrived at AMR.
15 March 1962	Missile weighed.
15 March 1962	Transferred to Complex 11 and erected.
23 March 1962	Successful fuel tanking (LO2 tanking terminated due to leaking filter in LO2 transfer unit).
26 March 1962	Successful LO2 tanking.
27 March 1962	Satisfactory Flight Acceptance Composite Test.
5 April 1962	Flight postponed during precount due to adverse weather conditions in the recoverable camera impact area.
9 April 1962	Flight.

A brief compilation of significant difficulties encountered during system testing follows:

Inertial Guidance

On 15 March 1962 the MGS System was warmed up and an attempt was made to complete an ACSIG Test, but a fuse kept blowing in the Platform Alignment Control Panel (1A2A3 Drawer) of the OGE each time the master programmer was stepped to Position No. 1.

On 16 March 1962 the cause of a fuse blowing in the 1A2A3 Drawer was investigated. A short was found in Umbilical 600U8. A new umbilical was checked out and installed. ACSIG Test was completed satisfactorily.

On 17 March 1962 AIG Readiness Test (CTP-37) was performed. Two computer "No-Go's" were experienced. Tapes were returned to Hangar N for analyzation.

On 19 March a decision was made to replace the computer due to "No-Go" resulted received during AIG Readiness Test. Due to defective ASC Channel (No. 16), it was also decided to replace ASC.

On 19 March 1962 the inductosyn loop was noticed to be running into stops intermittently. The problem was traced to a defective umbilical connection. The umbilical was replaced.

On 20 March 1962 Computer Serial No. 7230058 and ASC Serial No. 7150047 were removed and replaced with Computer Serial No. 7230069 and ASC Serial No. 7150042.

On 20 March 1962 the first two computer runs (No. 51 and 52) in countdown in Support of GD/A Release Sequence Test were Digital "No-Go". Hangar N flex board was installed and the computer runs were "Go". The "No-Go" tapes are to be analyzed by Hangar N. The diodes failed in the complex flex board.

On 20 March 1962 defective Umbilical 600U7 was replaced.

On 21 March 1962, eight successful computer runs were completed. Readings of the Gravity Oscillator over a period of seven hours indicated an unstable condition. the oscillator was out of specifications and this is possibly the reason that Z Storage has been out of specifications during the last two System Checks. This problem will be investigated.

On 22 March ten successful computer runs were completed. Additional stability data on gravity oscillator was obtained.

On 23 March 1962 Inertial Guidance Telemetry Test (CTP-43) was completed, and Missile Electrical Test was supported.

On 26 March 1962 additional Inertial Guidance Telemetry Test (CTP-43) was completed.

On 26 March 1962 Gravity Oscillator was replaced.

On 26 March 1962 an attempt was made to perform Automatic Checkout, but the Loop No. 1 integrator pot drove into the stops in MP 9, ASP 10. This will be investigated. The step was repeated twice, but the problem could not be duplicated.

On 27 March 1962 Missile 11F FAC Test was completed. The Z Storage was out of specifications. The Z Zero, in a ⁄1G, shifted between the in-specification reading at T-55 and out-of-specifications reading taken at T-12.

On 27 March 1962 Gyro temperature was on the high end of the specifications. Pod cooling will be increased to 50° to increase control of Mag. Amplifier.

On 28 March 1962 completed integrated and Pitch Polarity Check. The center tap on the Z Storage Pot of the OGE 1A1A6 Drawer was changed from .337 to .662 to prevent the pots from being driven into the stops.

On 28 March 1962 the Gravity Oscillator was adjusted. A two hour temperature run of the gyros at target angle was completed.

On 29 March 1962 X-1 Day System Readiness Check (CTP-37) was completed. "X" and "Z" Storages were in specifications. Channel 31 of the ASC appeared to be defective. The trouble, however, was traced to wet telemetry plugs.

On 2 April 1962, System Check (CTP-37) was completed. Z Storage was slightly out of specifications. X Offset did not set up properly.

On 2 April 1962 Platform Serial No. 7210026 was removed as per GCY request for investigation of gyro temperature problem. Serial No. 7210146 was installed.

On 3 April 1962 AIG Readiness Test (CTP-37) and Inertial Guidance Telemetry Test (CTP-43) were completed. The Integrated and Pitch Polarity Test were completed satisfactorily. Torque to Ready Mode Accelerometer Test (CTP-54) was also completed.

On 3 April 1962 problems were experienced with the 1A1A1 Computer Drawer. The drawer failed self-check approximately six times out of twenty. Runs 128 and 133 were Digital "No-Go's". The Data Checker indicated that at 275 seconds a noise or spurious G level was introduced in ZF1 (Run 128). This could have been caused by the drawer. Run 133 was a Digital "No-Go" as indicated by the computer drawer. Data Check result was that the problem was a "Go". 1A1A1 Drawer Serial No. 7510005 was replaced with Serial No. 7510042. X Offset was in specifications using actual GSE constants but a discrepancy exists when compared to constants used by Hangar N. This is being investigated.

On 3 April 1962 a TPS was initiated to check for a possible bias in the ASC gyro channels. A resistance bridge calibration of the ASC was performed and no bias was noticed.

On 3 April 1962 nine computer problems were completed using the new 1A1A1 drawer. All problems were "Go".

On 3 April 1962 GCY Special Accelerometer Checks were completed. A computer drawer self-check "No-Go" was experienced in countdown. Self-checks did not function in any mode of operation. Turning the GSE circuit breakers off and then on rectified the condition. A relay may have latched up and prevented S.C. completion.

On 4 April 1962 AIG Readiness Test (CTP-37) was completed. Storages and X Offset were in specifications. A problem again developed with the new computer drawer in that it would not pass Digital self-checks. One computer problem in which no SECO or VECO were received was run (Run 148). With problems experienced in self-check of drawer, incorrect G levels were sent to the computer causing a "No-Go". It was noticed that the area in which the GSE is located was abnormally warm. An air conditioning duct had been shut off. After opening this duct, located above the 1A1 rack, 12 computer problems were successfully completed.

