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**FLIGHT TEST WORKING GROUP  
FLIGHT TEST REPORT**

**ATLAS MISSILE 62D**

**22 JUNE 1960**

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CONVAIR ASTRONAUTICS  
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**AMR RANGE TEST NUMBER 801  
CONVAIR TEST NUMBER P4-402-00-62**

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FOREWORD

This report has been prepared to present preliminary information relative to the flight of Atlas Missile No. 62D. 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 WS 107A-1 Flight Test Working Group.

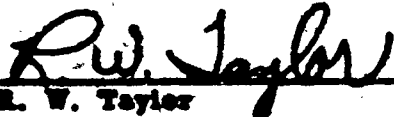
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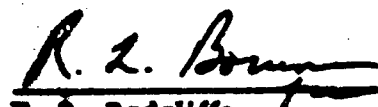
R. E. Payne  
Head of WS 107A-1  
Space Technology Laboratories, Inc.  
AMR, Florida



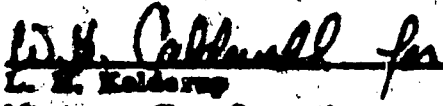
R. E. Newton  
Chief Test Conductor  
CONVAIR (ASTRONAUTICS) DIVISION  
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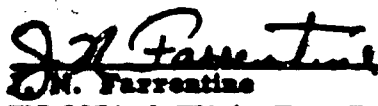
R. W. Taylor  
Responsible Representative  
WS 107A-1  
Rockethyna, AMR, Florida



F. R. Radcliffe  
Chief Test Conductor  
General Electric (DSD)  
AMR, Florida



L. E. Kaldorup  
Manager, Test Operations  
Ballistic Missile Division  
Burrroughs



J. M. Farrentine  
WS 107A-1 Flight Test Engineer  
GE (MSVD)



V. E. Smith  
Assistant Supervisor  
Sandia, Corporation



Howard R. Sloan  
Resident Senior Engineer  
Acoustics Associates



D. D. Hammett  
Responsible Test Base Engineer  
Aeromtronics, Division of  
Ford Motor Company, AMR



P. A. Wignall  
Colonel, USAF  
Commanding

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SUMMARY

Atlas Missile 62D was launched from AMR, Complex 14, at 0949 EST, on 22 June 1960. The flight was not completely successful in that the missile did not respond to the guidance vernier cutoff discrete and vernier cutoff was effected by the autopilot programmer backup. As a result, impact was approximately 18 nautical miles longer than nominal.

Due to a split in the aluminum bulbhead, Missile 62D was tanked to a special procedure under which LO2 was tanked to the 95 percent Propellant Loading Control Monitor (PLCM) probe and fuel was tanked to the 90 percent PLCM probe. This did not affect flight performance and enough residual propellants remained for approximately 11 seconds additional sustainer burning.

The missile was restrained in the launcher for an additional 4.28 seconds after main engine complete to increase the probability of shutting down the engines in the event of combustion instability during engine start and transition to main-stage. This was the first missile to undergo a dry start since combustion instability was encountered in Missiles 51D and 48D. Special landline FM recording gave no indications of instability in any thrust chamber and engine operation appeared normal throughout the flight.

This was the first flight test of the ASIS canister and the production type Optical Beacon System. Although a questionable abort was received, the data indicated satisfactory ASIS canister performance. Operation of the Optical Beacon System appeared satisfactory although the daylight launch precluded obtaining camera coverage.

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FLIGHT TEST OBJECTIVES

This report defines the flight performance of a guided missile.

The primary purposes of this flight were to determine the performance of the re-entry vehicle, with principle emphasis on the operation of the simulated warhead, and to evaluate the guidance system accuracy. Detailed objectives are listed on the following pages along with comments on the degree to which they were satisfied.

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ORDER YEM NO. PART

OBJECTIVE

- 1 - First Order
- 2 - Second Order
- 3 - Third Order

Weapon System Objectives

1. Obtain Data on the repeatability of all missile systems and associated ground systems.	2	X	Vernier engines did not respond to guidance discrete.
2. Evaluate the guidance system accuracy.	1	X	
3. Evaluate the performance of the arming and fusing system.	1		Evaluation of data not yet accomplished.
4. Demonstrate the proper operation of R/V subsystems.	1	X	
5. Evaluate the performance of the war-head.	1	X	
6. Obtain Data on R/V impact location for the statistical determination of CEP.	1	X	
7. Obtain Data relative to the effects of low-NPEH staging on the propulsion system.	3	X	
8. Evaluate the missile system with regard to engine start and potential causes for combustion instability.	1	X	

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COMMENT

GRADE YES NO PART

Mercury System Objectives

- |  |   |   |   |
|--|---|---|---|
| 1. Obtain Data on the transmission of free electrons at altitudes above 1,000,000 ft.                | 3 |   | No information available.   |
| 2. Obtain Data on the open loop performance of the Mercury abort sensing and instrumentation system. | 3 | X |   |
| 3. Demonstrate satisfactory strobe optical beacon performance.                                       | 3 | X | Telemetry data indicated proper operation. There was no camera coverage due to the daylight launch. |
| 4. Determine the performance of the experimental decay ejection system.                              | 3 | X |   |
| 5. Obtain Data on the performance of the decay during re-entry.                                      | 3 | X |   |

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### FLIGHT TRAJECTORY

The flight of Missile 62D was planned for a range of 4388 nautical miles with impact in the missile impact location system (MILS) splash net. This was the first R and D flight to use a lofted trajectory. The Guidance, Impact Predictor, and Asusa Systems placed impact approximately 18 nm beyond the target point.

This was a result of vernier cutoff being effected by the autopilot programme r back-up rather than the guidance discrete.

Figure I presents impact points as determined from several sources.

A comparison of nominal flight performance parameters from flight trajectory simulation case 62D-79A, and measured test values from Asusa and telemetry data at significant times along the trajectory are presented below.

**NOTE:** All times in this report are based on range zero time which occurred at 0949:33 EST.

<u>Param</u>	<u>Unit</u>	<u>Nominal</u>	<u>Measured</u>
Liftoff Weight	lbs.	241,940	240,883
Pitch Plane Azimuth	deg.	106	105
BCO Weight	lbs.	64,846	---
BCO Velocity	ft/sec	8,499	8,530
BCO Altitude	ft	212,222	214,714
BCO Range	nm	35.3	34.5
BCO Time	sec	118.6	118.0
SCO Weight	lbs.	14,005	---
SCO Velocity	ft/sec	20,129	20,073
SCO Altitude	ft	1,004,567	1,037,655
SCO Range	nm	386.1	353.9
SCO Time	sec.	284.8	284.4

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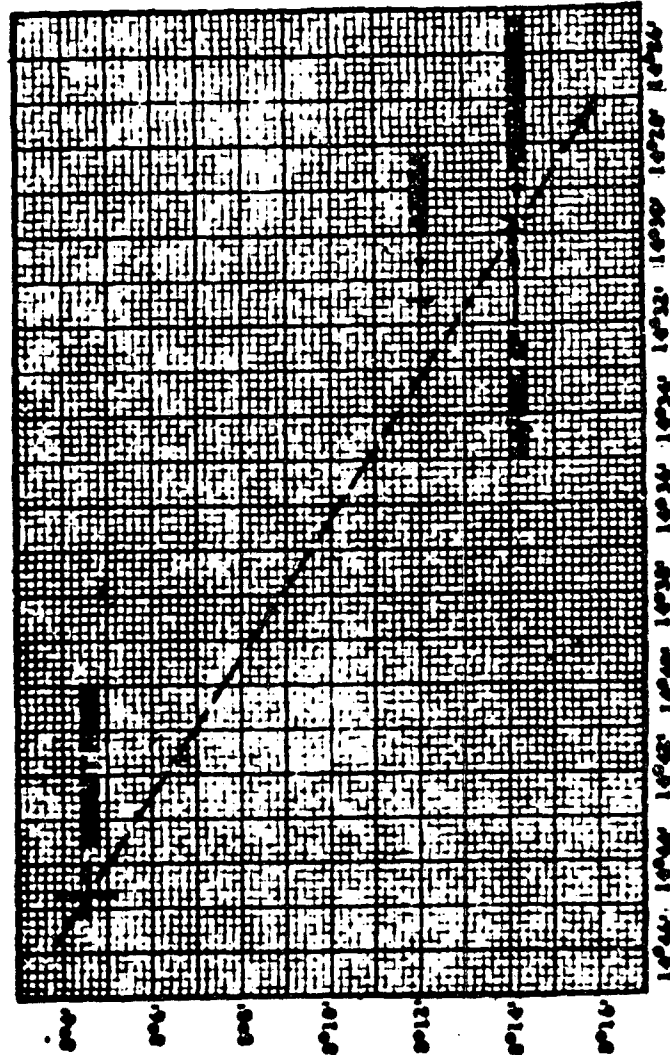
<u>Item</u>	<u>Unit</u>	<u>Nominal</u>	<u>Measured</u>
VCO Weight	lbs.	13,864	---
VCO Velocity	ft/sec	19,987	18,893
VCO Altitude	ft	1,116,163	1,192,860
VCO Range	nm	408.6	426.5
VCO Time	sec.	301.7	307.8
Impact Time	sec.	2008	2028.5
Impact Range	nm	4388	4406
Impact Latitude (Geodetic)	deg.S	8°4.572'	8°14.13'
Impact Longitude (Geodetic)	deg. W	14°44.698'	14°29.95'

**NOTE:** Nominal times are corrected for the difference between range zero and 2 inch motion. Measured velocity, altitude, range and impact time are taken from Asusa data. Measured impact co-ordinates are taken from GE/BRC guidance data. Measured cutoff times are taken from telemetry recordings of discrete generation. Altitude is height above launch horizontal. Velocity is speed relative to the earths surface. Range is horizontal range from the launch pad with the exception of impact range which is surface range.

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**IMPACT POINT COMPARISON**



**SOUTH LATITUDE**

**FIGURE 1**

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SYSTEM PERFORMANCE

**AIRFRAME**

Airframe structural integrity was maintained throughout powered flight and well beyond re-entry vehicle separation. Instrumentation monitoring booster section separation (measurement M 26 D) and missile axial acceleration data indicated satisfactory separation. Re-entry vehicle separation also appeared satisfactory as indicated by rate gyro data.

Peak axial accelerations were 6.5 G's and 5.5 G's at booster cutoff and sustainer cutoff respectively. Measurement A 622 I, Thrust Section Light in Quad IV, did not indicate illumination at any time and all thrust chamber temperature appeared normal.

Maximum temperatures of airframe measurements and corresponding times are presented below:

<u>Measure- ment No.</u>	<u>Description</u>	<u>Max Temp (DOF)</u>	<u>Time (sec)</u>
A 745 T	Amb @ S Fuel Pump	61	309
A 746 T	Amb @ V Hyd Supply	67	0
A 747 T	Fuel Stg Vlv Shielded	93	121
A 646 T	Dummy Hyd Vlv Inbd	--	*
A 647 T	Dummy Hyd Vlv Outbd	570	121
P 14 T	Eng Compartment Amb	64	1000

- \* Measurement Open Prior To Test
- \*\* Measurement Lost At Staging

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### PROPULSION SYSTEM

Performance of the MA-2 propulsion system was satisfactory and operation was normal throughout powered flight.

The engine start sequence was normal and all valve and timer operating times were within specifications.

Release of the missile was delayed an additional 4.28 seconds by means of a timer between main engines complete and pre-release cutoff disarm. The rough combustion cutoff (RCC) systems were active during this additional time.

During this test the propulsion system underwent a dry start and the booster RCC level was set at 30 G's for 40 milliseconds. There were no adverse effects on system performance caused by the dry start.

A total of nine Wiggins' quick disconnects were removed and replaced by solid plugs as follows: two in the B1 high pressure fuel ducting, three in the B2 high pressure fuel ducting, one in the booster turbopump low pressure ducting, one in each of the vernier orifice blocks, and one in the SGG fuel inlet line.

RCC accelerometer data recorded on the FM landline system indicated a level of 10 G's RMS or below for all 5 RCC systems during mainstage. Approximate individual levels in G's RMS were:

B1 Primary = 10, B1 Backup = 10, B2 Primary = 10, B2 Backup = 10,

Sustainer = 8.

The sustainer engine RCC accelerometer indicated an 1100 cps 30 G's RMS output for approximately one second during ignition stage. The oscillographic binary count data, recorded on all 5 RCC systems was zero.

Only three of the six accelerometers located on the LO2 and fuel high and low pressure lines yielded valid data. Accelerometer data on the B2 Fuel High Pressure Line, B1 LO2 High Pressure Line and B2 LO2 High Pressure Line were invalid. Values recorded on the remaining three accelerometers during mainstage in G's RMS were as follows:

B1 Fuel High Pressure Line = 30, Booster Fuel Low Pressure Line = 30,

Booster LO2 Low Pressure Line = 20.

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A malfunction of the ISS pneumatic regulator was observed at approximately 195 seconds. At this time the regulator locked up at a value of 75-100 psi above normal and remained there until sustainer cutoff. The regulator then recovered and vernier engine performance was not affected.

For this flight, booster cutoff was planned for a sustainer LO2 pump Net Positive Suction Head (NPSH) of 21.5 feet at staging. The actual NPSH during the staging transient did not fall below 23 feet and normal engine operation was indicated during this period.

Missile axial thrust levels during flight are presented below:

<u>Engine</u>	<u>Units</u>	<u>LL At</u>	<u>After</u>	<u>TLM</u>	<u>TLM</u>	<u>TLM</u>
				<u>Liftoff</u>	<u>Liftoff</u>	<u>Prior To</u>
				<u>BCO</u>	<u>SCO</u>	<u>VCO</u>
Vernier No. 1	lbs	--	850	960	750	650
Vernier No. 2	lbs	--	870	993	740	640
Sustainer	lbs	54,250	50,750	76,310	76,310	--
Booster No. 1	lbs	151,410	156,320	180,170	--	--
Booster No. 2	lbs	154,170	154,840	180,800	--	--

Equations used for computing thrust:

Verniers  $F = (1.543 - \frac{P_a}{P_c} \epsilon) P_c A_t \cos \theta$

Sustainer  $F = (1.749 - \frac{P_a}{P_c} \epsilon) P_c A_t$

Boosters  $F = (1.506 - \frac{P_a}{P_c} \epsilon) P_c A_t$

- Where
- $P_a$  = Ambient Pressure
  - $P_c$  = Combustion Chamber Pressure
  - $\epsilon$  = Expansion Ratio (Verniers = 5, Sustainer = 24.7, B1 = 24.7, B2 = 7.9, B3 = 8.0)
  - $A_t$  = Throat Area (Verniers = 2.10 in<sup>2</sup>, Sustainer = 67.2 in<sup>2</sup>, B1 = 205.8 in<sup>2</sup>, B2 = 204.3 in<sup>2</sup>)
  - $\theta$  = Angle of Verniers from Missile Longitudinal Axis in Yaw Plane.

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**TIMERS AND VALVE OPERATING TIMES**  
(all times in seconds)

<u>Sequence</u>		<u>Test Value</u>	<u>Rocketdyne Specifications</u>
1. BOG valve opening control signal until valve reaches full open		0.46	0.330 to 0.590
2. Main LO2 valve opening control signal until valve reaches full open	B1	0.34	0.330 to 0.470
	B2	0.34	0.340 to 0.480
3. Main fuel valve opening control signal until valve reaches full open	B1	0.12	0.090 to 0.170
	B2	0.12	0.090 to 0.190
4. S HS valve opening control signal until valve reaches full open		0.69	0.480 to 0.780
5. S PU valve opening control signal until valve reaches full open		0.67	0.486 to 0.770
6. BOG valve opening control signal until valve reaches full open		0.34	0.340 to 0.490
7. Y Engine valve opening control signal until valve reaches full open	Y1		1.500 Maximum
	Y2		1.500 Maximum
8. Ignition Stage Limiter opening control signal		2.60	2.16 to 2.64
9. Holddown time		4.28	4.25 Norm.

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<u>Measure- ment No.</u>	<u>Units</u>	<u>Steady State Nominal Value</u>	<u>L/L At After Liftoff</u>	<u>Prior To BCO</u>	<u>Prior To SCQ</u>	<u>Prior To VCO</u>
<b>Engine Pressurant Tank Pressures</b>						
P 1200 P	psia	615	648	584	630	600
P 27 P	psia	610	---	292	674	600
P 30 P	psia	610	---	33	702	600
<b>Yarns</b>						
P 28 P	psia	355	---	342	359	311
P 29 P	psia	355	---	354	354	305
<b>Roads</b>						
P 1125 P	psia	765	756	752	---	---
P 1026 P	psia	577	579	530	---	---
P 1100 P	psia	441	400	468	---	---
P 10 P	psia	---	---	550	---	---
P 1017 T	deg	1200	1045	---	---	---
P 1001 P	psia	50	40	94	---	---
P 1003 P	psia	50	50	105	---	---
P 1002 P	psia	73	30***	59	---	---
P 1004 P	psia	73	26***	58	---	---

Measure-	Passing	Steady State	L/L As After	Prior	Prior
Ident. No.	Units	Nominal Value	Marsh	IZ BCG	To BCG To YGO
P 1030 T	B1 LO2 Pump Inlet	---	-298	---	---
P 1054 T	B2 LO2 Pump Inlet	---	-293	---	---
P 84 B	B1 Turbopump Speed	6169	---	631200	646500
P 83 B	B2 Turbopump Speed	6189	---	6014	5986
P 1039 P	B1 Fuel Pump Outlet	788	680	---	---
P 1038 P	B2 Fuel Pump Outlet	820	680	---	---
P 1487 P	B1 Ign Fuel Inj	---	580	---	---
P 1488 P	B2 Ign Fuel Inj	---	600	---	---
P 1093 P	B1 Fuel Inj Man	658	680	---	---
P 1094 P	B2 Fuel Inj Man	658	640	---	---
P 1091 P	B1 LO2 Inj Man	649	0	---	---
P 1092 P	B2 LO2 Inj Man	649	750	---	---
P 1066 P	B1 Thrust Chm Press	544	537	552	552
P 1059 P	B2 Thrust Chm Press	544	550	552	558
<b>Sustainers</b>					
P 1344 P	S LO2 Reg Ref Press	808	812	790	780
P 339 P	SGG Discharge Press	589	---	626	634

Measure- ment No.	Description	Units	Steady State		L/L At Lift-off	Prior To BCO	Prior To SCO	Prior To VCO
			Nominal Value	Value				
P 648 T	S LO Press Lube Oil Man	psia	---	---	124	74	58	---
P 539 T	S LO3 Pump Inlet	dgf	---	---	-293	-287	-288	-289
P 56 P	S LO3 Pump Inlet	psia	53	---	82	107	68	---
P 850 P	S LO3 Pump Inlet Le Bag	psia	---	---	>45	>45	>45	23
P 1326 T	S Turbine Inlet	dgf	1100	945	---	---	---	---
P 349 B	S Turbopump Speed	rpm	9970	---	9,990	9,960	10,050	---
P 330 P	S Fuel Pump Discharge	psia	974	---	870	885	900	---
P 550 D	S Main Fuel Valve Pos	deg	81.2	---	24.6	24.6	24.6	---
P 539 D	S Main LO2 Valve Pos	deg	---	---	43.5	38.9	36.1	6
P 351 P	S LO3 Inj Man	psia	814	---	826	780	760	---
P 1666 P	S Thrust Chm Press	psia	693	670	640	650	650	---
<b>Miscellaneous</b>								
P 1681 T	LO2 At Breakaway Vlv	dgf	-294	-311	---	---	---	---
P 1673 T	B1 Ign Fuel Vlv Amb	dgf	---	104	---	---	---	---
P 1674 T	B2 Ign Fuel Vlv Amb	dgf	---	109	---	---	---	---
P 1675 T	Eng Oil Press Man	dgf	---	99	---	---	---	---



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### PNEUMATIC SYSTEM

Performance of the Pneumatic System was satisfactory throughout the flight.

Telemetered data indicated approximately zero pressure in the booster tank helium bottles at booster cutoff. These data are considered invalid since telemetered data of this measurement prior to engine start did not correlate with other related measurements.

The IES regulator experienced an extensive lockup period starting at 194 seconds and lasting until start of vernier solo operation.

All missile tanks and bottle pressures were within specifications at liftoff, and missile tank pressures were satisfactorily maintained until well after re-entry vehicle separation. The missile was equipped with the standard "D" Series Hadley pneumatic regulators which operated satisfactorily.

#### Tank Pressurization System

Booster tank helium bottle pressure was 3168 psia prior to engine start and decayed to 2920 psia during the ground run period as indicated by landline data; telemetry data indicated pressures of 2261 psia and 2121 psia at corresponding times. At booster cutoff, booster tank helium bottle pressure was zero psia as indicated by telemetry data. Telemetry and landline data of the engine control bottle pressure prior to engine start indicated pressure above 3100 psia. Just before liftoff these pressures should all be approximately the same since all bottles are manifolded together. Telemetered data of booster tank bottle pressure is therefore considered invalid.

The Hadley "D" Series pneumatic regulators operated satisfactorily as indicated by instrumentation monitoring missile tank pressures. During the ground run period, LO<sub>2</sub> and fuel tank pressures cycled only once at engine start from 39.9 psia to 39.5 psia for LO<sub>2</sub> and from 76.6 psia to 73.3 psia for fuel. Minimum differential pressure across the bulkhead was 6.73 psid at 0.84 seconds after liftoff.