On 9 April 1962 Precount Operations for Missile 11F Launch were started. X Offset was found to be out of specifications. Accelerometer steps were rerun due to out-of-specification conditions. The X Offset was still slightly out of specifications in the rerun, but all the storages were in specifications. It was decided to proceed with tests. Precount was completed at 1125 EST.

Pneumatics

During a test in San Diego a production F & G Regulator was checked out and the regulator failed to open. An investigation revealed that the Teflon Bumper behind the stop valve had unseated and jammed the valve closed. It was San Diego Pneumatics Design opinion that the breakage was probably due to the 3000 psi buildup behind the bumper with no relief during actuation. Modified regulators were installed on 11F and satisfactory checked out per Procedure 27-90392-2 on 30 March 1962. The modification was to perforate the bumper but the regulators did not have a new part number or dash number.

Complex Mechanical

During the LO2 Tanking Test slug delivery was not successful. This was believed to be due to a dry low level probe in the slug unit. Slug stop was initiated at 41 seconds from Hi Topping due to low level probe. Probe was dry for 29 seconds. This was due to not enough LO2 in the slug unit. During an investigation of slug cutoff, LO2 was observed to be leaking out of a filter in the LO2 line. The filter was examined and no filter element was found inside the filter. This was assumed the cause of the leak since the element acts as a pressure buffer in the LO2 line. Since the element had to be obtained from the PAA cleaning shop, LO2 tanking was terminated. A satisfactory Tanking Test was accomplished on 26 March 1962. Three slugs were delivered during this test.

During the performance of the helium storage preparation portion of 11F countdown procedure, a one hour hold was required due to an excessive LN2 leak in the Quad II launcher plumbing. Investigation of the leak revealed a split "B" nut in the 27-80195-111 LN2 hard line. The fitting was located on the Tee in Quad III and was heard to break during chilldown of the Airborne Helium Bottles. LN2 flow had progressed for approximately 3 minutes of the automatic 14.5 minutes of rapid flow. The LN2 line was replaced and the count was resumed.

At T-25 a hold was initiated due to leaks found in the LO2 Transfer Unit at Pumps LA and LB inlet flanges. These seals had been changed after the propellant tanking test and this was the initial chill on these seals. PAA maintenance crew tightened these flanges and the countdown was resumed.

Complex Electrical

During running of Airborne Quick Disconnect Plug Test, Procedure 27-93673, insufficient slack was found in missile cables to Connectors 100P11, 100P12, and 105P4. Harness was adjusted to obtain necessary slack.

Umbilical Cable 600U8 was replaced on 16 March due to open circuit at JA2 Box connector.

The following continuing difficulties were encountered with the Brine Air Chiller in the Transfer Room.

a. Pump controlling cooling water was inoperative and was replaced.
b. Control relay was inspected and replaced.
c. Five HP motor burned out and was replaced.
d. The pump controlling cooling water was inoperative. This was bypassed pending availability of replacement.

Umbilical Cable 600U7 was replaced on 20 March due to open or short circuit at JA2 Box connector.

Foreign matter and moisture in Umbilical Adapter 600U1 connectors caused malfunctions in Autopilot System on 26 March and in AVCO System on 28 March. The connectors were cleaned with alcohol and dried with GN2 in both cases.

Moisture in Umbilical Cable 600U3 at JA2 Box connectors short-circuited SPGG heater circuits. The connectors were cleaned with alcohol and dried with GN2. All umbilical adapters and JA1 and JA2 Boxes were protected with vinyl and taped in place. This protection will be installed on all future missiles immediately after erection.

Telemetry

During missile checkout on the complex, a number of problems were encountered and were corrected as follows:

IR 636012 was written on the 27-12581-3 Telemetry Accessory Package for improper length bolts in the case. This IR was dispositioned "Acceptable for flight".

IR 617383 was written against all the telemetry cans for corrosion on the bonding straps. The corrosion was removed and bonding grease was applied to prevent further corrosion.

During the FACT on 27 March 196' H 224 P indicated approximately 40 psi high, and F 246 P and F 145 P indicated open. IR 617390 was written to replace H 224 P transducer, IR 636340 was written to replace F 246 P transducer, and IR 636347 was written to replace F 145 P transducer.

During the telemetry functional test, RF No. 4 indicated no deviation. TPS 11F 55 was written to troubleshoot. Coax harness between the recorder output and the transmitter input was open. TPS 11F 57 was written to remove RF No. 4 Serial No. 6 and install Serial No. 7. IR 617388 was written on RF No. 4 Serial No. 7 for recorder plate misalignment preventing use of normal mounting screws. IR was dispositioned to use allen head screw to eliminate interference between recorder and mounting screw head.

The first telemetry run on the complex indicated the master pulse on RF No. 1 Channel A was grounded. TPS 11F 28 disclosed a grounded pigtail on 101U1P3 i which was the "B" section commutator output.

Measurement A 136 T was improperly routed and would not have been covered by the insulation installed on the missile skin. IR 617381 was written to extend insulation installation to cover the exposed wiring.

During performance of TPS 11F 25, Measurement A 132 T would not respond to the application of heat. IR 617392 was written to splice into the spare transducer provided for this measurement.

TPS 11F 46 was written to ringout Measurement H 212 P which appeared to have no excitation to the transducer. Further investigation revealed that in CIC 14313 rework, seven wires routed through Plug 100P23 in the thrust section were dead-ended in this plug. These seven wires were the excitation wires for Measurements A 354 P, A 355 P, H212 P, A 350 T, A 353 T, and P 6 P. EO Serial No. 239480 on 27-12263 was written and released to install these wires.

The Recoverable Camera Pod was installed at AMR on CIC 15178 and two discrepancies were discovered in the telemetry portion of the checkout of the Camera Pod. IR 636336 was written against SK 20-0005-1 Harness. The wires connected to Pins C & B on Plug 100P182-2 were reversed. IR was dispositioned to correct this reversal. IR 677391 was written against SK 20-0001-1 resistor assembly. The 26.5Kohm resistor in this assembly was open. IR was dispositioned to replace resistor assembly with a like item.

Azusa

IR 617345 was written on wrinkled Azusa aljax at Station 1133 Quad III. The aljax showed no evidence of being cracked. IR was dispositioned to wrap with fiberglass and epoxy to give aljax strength.