#### Engine Control Pressurization System

The IES pneumatic regulator operation was not normal. Pressures were satisfactory until 195 seconds when the regulator locked up at 100 psi higher than normal. This condition existed until sustainer cutoff and was also reflected in the vernier tank pressure data. Extensive periods of lock-up were also present during the flights of Missiles 56D and 54D.

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Engine control bottle pressure decayed from 3210 psia to 2920 psia during the ground run. This was expected due to the manifolding of the engine control bottle and booster tank bottles. Pressure was sufficient for engine control functions during flight.

Booster separation bottle discharge pressure was satisfactorily maintained until booster staging. Booster engine control manifold pressure was satisfactory throughout booster phase.

Values taken from landline and telemetry data are listed on the following page.

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Measure- ment No.	Description	Unit	L/L At Liftoff	After Liftoff	Prior To		Prior To
					BCO	SCO	
							YCO
F 1001 P	LO3 Tank Helium	pola	39.7	37.9	25.0	22.6	22.6
F 1003 P	Feed Tank Helium	pola	73.3	71.3	58.3	48.2	48.2
F 1116 P	DP Across Bulkhead	paid	--	8.73	8.73	21.8	22.1
F 1246 P	B Tk Helium Btl HI	pola	2859	1877**	0**	--	--
F 1291 P	S Ctl Helium Btl	pola	2920	2918	2641	2260	911
F 1125 P	B Ctl Press Reg Out	pola	755	768	752	--	--
F 1288 P	ISS Press Reg Out	pola	646	640	584	--	--
F 304 P	Separation Btl Disch	pola	--	3220	3115	--	--
F 1194 P	Facility GN2 Supply	pola	1773	--	--	--	--
F 1247 T	B Tank He Btl	dgl	*	-325	-372	--	--
F 115 T	LO3 Press Reg Inlet	dgl	--	202	292	232	232

\* Record had no calibration

\*\* Data questionable - Qualitative Only

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### HYDRAULIC SYSTEMS

Performance of the missile Hydraulic Systems was satisfactory.

The booster hydraulic system rose from a ground pressure level of 1850 psia, to a steady state airborne pressure level of 3072 psia where it remained until booster cutoff.

The sustainer hydraulic system rose from a ground system level of 1855 psia to an airborne steady state pressure of 3150 psia, which was maintained until sustainer cutoff.

The vernier hydraulic system consisted of a 25 cubic inch hydraulic accumulator which had a gas precharge pressure of 1000 psig. Vernier accumulator data indicated satisfactory pressure until 26 seconds after sustainer cutoff when the accumulator bottomed out at 840 psia.

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**MISSILE ELECTRICAL SYSTEM**

Performance of the Missile Electrical System was satisfactory. Telemetered data indicated that satisfactory a-c and d-c electrical power were supplied until re-entry vehicle separation. System parameters remained within specifications at all times.

The changeover from complex external power to missile internal power was accomplished without incident.

Missile main battery and inverter phase A voltages remained between 27.1 and 28.0 vdc and 113.6 and 113.8 vdc, respectively, over the time interval from engine start to re-entry vehicle separation. Inverter frequency remained between 399.4 and 400.9 cps during this interval except for the usual transients which reached a peak frequency of 402.4 cps at booster engine cutoff and 404.8 cps at sustainer engine cutoff.

During the countdown, at approximately -2 minutes a redline was called on the inverter phase A voltage panel meter reading, which read 112.0 vac on external power. A test was made under loaded conditions on internal power and voltage and frequency readings were within specifications.

**AZUSA SYSTEM**

Performance of the Azusa System was satisfactory. Realtime impact prediction plots were obtained during powered flight and trajectory information was obtained until 345 seconds. Telemetered klystron power output and r-f input/agg data indicated satisfactory transponder operation.

Solid r-f lock was acquired by the AMR ground station at 30 seconds. All ambiguities in the cosine channels were resolved to fine by 35 seconds. Ambiguities in the X cosine channel were re-resolved to fine at 150 seconds and no further resolutions were required during the flight.

During the countdown AMR reported a "GO" transponder. Received signal strength at the ground station was -122 DBW. Recovery, modulation, and coherency were satisfactory.

**RANGE SAFETY COMMAND SYSTEM**

Performance of the Range Safety Command System was satisfactory. Automatic and manual fuel cutoff command signals were received and properly decoded during the flight. Telemetered r-f input/agg data indicated that received signal strength was adequate to maintain proper system operation from launch until post re-entry vehicle separation. This was the first "D" Series R and D flight using the ARW-62 receiver.

The automatic sustainer fuel cutoff signal, generated by the Station 5 (San Salvador) Impact Predictor Computer and transmitted by AHR as a backup sustainer cutoff signal, was decoded at 284.516 seconds. The manual fuel cutoff signal, which served as a backup re-entry vehicle separation signal, was planned and requested for 330 seconds. Telemetry data indicated that the signal was decoded at 327.716 seconds.

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OPTICAL BEACON SYSTEM

Airborne system operation was satisfactory. This was the second flight test in which telemetry data indicated successful Optical Beacon System operation.

There was no ground photographic re-ordering of the beacon flashes due to the day-light launch, but telemetry data indicated satisfactory operation of the airborne system. The initiating signal was given at 284.22 seconds and the first flash occurred at 284.79 seconds. Seventy seven pulses were counted before telemetry channel E was switched to monitor other data. The last pulse shown occurred at 322.79 seconds.

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**ABORT SENSING & INSTRUMENTATION SYSTEM**

This was the first flight test utilizing the Abort Sensing and Instrumentation System (ASIS) canister. The system was in an open loop configuration and was a complete system with the exception of the capsule and capsule-missile interface circuits, and the redundant rate gyros.

It should be noted that on Project Mercury flights the sustainer and vernier engines are cut off simultaneously and therefore system operation for this missile is only applicable up to sustainer cutoff.

The system entered an abort ready condition at -4.8 seconds and remained there until sustainer engine cutoff, with the exception of a momentary abort signal generated 0.84 seconds after liftoff. This abort signal was initiated by F 133 X, Intermediate Bulkhead Differential Pressure Switches. These switches were set to generate abort signals at a minimum pressure of 4 psid. Simultaneously, abort conditions were noted on S 179 X, Engine Cutoff System Output, M 145 X, Booster Abort Ready, and E 34 X, AC Low Voltage. At the corresponding time F 116 P, Differential Pressure Across the Bulkhead, indicated 6.73 psi.

After sustainer engine cutoff it appeared that H 220 X, Sustainer Hydraulic Pressure Switch No. 2, failed to indicate an abort condition. This pressure switch finally indicated an abort condition at 170 seconds after sustainer cutoff which was well after sustainer hydraulic pressure had decayed below the 2000 psia abort limit.

Measurements P 574 X, Sustainer Injection Manifold Pressure Switch, M 145 X, Booster Abort Ready, and S 179 X, Engine Cutoff System Output, were transmitted on telemetry channel E which at sustainer engine cutoff was programmed to switch to a continuous channel for monitoring Strobe Light operation. Therefore evaluation of data on these measurements was limited to prior to sustainer cutoff and it was not possible to observe the expected abort indications immediately after sustainer cutoff.

All other pressure switches appeared to have operated satisfactorily. Autopilot rate gyre data indicated rates were within the abort limits throughout the duration of ASIS operation.

FLIGHT CONTROL SYSTEM

Flight Control System performance was satisfactory except for the interconnection between the guidance and flight control system for the vernier cutoff discrete. Thrust chamber displacements at engine start were within the allowable tolerance of  $\pm 0.6$  degrees. No roll program was planned and none occurred. The flight control programmer satisfactorily initiated and controlled the prescribed pitch program. The autopilot programmer properly generated a backup vernier cutoff signal 23.5 seconds after sustainer cutoff which shut down the vernier engines. Cutoff was not effected by the guidance discrete.

Evaluation of Vernier Cutoff Testing

Re-evaluation of data obtained during preflight testing revealed the following concerning the vernier cutoff problem:

1. Vernier engine cutoff was achieved normally by the guidance discrete during the two Factory Acceptance Tests of the missile.
2. Vernier engine cutoff was not achieved by the guidance discrete during the Autopilot/Guidance Integrated Test in the hangar nor during the Flight Acceptance Composite Test at Complex 14. Vernier cutoff was effected by the programmer backup signal in both these tests.
3. The loop test conducted at -50 minutes in the launch countdown indicated that the circuit from the autopilot to the engine relay box was intact.
4. The data link test conducted at -10 minutes during the launch countdown indicated that the vernier cutoff discrete was not received at the autopilot programmer.

These data indicate that although the vernier cutoff discrete was properly decoded by the guidance airborne system it was probably not received at the autopilot programmer.

The guidance decoder aboard during the flight test was used during the Flight Acceptance Composite Test but was not used during previous testing in which this difficulty could have been detected. Different decoders were used for the Factory Acceptance Tests and the Autopilot/Guidance Integrated Test.

The autopilot programmer aboard during the flight test was not used during previous testing. The programmer used during factory testing was not used

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during the Guidance/Autopilot Integrated Test or the Flight Acceptance Composite Test. The same programmer was used during these latter two tests.

**Flight Test Performance**

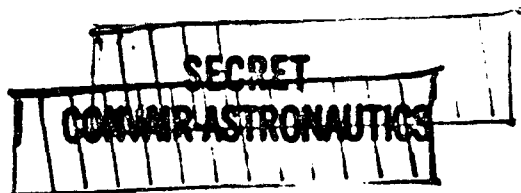
Roll rate and displacement gyro data indicated a clockwise roll transient at lift-off of 4.65 degrees/second and 2.25 degrees respectively. This transient was higher than previously encountered on Series "D" R and D missiles, however, it was not considered excessive.

Rate gyro data indicated that propellant slosh, in the pitch, yaw, and roll channels was normal.

Missile motion during and after staging appeared normal. Oscillations resulting from the staging sequence had a frequency of 0.72 cps and were completely damped out within 20 seconds after sustainer activation.

Response to guidance steering commands during the sustainer and vernier phase appeared satisfactory. The usual 12 cps bending mode present during the sustainer phase appeared normal.

All precount and countdown tests were satisfactory. This was the first "D" Series missile on which the special Mercury booster engine alignment procedures were utilized.



### GUIDANCE SYSTEM

Performance of the Guidance System was satisfactory. The necessary command and steering signals were generated to place the re-entry vehicle on the proper trajectory; however, the vernier engines failed to shutdown in response to the guidance vernier cutoff discrete command. Telemetered data indicated that the vernier cutoff discrete relay closed at the proper time, but the signal was not acted upon by the missile.

This was the first Atlas Missile flight at AMR to utilize the Operational Guidance Equations. The guidance commands were properly transmitted, received, and decoded.

The missile was tracked off the pad in monopulse hold with manual gain control on the monopulse receiver for the first 52 seconds in order to study tracking characteristics. Automatic monopulse tracking with automatic gain control was used for the remainder of the test. Track subsystem performance was satisfactory.

Telemetered data indicated that proper airborne system operating levels were maintained throughout the guidance phase.

Performance of the individual subsystems was as follows:

#### Command Link

The guidance system generated all missile guidance commands. These consisted of the steering commands and the four discrete commands.

Figure II is the graphical record of the steering and discrete commands. All commands were generated, transmitted, and received by the missile. Telemetry data indicated that the vernier engine cutoff command was properly processed by the decoder and that the decoder relay closed. However, the missile did not respond to the VCO command and vernier engines shutdown was actuated by the autopilot programmer backup signal at 307.85 seconds.

Pitch commands started at 129.6 seconds. Within one second the pitch commands reached 23 percent of full scale position then went to zero. Pitch commands remained zero until 239.9 seconds. Thereafter, they were small and smooth, reaching 8 percent of full scale.

Yaw commands started at 130.6 seconds (the time of the bad rate flag). Yaw commands were generated from track data for 8.8 seconds thereafter and reached a maximum of 35 percent of full scale positive during this period. During the



remainder of sustainer phase, yaw commands were smooth and small reaching a maximum of 7 percent of full scale. During the vernier phase yaw commands were unusually rough and reached a maximum of 73 percent of full scale negative.

The Range Safety Automatic Sustainer Cutoff Signal was generated by System 4 and transmitted to the missile via subcable to Grand Turk. Data indicated that the guidance sustainer cutoff arrived at the missile before the ASCO signal. Table I includes times associated with sustainer cutoff.

<u>Discrete Command(4)</u>	<u>Nominal Time Case Corrected (1)</u>	<u>Time Sent By Computer</u>	<u>Duration Seconds</u>	<u>Time Received By Missile (2)</u>
BCO	118.4	117.663	4.48	117.73 ± 0.1
SCO	285.0	284.418	0.507	284.41 ± 0.1
VCO	301.9	299.973	0.882	300.09 ± 0.1
Pre-Arm	315.0	313.799	(3)	313.8 ± 0.1

- (1) 0.24 second has been added to correct to Range Time
- (2) Decoder output.
- (3) Alternating half-second commands (PA #1 and PA #2) to end of tracking.
- (4) Vernier tank pressurization discrete was not programmed to be generated on this test.

Sustainer Cutoff Comparison  
Range Time - Seconds

	<u>SCO-Guidance</u>	<u>Automatic Sustainer Cutoff Range Safety</u>
Generated by Computer	284.418	284.51
Decoded on Telemetry	284.45 (1)	284.52 (1)

- (1) Continuous Instrumentation

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### Track Subsystem

The operation of the track subsystem was satisfactory. The missile was tracked off the pad in monopulse hold with manual gain control (MGC) set for -45 DBM for the first 52 seconds. This procedure was used to acquire data on the error signal characteristics during the early portion of the flight. Six seconds before the operator switched to automatic gain control (AGC) the system was changed to conical hold mode for 1.5 seconds to assure proper tracking. From 53.6 seconds until loss of signal at 398.5 seconds the track subsystem was in the automatic monopulse mode of operation.

During the sustainer phase the track received signal averaged -50 DBM with error signals of 0.05 mils, peak-to-peak. At retro-rocket firing the signal level decreased considerably, and from 342 seconds to 398.5 seconds the system tracked with an average signal of -83 DBM.

A comparison of the monopulse error signals on this test while in MGC with those recorded on the test of Missile 56D while in AGC was made, and no significant difference was detectable.

### Rate Subsystem

The rate subsystem performance was normal. The rate lock history was similar to previous missile tests- intermittent lock for the first 34.4 seconds, lock until 70.2 seconds, unlock until 123 seconds, solid lock established at 138 seconds, (10 seconds after the start of steering commands). Except for a momentary decrease in all three receiver signal levels at 136 seconds the average rate signal received was -86 DBM.

At retro-rocket firing the rate AGC's started to roll off and at 335.5 seconds all signals was lost.

### A-1 Computer

This was the first missile flight at AMR utilizing the Operational Guidance Equations. The major advantage of these equations over those previously used at AMR is that they are better able to generate realistic guidance commands when only track radar data are available to the computer. With these new equations VTP discrete is no longer generated, PAD (Pre-Arm Discrete) is generated approximately 30 seconds after SECO, and the vernier steering period is shorter.

The Mod III Guidance Computer (A-1) functioned properly throughout the flight and no equipment malfunctions were observed.

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Approximately 11 seconds after BCO discrete, a 50 percent positive pitch steering command was generated for a period of one second. Radar at this time however, appeared normal. An investigation of the guidance equations indicated that this condition was in fact, a function of the equation structure. Early in the sustainer phase, initial conditions are set into the equations for the Velocity-to-be-Gained function (V sub N) smoothing filter. As a result of this, the Time-To-Go function (T sub N time to next discrete) is made small causing another time function (Tau sub P) to be limited to its minimum value. This function (Tau sub P) is utilized in the denominator of the pitch steering (Omega sub P) equations, thereby greatly increasing the steering gain. The maximum pitch command generated by the computer for Missile 62D was approximately 200 times greater than had been specified in Trajectory Simulation XXII. This condition existed for a period of one second after the initiation of steering commands. After this time, the pitch steering gain factor decreased greatly and more nearly reflected the Time-To-Go function. It is assumed that this transient steering condition is objectionable and should be remedied, in that it is not reflected in the Trajectory Simulation.

Approximately 13.5 seconds after BCO discrete all rate data were lost to the computer. The yaw steering commands appeared relatively smooth, however. This was undoubtedly due to the improved features of the yaw steering equation. The remainder of the sustainer phase appeared normal.

When the vernier phase was entered, the yaw steering commands became extremely noisy. The magnitude of this noise was greater than evidenced in any previous flight. The yaw velocity error (Epsilon Dot Y) function was examined and its noise content appeared similar to previous flights. An investigation of the new equations indicates that the steering commands should fluctuate with the yaw velocity error signal, as it did in this flight. The effectivity of these new equations appears good in that the final cross range miss was 0.20 nm. The velocity to be gained function (Vn) used in the generation of the VCO discrete was investigated. It appeared normal and in close agreement with Trajectory Simulation XXII. It may be concluded, therefore, that the VCO discrete was properly generated by the computer.

Computer data indicated that the missile failed to respond to the VCO discrete, but instead had its vernier engines cutoff by the autopilot programmer. Because of this, fewer data points were available for the calculation of the following IP.

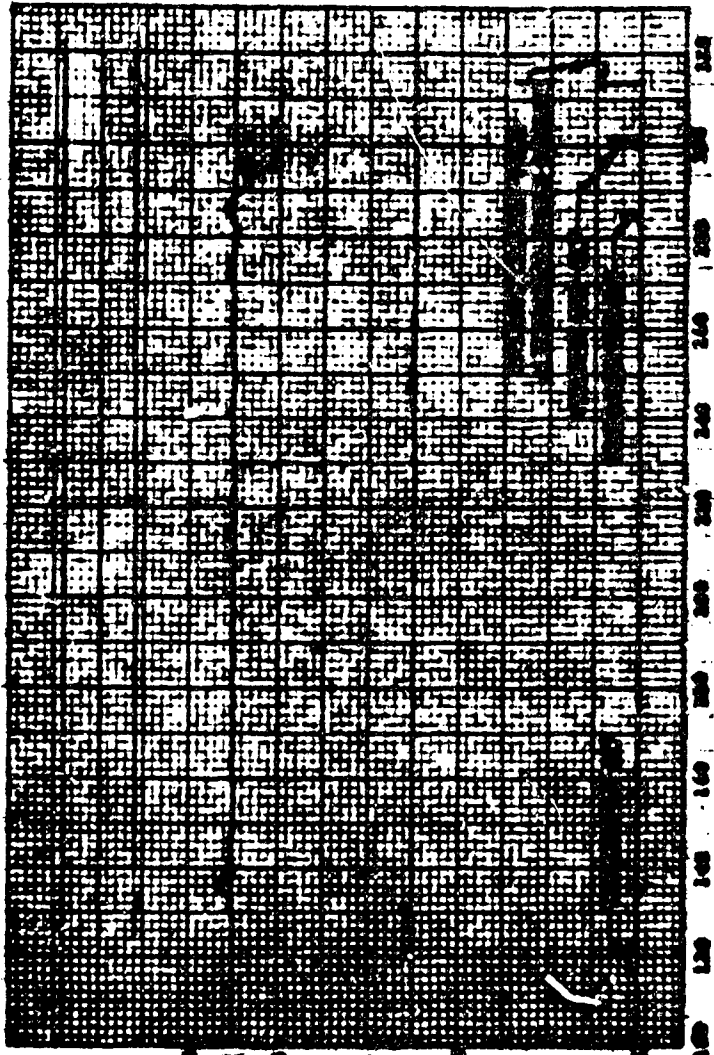
	<u>Mean Miss Distance</u>	<u>Standard Deviation</u>	<u>Deviation Of the Mean</u>
Cross Range	0.20 nm left	± 0.32 nm	± 0.06 nm
Down Range	17.90 nm long	± 0.44 nm	± 0.09 nm

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**ORDANCE COMMANDS AND FLAGS**



TRACK  
P.A.O.  
MAX. POS.  
MAX. POS.  
MAX. POS.  
MAX. POS.  
MAX. POS.  
MAX. POS.  
MAX. POS.  
MAX. POS.

10000  
FLARE  
AVE  
SERVING COASTERS  
NOZLE  
DUSTERS  
ELECTR  
ELECTR

TABLE OF ORDANCE COMMANDS AND FLAGS

FIGURE 2

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**SAN SALVADOR IMPACT PREDICTOR SYSTEM**

Performance of the Impact Predictor System was satisfactory. An automatic sustainer cutoff signal (ASCO) and a satisfactory impact prediction were generated. Telemetered data indicated normal operating levels from the airborne system components.

Performance of the individual subsystems was as follows:

**Track Subsystem**

Acquisition of the missile was accomplished in the first cube and automatic tracking was initiated at 127 seconds. Thereafter, tracking was uninterrupted until 354 seconds at which time there was a four second signal loss covered by memory operation. Following an additional three seconds of automatic tracking all airborne beacon returns were lost at 361 seconds.

Signal levels at acquisition were variable but averaged about -62 dbm. A broad maximum of -48 dbm was developed from 230 to 310 seconds and the signal level thereafter decayed slowly to bottom.

Angle tracking errors were typical of Atlas flights, being initially rough at low elevation angles and reducing to about 0.25 mils, peak-to-peak, through the major portion of tracking.

Transmissions from the airborne pulse beacon were received on a frequency 2.5 megacycles higher than expected.