Azusa Transponder Serial No. 731-0065 was IR'd for lack of coherency. Transponder was found to have noisy klystron.

Missile Electrical

Installation of recoverable camera proved to have interference with sustainer solid propellant gas generator. Additional supplement to CIC 15187 was issued to modify camera assembly mounting brackets to eliminate problem.

The photolights for recoverable camera were found to interfere with booster staging. Installation was IR'd and photo lights were moved approximately one-half inch towards center of missile to eliminate problem.

After first launch attempt camera capsule was removed and sent to lab to advance film. In lab checkout it was discovered the beacon was operating and one squib had electrically opened. A switch controlling the beacon was found to have malfunctioned and squib wiring was found open. The package was replaced.

Range Safety Command

No significant difficulties were encountered during launch preparations.

Mod III Range Safety and Instrumentation

On 6 March 1962 both beacons were sent to the lab for calibration. Rate Beacon Serial No. 1028 and Pulse Beacon Serial No. 1023 were installed on 14 March 1962. The wave guide assembly was bent and IR'd and replaced with the wave guide assembly from 8F. Leaks were found at canister connections and pressure window connections due to faulty "O" rings. Also a small leak was found in the antenna face plate. The antenna assembly was replaced. The system readiness checks were atisfactory up through FACT. On 29 March the ground station had trouble with Rate Beacon sweeping. It was replaced with Rate Beacon Serial No. 1018.

Flight Control

During the LO2 tanking test, it was noted that the null detector light for the Yaw Displacement Gyro was flashing. This signal was placed on the Sanborn Recorders and was found to be erratic. The Yaw Gyro Amplifier was also erratic but did not follow the Yaw Displacement Gyro. Investigation revealed that Umbilical 600U1 Pothead was full of what looked like a mixture of water and oil. This pothead was cleaned with alcohol and purged which eliminated the problem.

While performing the Readiness Test, it was found that the Yaw Displacement Gyro would not null. Investigation revealed that there was a bad Yaw Nulling Amplifier. This was replaced and the results were satisfactory.

Propellant Utilization

No significant problems were encountered during launch preparations.

Landline

No significant problems were encountered during launch preparations.

Airframe

During installation of the GE antenna boom, it was discovered that the hole in the 27-79060-803 Station 1133 Staging Ring was .474; blueprint is .500-.00, +.005. The discrepancy was corrected by reaming the hole to blueprint specifications.

Propulsion

A leak was discovered at the flange between the GD/A 27-02403-803 Vernier Fuel Supply Line and the Rocketdyne NA5-26360-1B Vernier Fuel Feed Line during the 1000 psi hydrostat test. A new 83-67900-059 (.063 diameter) seal was tried but did not correct the problem. After measurement of the depth of the seal groove of the -803 and -1B, it was determined that -1B line seal groove was too deep. The NA5-26360-1B Line was changed and the leak corrected.

The second problem was an interference between the outlet elbow flange on the sustainer LO2 self-referencing regulator and the sustainer low pressure fuel duct. This interference was only present with the sustainer against the pitch and yaw mechanical stops in Q III. The first time the interference was found approximately 0.060 inches were removed from the corner of the elbow. The interference was found again about 4 days later. At this time an additional approximate 0.040 inches were removed from the area adjacent to the corner of the elbow. The total metal removed from this area did not exceed approximately 0.060 inches. The interference was again found about 5 days later. At this time the distance was measured at the electrical stop in Quad III Pitch and Yaw. There was a .053 in clearance. It was also determined that by applying thrust section heat for an hour the interference was alleviated.

During propulsion mated leak checks and following both of the first two occurrences there was a clearance between the elbow and the duct. The only variable was readiness fuel tanking. It was concluded that with fuel in the duct the interference increased with time and temperature decrease.

Hydraulics

On 14 March 1962 a hydraulic leak was discovered at the Sustainer High Pressure Staging Disconnect (27-08556-3). At that time the system was pressurized to 100 psi.

Following replacement of the sustainer half of the disconnect, it was discovered that a portion of the "O" ring - approximately 1/32" x 1/16" x 3/8" - was missing. The system was IR'd and after San Diego Design consultation was dispositioned acceptable for flight.

Re-entry Vehicle

Re-entry Vehicle was received by AVCO, Florida, on 17 January 1962. Upon completion of preliminary systems tests, final systems tests were run and completed on 19 March 1962. Re-entry Vehicle was accepted for flight by Air Force and mated to Atlas Missile 11F at Complex 11 on 28 March 1962.

Mod II Penetration System

Problems were experienced with fit checks, both mechanically and electrically. There was not enough room between the LO2 duct in Quad III and the pod to use the ground handling fixture. A special sling was devised for pod installation. The electrical and instrumentation plugs to the pod were reversed. Wiring in the pod was rerouted to correct this.

A hold in the launch countdown was required to resolve an electrical problem. A polarity reversal was revealed and was the result of a discrepancy between Aeronutronic and GD/A blueprints. This was corrected.

APPENDIX

FLUID CHEMICAL ANALYSIS

	Unit	Sample	Specification
Liquid Oxygen			
Purity	Percent	99.5	99.2 Minimum
Hydrocarbons			
As Methane	ppm by wt.	17	75.0 Total Maximum
As Acetylene	ppm by wt.	None	1.5 Maximum
Particle Count			
350 - 500	Microns	None	20 per liter maximum
500 /	Microns	None	0 Maximum
Fibers, 25 x 6000	Microns	None	0 Maximum
Non-volatile residue	mg	0	2.5 per liter maximum

This item is within specifications.

Gaseous Helium

Purity	Percent	99.95/	99.95 Minimum
Hydrocarbons			
As Methane	ppm by wt.	None	75.0 Total Maximum
As Acetylene	ppm by wt.	None	1.5 Maximum

This item is within specifications.

Gaseous Nitrogen

Purity	Percent	99.8	99.5 Minimum
Hydrocarbons			
As Methane	ppm by wt.	None	75.0 Total Maximum
As Acetylene	ppm by wt.	None	1.5 Maximum

This item is within specifications.