**Rate Subsystem**

Rate subsystem operation was normal with all functions locked and flagged good by 112 seconds. Continuous lock was maintained until loss of signals at 368 seconds. Signal levels after acquisition were approximately -95 dbm and reached a broad peak of -88 dbm between 235 and 275 seconds.

There were no disturbances in the digital data other than the usual one-half second range rate roughness at booster separation.

**I-2 Computer**

The Range Safety Computer functioned properly throughout the flight. No equipment malfunctions were observed.

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Data from the computer were considered good. The following IP was calculated from these data:

	<u>Mean Miss Distance</u>	<u>Standard Deviation</u>	<u>Deviation of The Mean</u>
Cross Range	0.12 nm Left.	$\pm 0.36$ nm	$\pm 0.07$ nm
Down Range	17.59 nm Long	$\pm 1.08$ nm	$\pm 0.22$ nm

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**RE-ENTRY VEHICLE**

A Mark 3 Mod 2B Re-entry Vehicle, Serial Number 219, was flown for the first time on Missile 62-D. All systems were functioning properly at lift-off. Preliminary evaluation of flight data indicates that all systems performed properly during flight. No evaluation of impact fusing has been made since proper data reduction equipment is not available at AMR.

The following are the up-range events and times of receipt of the signals.

<b>Pre-arm Lock Out</b>	<b>73.9 seconds</b>
<b>Pre-arm Monitor</b>	<b>314.4 seconds</b>
<b>Separation Switch Monitor</b>	<b>319.4 seconds</b>

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**AERONUTRONIC PENETRATION DEVICE**

Performance of the Aeronutronic Penetration Device was not completely satisfactory in that telemetered data indicated the occurrence of only two of the four programmed device ejections. This was the second flight test of the X and D pod configuration.

Ejection of the devices from launch tubes 1, 3, 6, and 8 was planned; however, telemetered data indicated that only the devices from tubes 3 and 6 were ejected. Unlatch and eject signals for tubes 1 and 8 were properly generated, but the orientation measurements, ejection velocity measurements, and ejection micro-switch closure measurements, which indicate proper launch tube orientation and device ejection, did not activate.

Telemetered data indicated that all arming, timing, and firing events occurred as planned. Pod environmental temperature and pressure data were obtained and appear satisfactory.

Further evaluation of the system performance is precluded at this time due to lack of downrange data.

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CONVAIR PROPELLANT UTILIZATION SYSTEM

Closed loop performance of the Convair Propellant Utilization (PU) System was satisfactory. The missile was tanked to an excessively LO2 rich condition and this condition existed throughout the flight. PU valve response appeared normal in relation to the Error Demodulator Output signal with telemetry data indicating the valve positioned between 21.3 degrees and 23.7 degrees during the flight. Telemetered PU valve angle data appear to be qualitative only since the closed electrical limit was set at 23.1 degrees and the closed mechanical stop was at 24.6 degrees.

The fuel head pressure sensing port uncovered 0.60 seconds prior to sustainer cutoff, however, the LO2 head pressure sensing port was still covered at cutoff. This was expected due to the excessive LO2 rich tanking.

The following constants were applicable on Missile 62D:

PU Valve Control Limits

Open Electrical Limit	49.1 degrees
Nominal Angle	31.2 degrees
Closed Mechanical Limit	24.6 degrees
Closed Electrical Limit	23.1 degrees
EDO Sensitivity	0.849 VDC/1 Percent

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### PROPELLANT LOADING

The missile was propellant tanked by a special procedure to insure that the fuel level would be below the intermediate bulkhead liner.

Approximately 62,000 lbs. of fuel were tanked on X-1 Day on 19 June 1960 and topped to the 90 percent PLCM probe during the precount of the attempted launch on 20 June. Fuel was then left aboard until this test. LO2 was tanked slightly past the 95 percent PLCM probe. Sequence III pressure was then obtained and LO2 drained to a level below the probe. The load cell readout at the uncovering of the probe was used as the target weight of securing of LO2 tanking.

Tanking levels were satisfactorily obtained. The flow totalizer fuel readout was invalidated during the X-1 Day 90 percent PLCM probe check by draining back to the securing level while the totalizer by-pass valve was open. The PLCU 90 percent fuel probe did not activate even though it is located below the PLCM 90 percent probe. Due to the low tanking level of this missile the PLCU LO2 weight as obtained from the EDO is considered qualitative.

Due to holds and recycles of the countdown LO2 was topped to flight level three times. For all three of these topplings the panel lights indicated proper configuration for sub-cooled topping, however the first two times topping was accomplished the data indicated that the LO2 temperature at the fill and drain valve was higher than expected for sub-cooled LO2. Load cell, EDO and temperature data indicated the presence of gaseous oxygen in the fill line during the first topping. The temperature at the fill and drain valve was  $-283^{\circ}\text{F}$  and oscillating, and the EDO and load cell printout indicated variations in weight and LO2 level. These indications lasted for about 5 minutes. The data showed that the LO2 temperature remained well above that expected for sub-cooled LO2 during the additional three to four minutes of topping although the weight and EDO disturbances were no longer present. During the second topping the LO2 temperature remained steady at about  $-298^{\circ}\text{F}$ , which was warmer than expected. During the third topping the temperature was below the recorder limit of  $-300^{\circ}\text{F}$ . No oscillations in the EDO or load cell printout were present during the second and third topplings.

	<u>Units</u>	<u>Desired</u>	<u>Load Cells</u>	<u>PLCM</u>
LO2 Weight at Ignition	lbs	156,224	166,166	166,224
Fuel at Ignition	lbs	68,250	68,072	68,250
Missile Wet Weight	lbs	15,143*	15,143*	15,143*

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	<u>Units</u>	<u>Desired</u>	<u>Load Cells</u>	<u>PLCM</u>
Ignition Weight	lbs.	249,617	249,381	249,617
Ground Run Consumption	lbs.	8,734	8,734	8,734
Liftoff Weight	lbs.	240,883	240,647	240,893

\* This value may change slightly upon final reduction of data.

Weather Data

	<u>Fuel Tanking</u>	<u>Ignition</u>
Temperature	84.5°F	84.0°F
Barometric Pressure	30.040 inches of Hg.	30.045 inches of Hg.
Relative Humidity	73 Percent	61 Percent
Wind-Velocity and Direction	8 Knots, East South-East	8 Knots, West-Northwest
Cloud Cover	6/10	9/10

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HOLDDOWN AND RELEASE SYSTEM

The holddown and release system operated satisfactory in restraining the missile prior to release and in releasing the missile at liftoff. All values taken from the holddown cylinder pressure decay curves were within specifications. Residual pressure data were based upon zero pressures taken 5 seconds after the blow-down. This was necessary since holddown cylinder pressure data after liftoff was affected by engine blast and were erratic.

Values obtained were as follows:

<u>Event</u>	<u>Unit</u>	<u>Specification</u>	<u>Test Value</u>
Release signal to 2550 psig	sec.	0.5 Max.	0.388
Time difference between start of B1 and B2 cylinder pressure decay	sec.	0.010 Max.	0.010
Time intercept of tangent after 2550 psig	sec.	0.110 Min.	B1 = 0.136 B2 = 0.131
Residual pressure 0.5 seconds after 2550 psig	psig	350 Max.	B1 = 248 B2 = 226
Maximum differential cylinder pressure after 2550 psig	psid	400 Max.	116 @ B2 = 2550

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EXTERNAL INSTRUMENTATION

This section describes the coverage obtained by data recording systems other than telemetry and Convair acquired landline instrumentation as reported in item 1.0-10, Preliminary Estimate of Data Coverage.

The operation of the external data systems was satisfactory.

<u>Instrumentation</u>	<u>62D DTO Requirements</u>	<u>Test Results</u>
4 Engineering sequential Cameras	4.1.5.1 and 4.1.5.2	Satisfactory
7 Metric Cameras	4.1.5.3 and 4.1.5.4	Satisfactory.
<u>Electronic Coverage</u>		
'PS-16 (XN-1 at PAFB)	5.4.1.1	Tracked from 27 seconds to 185 seconds.
'PS-16 (XN-2 at GBI)	5.4.1.1	Tracked from 158 seconds to 238 seconds.
'PS-16 Sta. 12	5.4.1.4	Unsatisfactory. No track acquired.
Mod IV (X-Band)	5.4.1.2	Tracked from 12 seconds to 95 seconds.
.suca	5.4.1.3	Satisfactory. Tracked from Pad to 370 seconds.

**AIRFRAME INTERNAL INSTRUMENTATION**

Satisfactory telemetered data were received throughout flight. Telemetry signals were received at Cape Canaveral for approximately 15 minutes. There were three measurements that did not operate satisfactorily during the test:

<u>Measure- ment No.</u>	<u>Description</u>	<u>Comment</u>
A 646 T	Dummy Hyd Viv Inbd	Open prior to beginning of test
F 246 P	B Tk He Btl Hi	Yielded Questionable Data
P 14 T	Engine Comp Amb	Opened at Staging

Missile 62D contained one Bendix Mod 7 FM Telemeter package operational at the following frequency and with the following subcarriers and commutation capabilities:

<u>RF No.</u>	<u>Frequency</u>	<u>Continuous Channels</u>	<u>Commutated Channels</u>
1	229.9	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 12	11, 13, 14, 15, 16, E

Basic telemetry channel assignment is given in Convair report AZC-27-001-62. Included in that report are channel assignment, commutation information, frequency response, and make and model of transducer.

LANDLINE INSTRUMENTATION SYSTEM

The Landline Instrumentation System provided satisfactory information prior to missile liftoff, however, the measurements listed below were only partially satisfactory for the reasons stated.

<u>Measure- ment No.</u>	<u>Description</u>	<u>Source</u>	<u>Comment</u>
F 1003 P	Fuel Tank Helium	Browa	Intermittent with one to six percent oscillation.
P 1901 P	Booster Fuel Jacket Purge	Osc	Calibration Invalid. Meas. erratic after engine start.
P 1622 X	Sustainer Flight Lockin	Osc	Did not activate
A 1795 O	B2 HI Press Fuel Line	FM	Instrumentation Malfunction
A 1801 O	B1 HI Press LO2 Line	FM	Instrumentation Malfunction
P 1091 P	B1 LO2 Inj Man	FM	Instrumentation Malfunction
A 1802 O	B2 HI Press LO2 Line	FM	Instrumentation Malfunction
P 1002 P	B1 Fuel Pump Inlet	FM	Calibration Questionable
P 1004 P	B2 Fuel Pump Inlet	FM	Calibration Questionable
P 1060 P	B1 Chamber Press	FM	Calibration Questionable

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**FILM REVIEW**

A review of quick process engineering sequential films indicated all missile and launcher systems functioned properly from ignition to the limit of camera coverage.