	Unit	Pre Launch	Post Launch	Specification
Lubricating Oil				
Viscosity at 100°F	Centistokes	10.3*	14.97	11.0 Minimum
Viscosity at 210°F	Centistokes	3.35	3.88	3.0 Minimum
Flash Point	°F	282*	436	400 Minimum
Viscosity Index		167	177.2	80.0 Minimum
Appearance		Pass	Pass	Uniform. No sediment or suspended matter.

* As seen above, the sample taken after launch was within specifications. The pre-launch sample is questionable. The sample was taken from the lube oil overboard drain line, which drains fuel from the fuel volute bleed approximately 24 hours earlier.

	Unit	Sample	Specification
Trichlorethylene			
Appearance		Clear	Clear
Color		Not Dyed	Not Dyed
Odor		Characteristic	Characteristic
Specific Gravity	@68°/68°F	1.474	1.454 to 1.476
Distillation			
Initial	°C	188.7	187.7 Minimum
Dry Point	°C	189.5	198.4 Minimum
Water Content	@14.0°F	Pass	Cloudless
Non-volatile	Percent	.002	.002 Maximum
IR Absorbance	Percent	.0002	.0005 Maximum

This item is within specifications. The sample shown above was taken on 28 March 1962 (12 days prior to launch). The launch sample taken on 6 April 1962 was misplaced and subsequently never evaluated. A post launch sample was taken on 25 April 1962 and the only results available show the water content at 14°F to be cloudy. The influence of the missile destruction on the results is not known

	Unit	Sample	Specification
Fuel - RP-1			
Initial Boiling	°F	345	Report
10 Percent	°F	376	365 - 410
50 Percent	°F	416	Report
90 Percent	°F	456	Report
End Point	°F	486	525 Maximum
Residue	Percent	0.3	1.5 Maximum
Loss	Percent	0.7	1.5 Maximum
Flash Point	°F	158	110 Minimum
Gravity	°API	43.2	42.0 - 45.0

This item is within specifications.

	Unit	Sample	Specification
Hydraulic Fluid - Booster			
Flash Point	°F	216	200.0 Minimum
Color		Clear	Clear
Viscosity	Centistokes	8.5	8.0 to 10.0
Dye		Red	Red
Particle Count			
10 - 25	Microns	5350	5,500 Maximum
26 - 50	Microns	204	1,200 Maximum
51 100	Microns	20	300 Maximum
100 500	Microns	1	20 Maximum
500 /	Microns	None	0 Maximum
Fibers, 100 1000	Microns	0	20 Maximum
Fibers, 1000 /	Microns	None	0 Maximum

This item is within specifications.

	Unit	Sample	Specification
Hydraulic Fluid - Sustainer			
Flash Point	°F	224	200.0 Minimum
Color		Clear	Clear
Viscosity	Centistokes	9.9	8.0 to 10.0
Dye		Red	Red
Particle Count			
10 - 25	Microns	5900*	5,500 Maximum
26 - 50	Microns	880	1,200 Maximum
51 - 100	Microns	540*	300 Maximum
100 - 500	Microns	3	20 Maximum
500 /	Microns	None	0 Maximum
Fibers, 100 - 1000	Microns	0	20 Maximum
Fibers, 1000 /	Microns	None	0 Maximum

* This item is not within specifications.

REFERENCE DOCUMENTS

Flight Test Plan - Missile 11F	AE 61-0739
Flight Test Program, SM-65 Series F, R and D Missiles	AE 60-0944
Detailed Test Requirements (AFBMD /STL)	6101-6390-OC-000
Flight Test Directive (FTWG)	AA 62-0028

Additional reports which may be referenced for further information regarding this missile are listed below:

Reports	Approximate Issue Date (time after test)
General Dynamics/Astronautics, San Diego, Calif.	
Flight Test Evaluation Report	14 days
AFBMD/STL, Inglewood, Calif.	
Flight Summary Report	8 - 12 weeks
ARMA, CCO	
CCO Quick Look Report	7 - 10 days
American Bosch ARMA Co., Garden City, N.Y.	
Flight Test Evaluation Report	30 days
AVCO RAD, Wilmington, Mass.	
Evaluation Report	30 days
General Electric, Syracuse, N.Y.	
Evaluation Report of Mod III Instrumentation System with Missile 11F	6 - 10 weeks
Acoustica Associates, Inc., Los Angeles, Calif.	
Flight Test Evaluation Report	30 days
Aeronutronics, Newport Beach, Calif.	
Flight Test Report	30 days

SERIAL NUMBERS OF SYSTEM COMPONENTS

Azusa Transponder

Canister, Part No. 26-11000-855, Serial No. 731-0074

Range Safety Command System

Receiver No. 1, Part No. AD319600 Mk 1, Serial No. AF61-168
Receiver No. 2, Part No. AD319600 Mk 1, Serial No. AF61-236
Receiver No. 1 Battery, Part No. 7-06380-3, Serial No. 112-0599
Receiver No. 2 Battery, Part No. 7-06380-3, Serial No. 112-0600
Power and Signal Control Unit, Part No. 27-36236-5, Serial No. 108-0056 (63)

Electrical System

Inverter, Part No. 27-06178-1, Serial No. 012-0197
Main Missile Battery, Part No. 27-06160-3, Serial No. 110-0692
Power Changeover Switch, Part No. 27-06177-3, Serial No. 107-0191 (230)

Flight Control System

Gyro Canister, Part No. 27-41002-895, Serial No. 110-0220 (277)
Rate Gyro Canister, Part No. 27-45045-5, Serial No. 109-0134 (119)
Servo Canister, Part No. 27-41000-853, Serial No. 112-0151 (305)
Programmer Canister, Part No. 27-41001-987, Serial No. 112-0042(326)

Pneumatics System

LO2 Tank Pressure Regulator, Part No. 27-08101-33, Serial No. 1110-407
Fuel Tank Pressure Regulator, Part No. 27-08102-23, Serial No. 1110-393

Telemetry System

RF Canister No. 1, Part No. 27-12571-883, Serial No. 105-0019 (0086)
RF Canister No. 2, Part No. 27-12572-827, Serial No. 105-0012 (0093)
RF Canister No. 3, Part No. 27-12573-863, Serial No. 105-0017 (0079)
RF Canister No. 4, Part No. 27-12413-3, Serial No. [illegible]
RF Canister No. 1 Battery, Part No. 27-06161-1, Serial No. 105-0239
RF Canister No. 2 Battery, Part No. 27-06161-1, Serial No. 105-0244
RF Canister No. 3 Battery, Part No. 27-06161-1, Serial No. 001-0095
Accessory Canister, Part No. 27-12581-3, Serial No. 104-0022 (23)

Propellant Utilization System

Computer, Model CA-108B, Part No. 101670-2, Serial No. ACA 0105
LO2 Stillwell, Model SL 192, Serial No. ASL 0172
Fuel Stillwell, Model SF 191, Serial No. ASF 0172

Inertial Guidance System

Platform, Part No. 2-00029-005, Serial No. 7210140
Control, Part No. 2-00044-085, Serial No. 8220058
Computer, Part No. 2-00031-539, Serial No. 7230069
Analog Signal Converter, Part No. 2-00010-501, Serial No. 7150042
Digital Signal Converter, Part No. 2-00012-640, Serial No. 7140053

Mod III E Instrumentation Beacon System

Pulse Beacon, Part No. 7641086G1, Serial No. 6E1023
Rate Beacon, Part No. 7641226G9, Serial No. 6E9018

Propulsion System

Sustainer, Part No. 100116, Serial No. 222787
Booster No. 1, Part No. 100651, Serial No. 112821
Booster No. 2, Part No. 100651, Serial No. 112822
Vernier No. 1, Part No. 350300, Serial No. 332883
Vernier No. 2, Part No. 350300, Serial No. 332885

Penetration System

Pod A (Quad I), Mod II, Serial No. PA01022
Pod B (Quad III), Mod II, Serial No. PA01023

Re-entry Vehicle

Mark 4 Mod 1B, Serial No. 307410

Thrust Section Camera Assembly

Assembly, Part No. 27-01679-1, Serial No. A1
Camera, Part No. DBM 3A, Serial No. 3188
Camera Control Battery, Part No. 27-06190-1, Serial No. 009-0037

SIGNIFICANT DATES DURING TESTING OF "A" SERIES FLIGHT MISSILES AT AMR

Missile	Arrival	Complex	Erection	FRF	Flight	AMR Range No.	Comments
4A	12-8-56	14	3-22-57	6-3-57	6-11-57	8[illegible]5	Engine shut down at 29.9 seconds of flight. Missile destroyed at 50.1 seconds.
6A	4-4-57	14	8-2-57	9-20-57	9-25-57	1422	Engine shut down at 47.7 seconds of flight. Missile destroyed at 74 seconds.
12A	11-1-57	14	11-20-57	12-11-57	12-17-57	2148	Successful flight. Impacted approximately 490 nm downrange.
10A	7-18-57	12	9-27-57 10-27-57 11-6-57	*11-27-57 **12-10-57 1-4-58	1-10-58	10	Successful flight. Impacted approximately 542 nm downrange.
13A	12-4-57	14	1-17-58	***1-31-58	2-7-58	222	Engine shut down prematurely at 117.8 seconds of flight due to flight control system failure. Missile broke up at 167 seconds.
11A	12-28-57	12	1-25-58	2-8-58	2-20-58	449	Engine shut down prematurely at 124 seconds of flight due to flight control system failure. Missile broke up at 126.5 seconds.
15A	1-6-58	14	2-26-58	3-22-58	4-5-58	634	Engine shut down prematurely at 105 seconds of flight due to B1 turbopump failure. Missile remained intact and impacted approximately 200 miles downrange.
16A	2-5-58	12	3-17-58	****[illegible]-18-58 5-22-58	6-3-58	1261	Successful flight. Impacted approximately 480 nm downrange.

* Premature cutoff at 8 seconds. Both booster chambers damaged, necessitating replacement.

** Full duration, but damaged B1 chamber, necessitating replacement.

*** FRF terminated prematurely, but considered satisfactory.

**** Prematurely terminated due to APS shutdown.

SIGNIFICANT DATES DURING TESTING OF "B" SERIES FLIGHT MISSILES AT AMR

Missile	Arrival	Complex	Erection	FRF	Flight	AMR Range No.	Comments
3B	4-12-58	11	5-29-58	*6-23-58 **6-27-58 7-8-58	***7-12-58 7-19-58	1564	Missile broke up at 42 seconds of flight. Due to failure of the yaw rate gyro.
4B	5-31-58	13	6-13-58	7-15-58	8-2-58	1382	Successful flight. Impacted approximately 2345 nm downrange.
5B	5-30-58	11	7-22-58	8-20-58	8-28-58	1383	Successful flight. Impacted approximately 2853 nm downrange. First completely closed loop guidance system flight.
8B	7-31-58	14	8-4-58	9-6-58	9-14-58	1511	Successful flight. Impacted approximately 3151 nm downrange.
6B	7-17-58	13	8-14-58	9-10-58	9-18-58	1512	B1 turbopump failed at 80.8 seconds after lift-off. Missile exploded two seconds later.
9B	8-7-58	11	9-12-58 ##9-30-58	#10-4-58 ###10-24-58 ####10-27-58	11-17-58	1513	Depletion of fuel supply caused simultaneous premature sustainer and vernier shutdown. Missile impacted 800 to 900 nm short of intended impact point. First flight of modified booster turbopumps.
12B	9-4-58	14	11-8-58	11-24-58	11-28-58	1730	Successful flight. Impacted approximately 5506 nm downrange.
10B	10-22-58	11	11-20-58	****12-9-58 ****12-10-58 12-12-58	12-18-58	1729	Successful flight. Missile placed into orbit.
13B	12-4-58	14	12-5-58	12-22-58	1-15-59	30	Flight prematurely terminated due to unexplained difficulties starting at 100 seconds after liftoff. Missile impacted 170 nm downrange. There was no telemetry system aboard this missile.
11B	8-22-58	11	12-23-58	1-20-59	2-4-59	29	Successful flight. Impacted approximately 3122 nm downrange.

* Automatic cutoff initiated by sustainer overspeed/underspeed trip 1.96 seconds after BGG links break.

** Automatic cutoff initiated by sustainer overspeed/underspeed trip 1.08 seconds after BGG links break.

*** Prematurely terminated by an automatic cutoff 4.98 seconds after BGG links break.

**** Vernier ignition only.

\# Manual cutoff at 6.69 seconds.