Operation of both east and west launcher heads appeared normal and in general launcher operation was satisfactory. The clamshell doors appeared to close properly at missile liftoff. Tracking films showed proper missile performance until the missile was lost in the clouds early in the pitch program. A tabulation of items reviewed follows.

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CONCLUSIONS AND RECOMMENDATIONS

Conclusions:

1. All systems functioned properly except that the vernier engines cutoff discrete was not received by the vernier engines. Vernier cutoff was accomplished by the autopilot programmer backup signal.
2. Initial pitch steering commands in the sustainer phase were abnormally large.

Recommendations:

1. Investigate reasons for failure of the vernier engines cutoff discrete to reach the vernier engines. Re-evaluate system checkout procedures particularly with respect to receipt of engine cutoff signals.
2. Investigate pitch steering command equations.

COUNTDOWN TIME VERSUS EVENTS

This test was planned for a 150 minute countdown and started at 0630 EST as planned. The countdown required 199 minutes to complete as there were 3 holds and 2 recycles totaling 49 minutes. The holds were as follows:

1. At -45 minutes (0815 EST) for 30 minutes, due to a noisy audio warning amplifier in the B1 RCC circuitry. A new amplifier was installed and calibrated. The count was resumed at 0851 EST.
2. At 3:30 minutes (0932.5 EST) for 2.5 minutes, due to the loss of communications to Station No. 5. Communications were restored and the countdown was recycled to -7 minutes and resumed at 0935 EST.
3. At -2 minutes (0940 EST) for 2 minutes, when it was noted that missile inverter voltage was below redline in an unloaded condition. A test was performed under loaded conditions and all parameters were within specifications. The countdown was recycled to -7 minutes and resumed at 0942 EST.

No further difficulties were encountered and the remainder of the countdown was performed as planned.

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

<u>EST</u>	<u>Countdown Time</u>	<u>Countdown Procedure</u>	<u>Event</u>
0630	T-150	T-150	Countdown Started. Range Safety Command Checks Started. Complex (Test Stand) In Red Condition. Road Blocks Set.
0638	T-142	T-140	Range Safety Command Checks Completed Satisfactorily. Electrical Connection of Retro-Rockets Started.
0642	T-138		Retro-Rockets Electrical Connection Completed.

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<u>EST</u>	<u>Countdown Time</u>	<u>Countdown Procedure</u>	<u>Event</u>
0649	T-131		Area Is Open For Normal Work. Red Box Installation Completed.
0705	T-115		Tower Removal Started.
0706	T-114		Tower Will Not Move - No Air Pressure.
0721	T-99	T-90	Leadline Calibrations Started.
0723	T-97		Nose Cone Telemetry On For Check.
0727	T-93		Tower Is In The Maintenance Area.
0734	T-86	T-85	Flight Control Checks Started.
0736	T-84		Leadline Calibrations Completed.
0742	T-78		Guidance Beacon Testing Started.
0750	T-70		Helium Storage Started.
0751	T-69		Leadline Reports . Bad RCC Audio Warning Amplifier Will Be Replaced.
0759	T-61	T-60	Loop Test Preparation Started.
0807	T-53	T-50	Loop Test Started.
0814	T-46		Loop Test Completed Satisfactorily.
0818	T-43H		Holding for Estimated 35 Minutes for BI RCC Audio Warning Amplifier Problem.
0840	T-43H		Hold Extended 5 Minutes.
0845	T-43H		Hold Extended 10 Minutes.

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<u>EST</u>	<u>Countdown Time</u>	<u>Countdown Procedure</u>	<u>Event</u>
0849	T-45H		Landline Reports Audio Warning Trouble Received.
0851	T-45		Countdown Resumed.
0900	T-36		Guidance And IP Report "GO" Condition.
0901	T-35	T-20	Flight Control Final Checks Started.
		T-35	LO2 Tanking Started.
0925	T-11		Nose Cone Telemetry "ON". Autopilot Checks Complete. Ready Light "ON".
0928	T-8		Strobe Light "GO".
0932	T-3:30H		And Holding. Recycle to -7 Minutes Due To Loss Of Communications To San Salvador.
0935	T-7	T-7	And Counting, All Systems "GO".
0937	T-5:00	T-5:00	All Communications Switch To Channel 1.
	T-3:50	T-3:50	Status Check - All Systems "GO".
	T-3:30	T-3:30	T-3 Minutes And 30 Seconds And Counting.
	T-2:30	T-2:30	Turn Water System "ON".
	T-2:10	T-2:10	Secure LO2 Tanking.
0940	T-2:00		Held Momentarily - Inverter Out Of Specification. Recycle To T-7 Minutes.
0942	T-7	T-7:00	And Counting - All Systems "GO".

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<u>EST</u>	<u>Countdown Time</u>	<u>Countdown Procedure</u>	<u>Event</u>
	T-3:30	T-3:30	T-3 Minutes And 30 Seconds And Counting.
	T-2:30	T-2:30	Turn Water Systems "ON".
	T-2:10	T-2:10	Secure LO2 Tanking.
	T-2:00	T-2:00	Start Flight Pressurization.
	T-1:45	T-1:45	Arm Switch To "ARM", Engine Preparation Light Complete.
	T-1:40	T-1:40	Missile To Internal Power.
	T-1:35	T-1:35	Nose Cone "READY".
	T-1:25	T-1:25	RF Systems "READY".
	T-1:15	T-1:15	Status Check - All Systems "GO".
	T-0:60	T-0:60	Water Full Flow.
	T-0:55	T-0:55	RSO Ready Switch "ON".
	T-0:49	T-0:40	Status Check - All Systems "GO".
	T-0:40	T-0:40	Ready Light "ON".
	T-0:25	T-0:25	Oil Evacuate. Nose Cone Umbilical Eject. Nose Cone Beam Clear.
	T-0:18	T-0:18	All Recorders To Fast. T-18 Seconds And Counting. Engine Start.  Range Zero Time.

0749:33

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### MISSILE CONFIGURATION

The Atlas Missile consists of three basic sections: re-entry vehicle, body section, and propulsion system. There are no external aerodynamic control surfaces. The re-entry vehicle is releasable and carries instrumentation and ballast to simulate the operational re-entry vehicle. The body section of the missile consists primarily of a thin-walled, pressure stabilized, stainless steel tank, housing the missile propellants. Missile propulsion is provided by the Rocketdyne MA-2 rocket engine propulsion system. Missile stability is accomplished by a flight control system consisting of an autopilot and a hydraulic system to gimbal the thrust chambers.

The following is a resume of the major systems and components comprising Missile 62D. Additional details are included for systems being flight tested for the first time, as well as systems which have received significant modifications.

#### Airframe

Standard airframe for dry starts. Missile 62D utilized a new type vernier fairing. (V-1 only). The vernier fairing replaced the APS fairing previously installed. The new Retro-Rocket Blast deflector cones and mounting plate were installed on this missile (first flight).

#### Re-entry Vehicle

GE MSVD Mark 3 Mod 2B Re-entry Vehicle with the biconic flare.

#### Pneumatic System

Standard "D" Series pneumatic system with Hadley "D" tank pressurization regulators.

#### Hydraulic System

Standard "D" Series hydraulic system with the vernier sole accumulator system.

#### Electrical System

A primary remotely-activated battery furnished missile main electrical power. The telemetry battery was remotely activated. REC battery was secondary type.

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### Propellant Utilization System

The Convair PU system was operated "closed-loop".

### Propellant Loading System

Propellant loading was monitored by the Acoustica Propellant Loading Control Monitor (PLCM). Missile 62D was the third missile equipped with the new Convair propellant loading system fuel probes. The four new fuel probes were electrically the same as the old probes but were physically changed. The old probes screwed into 1/4 inch tubing with the electrical wires protruding for connecting purposes. The new probe had a different shape and was mounted by a flange which was attached to brackets and the electrical connections were made to terminal posts. The new fuel probes had better structural integrity as well as improved maintenance features. The Stratons LO2 fill and drain valve was replaced with an Airesearch LO2 fill and drain valve. This was the first flight to utilize this valve.

### Anti-Slosh Control

Eleven annular baffle rings were installed in the LO2 tank to reduce propellant "sloshing".

### Propulsion System

Basic Rocketdyne MA-2 rocket engine assembly. The propulsion system was dry started and was the third flight with the MA2-55 engine oxidiser tank rapid fill installation.

### Booster Staging System

Standard "D" Series configuration, which utilized a separate fiberglass bottle to supply pneumatic pressure to actuate the release fittings.

### Re-entry Vehicle Separation System

The GE Mark 3 Mod 2B Re-entry Vehicle was released from the airframe by means of a pre-loaded tension bolt which is part of the re-entry vehicle assembly. First flight of a Mod 2B Vehicle.

### Guidance System

A GE Mod III airborne guidance system was installed. The system consisted of three "D" series canisters (a pulse beacon, a rate beacon, and a decoder

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unister), a junction box, and an antenna assembly.

The ground station configuration consisted of the Mod III Radio Tracker and the Burroughs A-1 computer.

#### Telemetry System

Standard "D" Series which utilized one airframe transmitter.

#### Transponder System

Comprised of the Type B Coherent Carrier transponder system.

#### Impact Predictor System

The GE Mod II airborne system in conjunction with the Mod I ground system and Mod I Burroughs computer served as a downrange range safety impact predictor system.

#### Range Safety Command System

The Range Safety Command System used the ARW-62 (AD-319600-MK 1) receiver, AVCO built and furnished as GFE. This was the first "D" series R and D radio guidance missile to utilize the new receiver. Prior to this test the receiver was aboard 42D and 48D, both AFG missiles.

#### Light Control System

Comprised of a gyro canister, a programmer-integrator amplifier package, and ten electro-hydraulic actuators. The programmer switch, in addition to providing normal missile flight switching functions, initiated the light beacon and switched the CV-A telemetry system.

#### Air Force Special Weapons Center (AFSWC) Package

The AFSWC (Air Force Special Weapons Center) package contained special instrumentation for obtaining scientific data at high altitudes. Convair provided installation brackets, nose fairing, and a lanyard for activation of package timing device.

The package was located in Quad IV, 170° F. clockwise from the XX axis, between missile stations 1083 and 1110. The package weighed approximately 7 lbs. with the following external dimensions: 7" deep, 12" wide, and 18" long. The electrical system on the AFSWC package was self-contained.

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and powered a single R/F telemetry package.

### ADF System

Missile 62D had the R and D pod ADF system attached to the missile airframe (Station #1036 and #1105). The ADF system pod consisted of four single launch tubes, a base plate, and an aerodynamic fairing which was attached to the missile airframe. Canister ejection followed re-entry vehicle separation, and depended on the final ADF provisioned arming, timing, and firing unit sequencing. ADF pod #7 was used. It was planned that the dart from tube 6 would land 30 mm short of the nose cone impact point and the dart from tube 3 would land 3 mm to the right and 7 mm short of the nose cone impact point.