\## After installation of "C" Series power pack in Hangar "J".

\### Automatic cutoff initiated by sustainer overspeed/underspeed trip 1.0 seconds after BGG links break.

\#### Full duration, but engine compartment fire delayed schedule approximately 10 days.

SIGNIFICANT DATES DURING TESTING OF "C" SERIES FLIGHT MISSILES AT AMR

Missile	Arrival	Complex	Erection	FRF	Flight	AMR Range No.	Comments
3C	10-31-58	12	11-4-58 *11-25-58	12-17-58	12-23-58	2501	Successful flight. Impacted approximately 3803 nm downrange.
4C	11-9-58	12	1-6-59	1-19-59	1-27-59	10	Although impact was close to intended point, the guidance system did not function.
5C	1-31-59	12	2-4-59	None	2-20-59	251	Missile exploded at 174 seconds due to a malfunction at staging. Probable cause was improper operation of the fuel staging valve.
7C	2-12-59	12	2-23-59	None	3-18-59	761	Booster engine shutdown prematurely at 131 seconds of flight. Missile was unstable for remainder of flight.
8C	5-7-59	12	5-11-59	**5-22-59 **7-9-59	#7-15-59 7-21-59	2103	Successful flight. Impacted in target area 4385 nm downrange. X-2 Re-entry Vehicle recovered.
11C	7-15-59	12	7-25-59	8-14-59	8-24-59	2121	Successful flight. Impacted almost 5 miles long in MILS net due to residual thrust after vernier cutoff. Re-entry vehicle was recovered.

* After power pack modification.

** Two successful Flight Readiness Firings performed.

\# Ignition achieved twice. Manual cutoff for 1st. attempt in vernier ignition phase. Second attempt terminated by release timer.

SIGNIFICANT DATES DURING TESTING OF "D" SERIES FLIGHT MISSILES AT AMR

Missile	Arrival	Complex	Erection	FRF	Flight	AMR Range No.	Comments
3D	2-25-59	13	2-27-59	3-27-59	4-14-59	1002	Booster section exploded 27 seconds after liftoff due to failure of airborne LO2 fill and drain valve to close. Missile destroyed at 37 seconds.
7D	3-20-59	14	4-13-59	5-8-59	*5-15-59 5-18-59	1754	Missile exploded at 65 seconds due to improper launcher operation which resulted in loss of fuel tank pressure.
5D	3-8-59	13	4-28-59	5-15-59	6-6-59	1753	Missile exploded at 160 seconds due to a malfunction at staging. Probable cause was improper operation of the fuel staging valve.
11D	4-10-59	11	5-11-59	**7-14-59 7-22-59	7-28-59	2002	Successful flight. Impacted 4384 nm downrange less than 1/2 mile from target in MILS net.
14D	5-7-59	13	6-10-59	7-28-59	8-11-59	2003	Successful flight. Impacted in MILS net less than 1 mile from target.
17D	5-27-59	13	8-17-59	9-9-59	9-16-59	2106	Successful flight. Impacted 2 miles short of target in MILS net due to failure of vernier solo hydraulic package.
18D	5-27-59	11	9-2-59	None	10-6-59	2120	Successful flight. Impacted in MILS net less than 1/2 mile from target.
22D	8-26-59	13	9-21-59	None	10-9-59	3505	Successful flight. Impacted in MILS net less than 1 1/2 miles from target.
26D	9-18-59	11	10-8-59	None	10-29-59	2344	Due to malfunction of V2 engine at staging. Impacted approximately 14 miles short of target point.
28D	9-18-59	13	10-14-59	None	11-4-59	4203	Unsuccessful. A/B IP failure prevented Station 5 IP system from acquiring the missile. Range safety cutoff caused R/V to impact approximately 260 miles short of target.
15D	5-9-59	11 14 13	7-11-59 9-23-59 11-7-59	None	11-24-59	2105	Successful although re-entry vehicle did not seperate. Impacted in MILS net.
31D	10-10-59	13	11-28-59	None	12-8-59	2205	Successful flight. Impacted 1/2 mile from target in MILS net.

Missile	Arrival	Complex	Erection	FRF	Flight	AMR Range No.	Comments
40D	11-20-59	13	12-10-59	None	12-18-59	16	Successful flight. Delivered a Mk-2 Re-entry Vehicle within 3 nm of target over a 5500 nm range.
43D	12-8-59	13	12-22-59	None	1-6-60	32	Successful flight. Delivered a Mk-3 Re-entry Vehicle within 3 miles of target over a 5500 nm range.
44D	12-17-59	13	1-11-60	None	1-26-60	54	Successful flight. RVX4-A2 Re-entry Vehicle impacted approximately 1/2 mile from target in MILS net.
49D	1-5-60	13	1-28-60	None	2-11-60	320	Successful flight. Mk-3 Re-entry Vehicle impacted less than 1 1/2 nm from target over a 5500 nm range.
42D	12-5-59	11	12-21-59	02-4-60 2-23-60	03-4-60 3-8-60	17	Successful flight. First missile to use all-inertial guidance system open loop.
51D	1-29-60	13	2-15-60	None	3-10-60	775	Destroyed by fire and explosion immediately after liftoff.
48D	2-19-60	11	3-10-60	None	4-7-60	301	Destroyed in the stand by fire and explosion during a launch attempt.
56D	3-3-60	12	4-11-60	None	0005-12-60 5-20-60	1885	Successful flight. Delivered Mk-3 Re-entry Vehicle within 4 nm of target over an extended range of 7859 nm.
54D	2-25-60	11	5-13-60	None	6-11-60	615	Successful flight. Delivered Mk-3 Re-entry Vehicle 4306 nm downrange within 2.2 nm of target. First flight with AIG system providing active guidance functions.
62D	4-19-60	14	5-26-60	None	6-22-60	801	Impacted approximately 18 nm long due to failure of the vernier engines to shutdown when the guidance cutoff discrete was received.
27D	5-27-60	12	6-4-60	None	6-4/-60	1002	Successful flight. Impacted within 1 nm of target in MILS net 4388 nm downrange.
60D	4-5-60	11	6-14-60	None	7-2-60	803	Inadvertent pressurizations of the engine tanks caused premature depletion of control helium. Re-entry vehicle impacted 40 nm short.
32D	6-22-60	12	7-1-60	None	0000-2-60 8-9-60	1003	Successful flight. Impacted within 4 nm of target in South Atlantic Ocean over the intermediate range of 6350 nm.