### Strobe Light

This was the first flight of the production series Strobe light. The Strobe light system was housed in a single package which contained a strobe lamp, associated electronics, and a remotely activated primary type battery which provided system power. The system was mounted on the forward fairing of the B2 hump pod. Battery activation was accomplished from Blockhouse controls prior to launch. System activation was initiated during flight by the sustainer engine cutoff command, after which time high intensity light flashes were emitted at half-second time intervals, until depletion of battery power (minimum of 30 seconds operation).

### Abort Sensing And Subministration System

This system is comprised of instrumentation to sense missile malfunctions which would affect the safety of an astronaut. The system in use for this flight monitored significant pressures, missile voltages and rate gyre outputs. Outputs from the ASES package were monitored via airframe telemetry. The system was complete with the exception of capsule and capsule-missile interface circuits and back-up rate gyres.

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HISTORY OF XSM-65D MISSILE NO. 62

Atlas Missile 62 D arrived at AMR by air transport (C-133) on 19 April 1960. The missile was transferred from the IOC trailer to the R and D trailer and weighed in Hangar "H" and then transported to the north bay of Hangar "J" the same day.

Missile 62 D remained at AMR for a period of approximately nine weeks before launch. This time was utilized in performing system tests and in readying the missile and launching complex for flight test. Preflight testing of the missile was accomplished in accordance with planning documented in Report AA 60-0013, Flight Test Directive, Series "D" Missile No. 62. Unplanned operations were performed on an "as required" basis. A significant amount of time was consumed before transfer to the complex in inspecting for the possibility of contamination in the LO2 and fuel systems and in the installation of landline AM and FM data acquisition systems.

Significant events concerning Missile 62 D from arrival at AMR to launch are delineated chronologically below:

<u>Date</u>	<u>Event</u>
19 April 1960	Arrived AMR by air transport, weighed in Hangar "H", transferred to north bay of Hangar "J".
20 April 1960	Completed receiving inspection.
26 May 1960	Weighed, transferred to Complex 14 and erected.
1 June 1960	Flight Acceptance Composite Test completed satisfactorily.
2 June 1960	LO2 Tanking Test completed satisfactorily.
2 June 1960	Fuel Tanking Test completed and split in the insulation supporting bulkhead discovered.
19 June 1960	X-1 Day Operations.

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<u>Date</u>	<u>Event</u>
20 June 1960	The initial launch countdown occurred as planned at 1900 EST and was terminated at 2344 EST at -70 minutes. Termination was due to loss of Range Gate for the automatic tracker at San Salvador.
21 June 1960	X-1 Day Operations.
22 June 1960	Flight

Attempted Launch Countdown Results  
P4-401-00-62

The initial launch countdown occurred on 20 June 1960. The countdown was started as planned at 1900 EST and was terminated at 2344 EST at -70 minutes. Cancellation occurred due to loss of the Range Gate for the Automatic Tracker at San Salvador. The only hold was called at -70 minutes (2020 EST) for the San Salvador Automatic Tracker problem. This hold was still in effect when the test was cancelled.

A brief compilation of significant difficulties in system preparation and testing accomplished follows:

**ASAS**

There were no major difficulties encountered during flight test preparation.

The following procedure was completed in the hangar:

<u>Procedure</u>	<u>Description</u>	<u>Date</u>
27-92504H	ASAS System Test	4-28-60

The following procedures were completed at the complex:

<u>Procedure</u>	<u>Description</u>	<u>Date</u>
FTP-3-001A	ASAS Electronics Compatibility Test	5-31-60
FTP-M-050	RF and Missile Electrical X-1 Day Checks	6-17-60
FTP-M-052A	RF and Electrical Precountdown	6-22-60

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Guidance System

There were no major difficulties encountered during hangar checkout. After the completion of hangar testing the Decoder, Serial No. 38, was removed for laboratory checks. These checks revealed an inoperative beacon and AGC Gates. Decoder, Serial No. 27 was installed after missile erection.

Rate Beacon, Serial No. 41 was replaced by Serial No. 6 due to failure of transmitter voltage proportional crystal.

There were no further difficulties encountered.

The following procedures were completed in the hangar:

<u>Procedure</u>	<u>Description</u>	<u>Date</u>
FTP-G-017	Guidance System Test	4-22-60 DA 901
FTP-G-022	Waveguide Pressure Check	5-26-60
FTP-G-011A	Antepilot-Guidance Intergrated Test	5-26-60

The following procedures were completed at the complex:

<u>Procedure</u>	<u>Description</u>	<u>Date</u>
FTP-G-021	Mod III GE Guidance Compatibility Test	6-1-60
FTP-G-002A	Missileborne Waveguide Pressure Check	6-17-60
FTP-026	Guidance X-1 Day Check List	6-17-60

Range Safety Command

There were no major difficulties encountered during flight test preparation.

The following procedures were completed in the hangar:

<u>Procedure</u>	<u>Description</u>	<u>Date</u>
27-93517	Range Safety Command System Checkout	4-26-60
FTP-D-002C	Range Safety Command Ejection Test	4-29-60

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The following procedures were completed at the complex:

<u>Procedure</u>	<u>Description</u>	<u>Date</u>
FTP-D-001C	Range Safety Command Blockhouse Compati- Milty Test	5-31-60
FTP-M-050	RF and Missile Electrical X-1 Day Checks	6-17-60
FTP-M-052A	RF and Missile Electrical Precountdown	6-22-60

**Impact Predictor**

There were no major difficulties encountered during flight test preparation.

The following procedure was completed in the hangar:

<u>Procedure</u>	<u>Description</u>	<u>Date</u>
FTP-G-015	Impact Predictor System Test	6-21-60

The following procedures were completed at the complex:

<u>Procedure</u>	<u>Description</u>	<u>Date</u>
FTP-V-005	Impact Predictor Monitor Set DEC-2 Valid Procedures	5-27-60
FTP-G-001A	RF Impact Predictor Blockhouse Compatibility Test	6-1-60
FTP-M-054C	Impact Predictor X-1 Day Check List	6-17-60

**Missile Electrical System**

There were no major difficulties encountered during flight test preparation.

The following procedures were completed in the hangar:

<u>Procedure</u>	<u>Description</u>	<u>Date</u>
FTP-E-030	Separation Circuitry Check	4-20-60
FTP-E-031	Inspection of Electrical Disconnects	4-22-60

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<u>Procedure</u>	<u>Description</u>	<u>Date</u>
27-92020J	Missile Electrical System Checkout Procedure	4-26-60

The following procedures were completed at the complex:

<u>Procedure</u>	<u>Description</u>	<u>Date</u>
FTP-E-006A	Missile Electrical Blockhouse Compatibility Test	6-7-60
FTP-M-050	RF and Missile Electrical X-1 Day Check	6-17-60
FTP-M-052A	RF and Electrical Precountdown	6-22-60

Propulsion System

During hangar checkout the sustainer LO2 reference regulator was replaced because of a suspected manufacturing defect. The sustainer fuel pre-valve was replaced due to leakage.

Contamination checks were performed as follows:

The V-2 engine was suspected of contamination. The system was cleaned in the mechanical lab.

The liquid oxygen system and supply line installation were found to be contaminated and were cleaned.

Due to contamination of low pressure LO2 ducting, the sustainer turbo pump was cleaned with trichloroethylene.

The booster engine was suspected of contamination and turbo pumps and the B-1 engine main LO2 valve were cleaned.

During checkout at the complex, the closed microswitch on the B-1 engine main fuel valve stuck in the closed position and was replaced. This problem has occurred on other missiles.

The sustainer pre-valve was replaced due to internal leakage in the closed position. Valve operation from the open position to the closed position was slow and erratic.

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The sustainer ISS regulator was replaced due to excessive drop in regulator outlet pressure when the start tanks were pressurized.

The Wiggins' fuel quick disconnects were removed per GMA 7923 and TVA 4903.

There were no further major difficulties encountered.

The following test procedures were completed in the hangar:

<u>Procedure</u>	<u>Description</u>	<u>Date</u>
37-93564	Fuel Staging Valve Adjustment Check	4-28-60
FTP-P-027	Main Propellant and Hot Gas System Leak Checks	4-29-60
FTP-P-025A	Propulsion Pneumatic Control Leak and Functional Check	5-23-60
FTP-P-024B	Verrier Engine Start System Leak Checks	5-25-60

The following procedures were completed at the complex:

<u>Procedure</u>	<u>Description</u>	<u>Date</u>
FTP-P-022	Retorquing Procedure on Booster and Sustainer Chabaling Blocks	5-27-60
FTP-P-029	Pneumatic Purge System Leak and Functional Check	5-30-60
FTP-P-026B	Propulsion System Leak and Functional Test Mated	6-2-60
FTP-P-027B	Propulsion X-1 Day and Precountdown Operations	6-22-60

**Convair Propellant Utilization**

There were no major difficulties encountered during hangar checkout:

During checkout at the complex, backup set, Serial No. 242 was replaced by Serial No. 256 because it was found to be out of specification during the rerunning of FTP-U-014 (Lab Checkout of PU Manometers and Control Canisters.)

The following procedures were completed in the hangar:

<u>Procedure</u>	<u>Description</u>	<u>Date</u>
FTP-U-016	Propellant Utilization Sensing System Test	5-2-60
FTP-F-018A	Propellant Utilization System Leak Test	5-2-60
FTP-U-026	Propellant Utilization Valve Angle Check	5-24-60

The following procedures were completed at the complex:

FTP-U-013D	Calibration of PU Null Meter	5-27-60
FTP-U-016A	PU Sensing System Readiness Test	6-1-60
FTP-U-018B	27-43040 Alignment Procedure Fuel/LO2 Rate Valve	6-13-60
FTP-U-019A	Functional Check of PU System	6-15-60
FTP-U-018	Five Point Pressure Check of PU Error Sensor/actuator Output	6-16-60

**Hydraulic System**

There were no major difficulties encountered with this system during hangar checkout.

During 2-1 Day fill and bleed of the booster airborne hydraulic system, a proper bleed could not be maintained. Investigation revealed that air was entering the

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hydraulic system through the reservoir (P/N 27-08552-3). The reservoir was replaced and proper bleed was obtained and maintained.

The following procedure was completed in the hangar.

<u>Procedure</u>	<u>Description</u>	<u>Date</u>
FTP-H-005B	Hydraulic System Leak and Function Check	5-26-60

The following procedures were completed at the complex.

<u>Procedure</u>	<u>Description</u>	<u>Date</u>
FTP-H-007A	Vernier Solo Hydraulic Accumulator Installation Checkout	6-2-60
FTP-H-002D	Ground and Airborne Hydraulic System Fill and Bleed	6-14-60

Flight Control System

During hangar checkout major delays were caused by lack of a Gyro Canister of the proper configuration which could be used for missile testing. The Gyro Canister had been sent to San Diego on 4-26-60 for rework and was not returned until 5-28-60. The autopilot testing slipped accordingly.