SIGNIFICANT DATES DURING TESTING OF "D" SERIES FLIGHT MISSILES AT AMR (Cont'd)

Missile	Arrival	Complex	Erection	FRF	Flight	AMR Range No.	Comments
66D	6-14-60	11	7-7-60	None	8-12-60	1004	Successfully impacted re-entry vehicle within 2 nm of target. First Atlas to use AIG system with impact programmed for Station 12 MILS net.
76D	7-5-60	11	8-15-60	None	9-16-60	2617	Successfully placed RVX-2A Re-entry Vehicle within 5 nm of target. Second Atlas to use AIG System with impact in Station 12 MILS net.
79D	7-13-60	14	8-26-60	None	***9-15-60 9-19-60	802	Successful flight. Second Atlas to deliver a Mark 3 Re-entry Vehicle to target over an extended range of 7863 nm.
71D	8-19-60	11	9-26-60	None	10-13-60	1502	Successful flight. Impacted within 2 nm of target 4387 nm downrange. Last D-AIG Missile to be flight tested. RVX-2A Re-entry Vehicle recovered.
55D	2-27-60	12	3-7-60 5-24-60 10-3-60	None	10-22-60	613	Successful flight. Impacted within 1 nm of target 6350 nm downrange. The missile was flown without insulation and insulation bulkhead at the intermediate bulkhead with no adverse results.
83D	10-6-60	12	10-27-60	None	11-15-60	3502	Successful flight. Impacted less than 1 nm from target 4388 nm downrange. Data cassette recovered.
90D	12-14-60	12	12-20-60	None	1-23-61	3505	Successful flight. Last of "D" Series Weapon System flights. Impacted Mk-3 Mod 1B Re-entry Vehicle within 1/2 nm of target 4394 nm downrange.

* Launch aborted due to faulty release timer which initiated automatic cutoff.

** Test terminated by sustainer rough combustion cutoff circuitry.

*** Launch aborted 5.45 seconds after sustainer flight lockin because no release signal was generated.

\# Rerun due to Guidance System difficulties.

\#\# Engine cutoff prior to release due to erroneous callout in blockhouse.

\#\#\# Terminated by erroneous output from B2 primary RCC accelerometer.

\#\#\#\# Terminated 1.53 seconds after sustainer flight lockin by the sustainer RCC system.

SIGNIFICANT DATES DURING TESTING OF "E" SERIES FLIGHT MISSILES AT AMR

Missile	Arrival	Complex	Erection	FRF	Flight	AMR Range No.	Comments
3E	5-19-60	13	7-29-60	*9-23-60 10-3-60	10-11-60	1402	Malfunction in sustainer hydraulic system caused loss of missile after staging.
4E	7-15-60	13	10-21-60	None	11-29-60	2800	Sustainer hydraulic pressure was lost at 41 seconds and caused missile to become unstable at booster cutoff. Sustainer thrust was lost at about 150 seconds.
8E	10-25-60	13	12-5-60	None	1-24-61	3504	Missile stability was not maintained after 161.8 seconds due to loss of engine servo control in flight control system. Sustainer engine shutdown at 249 seconds.
9E	11-11-60	13	1-30-61	None	2-24-61	3803	Successful flight. Impacted Mark 3 Mod II B Re-entry Vehicle within 600 yds. of aim point.
13E	1-13-61	13	2-27-61	None	3-13-61	403	Malfunction in PU system caused fuel depletion and premature shutdown of sustainer engine at 252 seconds.
16E	3-10-61	13	3-14-61	None	3-24-61	811	Failed to jettison the booster section because of premature depletion of engine control bottle helium pressure.
12E	12-20-60	11	2-16-61	None	5-12-61	404	Successful flight. Impacted Mark 5 Mod I Re-entry Vehicle within 0.5 mile of target at a range of 4388 miles. First "E" Series from Complex 11.
18E	3-30-61	13	4-5-61	None	5-26-61	813	Successful flight. Impacted Mark 4 Mod IV Re-entry Vehicle 1 mile of target at a range of 4388 nautical miles. First "E" Series missile flown without insulation and insulation bulkhead at the intermediate bulkhead with no adverse results.
17E	3-21-61	11	5-18-61	None	6-22-61	812	Unsuccessful flight. Malfunction in the Flight Control System caused loss of missile after 101 seconds.

* B2 lube oil pump shaft sheared. Test duration 14 seconds.

SIGNIFICANT DATES DURING TESTING OF "E" SERIES FLIGHT MISSILES AT AMR

Missile	Arrival	Complex	Erection	FRF	Flight	AMR Range No.	Comments
22E	6-4-61	13	6-14-61	None	7-6-61	1251	First "E" Series missile to be successfully flown to a maximum range target of 7863 nautical miles with impact within 2.1 nautical miles of target.
21E	6-24-61	11	7-5-61	None	7-31-61	1360	Impacted a Mark 5 Mod I Re-entry Vehicle within 3.1 nautical miles of target at a range of 4388 nautical miles.
26E	7-7-61	13	8-9-61	None	9-8-61	1803	Flight prematurely terminated when the sustainer engine shut down during booster jettison sequence. Operation of all other systems was satisfactory.
25E	7-18-61	11	8-14-61 9-7-61*	None	10-2-61	1252	Impacted a Mark 5 Mod I Re-entry Vehicle within 1.5 nautical miles of target. A scientific passenger pod containing Centaur Guidance System was carried for the first time. * Re-erected after complex modification to "F" Series.
30E	8-22-61	13	9-12-61	None	10-5-61	1804	Fourteenth "E" Series missile to be flight tested at AMR. First flight for a Mark 4 Re-entry Vehicle to a long range target of 7539 nautical miles. All prime objectives were satisfied.
32E	10-5-61	13	10-9-61	None	11-10-61	3203	Unsuccessful flight due to a premature shutdown of the sustainer engine. Missile was destroyed by Range Safety Officer at 35 seconds.
35E	10-17-61	13	11-10-61	None	12-1-61	5462	Sixteenth "E" Series missile to be flight tested at AMR. Successfully impacted Mark 4 Mod 4 Re-entry Vehicle within 2.1 nautical miles of target.
36E	11-22-61	13	12-2-61	None	12-19-61	5464	Impacted a Mark 5 Mod 1A Re-entry Vehicle within 1.2 nautical miles of target at a range of 6000 nautical miles in the Mid Ocean Target Array.
40E	12-15-61	13	12-27-61	None	2-13-62	101	Eighteenth "E" Series missile to be flight tested at AMR. Successfully impacted a Mark 4 Mod 2A re-entry vehicle at a range of 6000 nautical miles in the Broad Ocean Area within 0.75 nautical miles of target. Re-entry vehicle data cassette was not recovered.

SECRET

SIGNIFICANT DATES DURING TESTING OF "F" SERIES FLIGHT MISSILES AT AMR

MISSILE	Arrival	Complex	Erection	FRF	Flight	AMR Range No.	Comments
2F	7-2-61	13	7-12-61	None	8-8-61	1805	First "F" Series Missile to be flight tested. Impacted Mark 5 Mod 1 Re-entry Vehicle 4388 nautical miles within 2.1 nautical miles of aim point.
4F	8-12-61	11	10-6-61	None	11-25-61	3751	Impacted a Mark 5 Mod 2 Re-entry vehicle within 1.2 nautical miles of target at a range of 4,388 nautical miles. First flight with dual Scientific Passenger Pods on board.
5F	9-15-61	11	11-24-61	None	12-12-61	3752	Unsuccessful flight. Guidance computer failure resulted in premature command shutdown of the sustainer and vernier engines. Operation of all other systems was satisfactory.
6F	12-2-61	11	12-13-61	None	12-20-61	4501	Unsuccessful flight. Loss of sustainer hydraulic pump inlet pressure and vernier return pressure at staging resulted in loss of missile stability at 226 seconds.

SIGNIFICANT DATES DURING TESTING OF MERCURY/ATLAS VEHICLES AT AMR

Missile	Arrival	Complex	Erection	FRF	Flight	AMR Range No.	Comments
10D	4-10-59	14	6-2-59 7-22-59*	9-3-59	9-9-59	2119	Successful flight although booster section failed to jettison. Project Mercury Capsule recovered.
50D	5-17-60	14	6-30-60	7-21-60	7-29-60	1505	Unsuccessful. Missile apparently destroyed after 60 seconds of flight. Mercury Capsule remained intact until impact.
67D	7-8-60	14	11-4-60	11-19-60	2-21-61	419	Successful MA-2 mission. Impacted Mercury Capsule as planned. First closed loop flight for ASIS. Capsule recovered.
100D	3-14-61	14	-27-61	None	4-25-61	835	Unsuccessful. Missile was destroyed by range safety action 40 seconds after lift-off. This action was necessitated by the absence of the roll and pitch-over maneuvers.
88D	7-16-61	14	7-19-61	None	9-13-61	1254	Flight was successful. Capsule was placed in orbit; after one scheduled orbit capsule was recovered east of Bermuda. All objectives were satisfied.
93D	8-12-61	14	10-6-61	None	11-29-61	1810	Successfully placed a Mercury Capsule, containing a chimpanzee, into orbit. After two of three planned orbits the capsule was successfully recovered in the planned recovery area near Bermuda.
109D	11-30-61	14	12-2-61 12-20-61**	None	2-20-62	5460	Successfully placed a Mercury Capsule, containing an Astronaut, into orbit. The capsule, after completing three orbits, landed within visual range of a destroyer and was successfully recovered.

* Returned to hangar for booster power package replacement.
** Returned to hangar to facilitate work on launcher heads.

SECRET

SIGNIFICANT DATES DURING TESTING OF MIDAS VEHICLES AT AMR

Missile	Arrival	Complex	Erection	FRF	Flight	AMR Range No.	Comments
29D	10-10-59	14	1-18-60	None	2-26-60	304	MIDAS I Booster shot. Atlas portion of flight was successful.
45D	1-26-60	14	3-3-60	None	5-24-60	619	MIDAS II Booster shot. Atlas portion of flight completely successful.

SIGNIFICANT DATES DURING TESTING OF RANGER VEHICLES AT AMR

Missile	Arrival	Complex	Erection	FRF	Flight	AMR Range No.	Comments
111D	5-27-61	12	5-29-61	None	8-23-61	5050	Atlas/Agena Booster portion of flight was successful. Agena spacecraft orbit was not satisfied due to a malfunction in upper stage operation.
117D	9-17-61	12	9-19-61	None	11-18-61	4507	Atlas/Agena Booster portion of flight was successful. Agena spacecraft orbit was not satisfied due to a malfunction in upper stage operation.
121D	12-19-61	12	12-21-61	None	1-26-62	125	Primary objective to place Ranger Spacecraft into a moon collision orbit was not satisfied due to an Atlas Guidance System failure. Due to excessive velocity being imparted to the spacecraft, it passed the moon at a distance of approximately 22,000 miles and went into a solar orbit. Operation of all other systems was satisfactory.

SIGNIFICANT DATES DURING TESTING OF ATLAS/ABLE LUNAR PROBES AT AMR

Missile	Arrival	Complex	Erection	FRF	Flight	AMR Range No.	Comments
9C	4-4-59	12	4-15-59 *8-17-59	9-24-59		2944	Destroyed by fire and explosion following premature cutoff during flight readiness firing.
20D	9-10-59	14	10-19-59	None	11-26-59	4122	Atlas/Able IV Lunar Probe. Atlas portion of flight was successful. Portions of Able failed at 47 seconds.
80D	8-13-60	12	9-2-60	None	9-25-60	2801	Atlas/Able V Lunar Probe. Atlas portion of flight was successful. Second stage engine operation unsatisfactory.
91D	10-15-60	12	11-17-60	None	12-15-60	4506	Unsuccessful. Flight was terminated after 74.5 seconds when the vehicle destroyed itself.

* Erected twice due to cancellation of test and subsequent return to hangar for storage.