During checkout at the complex, Servo Canister, Serial No. 150, was replaced with Servo Canister 151, because the programmer high power switches had burned out when the programmer was run in the armed condition with the safety grounds not tied back.

The following procedures were completed in the hangar.

<u>Procedure</u>	<u>Description</u>	<u>Date</u>
FTP-G-035	Preliminary Voltage and Circuit Checkout	4-25-60
FTP-G-034A	Autopilot Preliminary Test	4-26-60
FTP-G-042A	Vernier Engine Alignment	4-26-60
FTP-G-045A	Pyrotechnic Substitution Fuse Test	4-27-60

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<u>Procedure</u>	<u>Description</u>	<u>Date</u>
FTP-S-024A	Static Gain Test	4-29-60
FTP-S-027A	Position and Polarity Test	5-25-60
FTP-G-011A	Autopilot/Guidance Intergrated Test	5-26-60

The following procedures were completed at the complex.

<u>Procedure</u>	<u>Description</u>	<u>Date</u>
FTP-S-006B	Sustainer Engine Alignment	5-27-60
FTP-S-034A	Sustainer Engine Alligament Check	5-27-60
FTP-S-021B	Flight Control System Threshold Transfer Function Analyzer	5-31-60
FTP-S-013A	Autopilot Polarity Test	5-31-60
FTP-S-019C	Autopilot Frequency Response Test	5-31-60
FTP-S-053A	Autepilot System Readiness Test	6-19-60
FTP-S-032A	Autepilot Precountdown Operations	6-20-60 6-22-60

#### Pneumatic System

No major difficulties were encountered during preparation of this system for flight test.

The following procedures were completed in the hangar.

<u>Procedure</u>	<u>Description</u>	<u>Date Completed</u>
FTP-F-602A	Differential Pressure Switch Checkout	5-2-60
FTP-F-019B	Airberae Pneumatic System Leak Check	5-24-60

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The following procedures were completed at the complex.

<u>Procedure</u>	<u>Description</u>	<u>Date Completed</u>
FTP-F-005C	Checkout and Validation of Ground Airborne Pneumatic System.	6-2-60
FTP-F-015A	LO2 Tank Relief and Shut-Off Valve Checkout.	6-2-60
FTP-F-003C	Cold Test LN2 Shroud and Transfer System Checkout.	DH 372 6-3-60
FTP-F-009A	Checkout of Bulkhead Differential Pressurization Switch and Warning Horn.	
FTP-F-020	High Pressure Leak Check and Airborne Regulator Lock-up Checkout.	6-3-60

Holddown and Release System

Three of the five cold release tests performed were unsatisfactory; two due to the cylinder pressure break time being out of specification and one due to electrical calibration problems. Difficulty was encountered during the fill and bleed of the holddown hydraulic system in maintaining the B2 bleed within specification.

The following procedures were performed on the system.

<u>Procedure</u>	<u>Description</u>	<u>Date Completed</u>
FTP-L-017A	Launcher Release System Functional and Restraint Test.	5-25-60
FTP-L-001C	General Launcher Alignment.	5-26-60
FTP-L-005B	Checkout of the Launcher Stabilizing System.	5-31-60
FTP-L-008C	Servicing Launcher Arresters.	5-31-60

<u>Procedure</u>	<u>Description</u>	<u>Date Completed</u>
FTP-L-007D	Functional Checkout Launcher Stabilizing and Launcher Auxiliary Frame System.	6-3-60
FTP-:-014A	Launcher Lines Leak Check.	6-3-60
FTP-L-006B	Shakedown for Launcher Cold Release.	6-17-60

Telemetry System

During hangar checkout, RF Canister No. 1, Serial No. 0157, was removed because of low RF Output, and RF Canister No. 1, Serial No. 9846, was installed as a replacement. RF Canister, Serial No. 0157, was sent to the telemetry lab where the output was found to be satisfactory. The RF cables used during hangar testing were checked and found to be bad and were replaced. Telemetry system checkout was then completed satisfactorily.

There were no farther difficulties encountered during flight test preparations.

The following procedures were completed in the hangar.

<u>Procedure</u>	<u>Description</u>	<u>Date Completed</u>
FTP-T-017	Vernier Engine Position Calibration	4-28-60
FTP-T-023	Telemetry Hi-Pressure Transducer Checkout.	4-28-60
FTP-T-005	Bridging Temperature Transducer.	5-3-60
FTP-T-009	Telemetry System Checkout.	5-3-60
FTP-T-022	Telemetry System Functional Checkout.	5-24-60

The following procedures were completed at the complex.

<u>Procedure</u>	<u>Description</u>	<u>Date Completed</u>
FTP-T-018	Telemetry Blockhouse Compatibility Test.	6-1-60

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<u>Procedure</u>	<u>Description</u>	<u>Date Completed</u>
FTP-T-011	Telemetry System Functional Test.	6-1-60 6-14-60
FTP-T-008B	Alignment and Calibration of Engine Position Transducers.	6-2-60
FTP-T-007	Missile Telemetry System X-1 Day and Precountdown Operations.	6-21-60

Abort Sensing And Instrumentation System

No major difficulties were encountered during Flight Test Preparation.

The following tests were performed on the Abort Sensing And Instrumentation System after the missile arrived at the complex:

<u>Procedure</u>	<u>Description</u>	<u>Date Completed</u>
27-92877-1	ASIS Checkout.	6-7-60
TFS 14-139	ASIS Pre-Readiness Operations	6-13-60

On 1 June 1960, San Diego design personnel performed Abort Monitoring functional checks during the FAC Test.

Airframe

Following the fuel tanking test on 2 June 1960, the intermediate insulation bulkhead was found to have fuel in it. Upon removing the Acoustical probe in Pod I at Station 960, a visual inspection revealed a split in Quad II area which ran from the bottom of the bulkhead to approximately 10 inches from the top. Although fuel tanking was started about one and one-half hours after the completion of LO2 tanking, it is not known if the tanking sequence is in any way connected to the split in the bulkhead.

On 4 June 1960, Convair Engineering Design, STL, and BMD personnel inspected the split and dispositioned it to fly "as is".

Strobe Optical Beacon System

During early testing it was found that a negative pulse was generated into the Strobe light deactivate line when the RF system panel power was turned off. A diode was installed in this line to prevent this problem. In following tests the system operated properly and on 14 June 1960, Strobe light check-out procedure, FTP E-049, was completed.

Re-entry Vehicle Test Schedule

The nose cap, flare, and spacer for re-entry vehicle 219 were received at AMR on 6 April 1960. The mid-section arrived at Hangar "F" on 12 May 1960. No major failures or problems were encountered during testing.

The following tests were performed at Hangar "F" and Complex 14 in preparing the re-entry vehicle for flight.

<u>FTI No.</u>	<u>Tests</u>	<u>Date Completed</u>
23891	NOPO Battery Squib and Heater Test	6 April 1960
24136	Flare and Spacer Subassembly Test	28 April 1960
23885C	Mate Spacer to Airframe	1 June 1960
23885C	Demate Spacer	1 June 1960
23885C	Mate Re-entry Vehicle to Airframe	3 June 1960
24137	Airframe Compatibility	3 June 1960
23885C	Demate Re-entry Vehicle	3 June 1960
23885C	Mate Re-entry Vehicle to Airframe for Launch	6 June 1960
24139	T-1 Day	6 June 1960

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**APPENDIX**

**FLUID CHEMICAL ANALYSIS**

All fluid chemistry samples were taken for Missile 62D launch on 22 June 1960. The results were acceptable, and were as follows:

<u>Fuel - RP-1</u>	<u>Units</u>	<u>Sample</u>	<u>Specifications</u>
Initial Boiling	°F	378	Report
10 Percent	°F	390	365-410
50 Percent	°F	416	Report
90 Percent	°F	449	Report
End Point	°F	471	525 Max.
Residue	Percent	1.0	1.5 Max.
Loss	Percent	1.0	1.5 Max.
Flash Point	°F	144	110 Min.
Gravity	°API	43.9	42.0 Min.
 <u>Particle Count -</u>			
<u>100 ml</u>			
10 - 20	Microns	3,600	No solid particles greater than 175 microns. (Fibers not defined).
20 - 30	Microns	1,560	
40 - 80	Microns	540	
80 +	Microns	30	
Moisture Content		None	
 <u>Liquid Oxygen</u>			
Purity	Percent	99.55	99.5 Min.
 <u>Hydrocarbons</u>			
As Methane	ppm	12	75.0 Total Max. 0.5
As Acetylene		None	
 <u>Gaseous Nitrogen</u>			
Purity	Percent	99.9	99.5 Min.
 <u>Hydrocarbons</u>			
As Methane	ppm	None	75.0 Total Max. 0.5
As Acetylene		None	

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<u>Gaseous Helium</u>	<u>Units</u>	<u>Sample</u>	<u>Specifications</u>
<b>Purity</b>	<b>Percent</b>	<b>99.9 /</b>	<b>99.9 / Min.</b>
<b><u>Hydrocarbons</u></b>			
<b>As Methane</b>	<b>ppm</b>	<b>None</b>	<b>75.0 Total Max.</b>
<b>As Acetylene</b>		<b>None</b>	<b>0.5</b>
<b><u>Lubricating Oil</u></b>			
<b>Viscosity</b>	<b>Centistokes @ 100°F</b>	<b>24</b>	<b>23-24</b>
<b>Flash Point</b>	<b>°F</b>	<b>300</b>	<b>200 Min.</b>
<b>Viscosity Index</b>	<b>136.7</b>	<b>118.7</b>	<b>80 Min.</b>
<b><u>Hydraulic Fluid</u></b>			
<b>Flash Point</b>	<b>°F</b>	<b>219</b>	<b>200 Min.</b>
<b>Color</b>		<b>Red</b>	<b>Report</b>
<b>Viscosity</b>	<b>Centistokes @ 130°F</b>	<b>8.60</b>	<b>10.0 Min.</b>
<b>Water by Distillation</b>	<b>Percent</b>	<b>Trace - cannot be measured by spec. method.</b>	<b>0.005 Max.</b>
<b><u>Particle Count</u></b>			
<b>ML/ml</b>			
<b>10 - 20</b>	<b>Microns</b>	<b>2,000</b>	<b>4000 Max.</b>
<b>21 - 40</b>	<b>Microns</b>	<b>700</b>	<b>2400 Max.</b>
<b>41 - 60</b>	<b>Microns</b>	<b>400</b>	<b>800 Max.</b>
<b>61 - 100</b>	<b>Microns</b>	<b>100</b>	<b>160 Max.</b>
<b>Over 100</b>	<b>Microns</b>	<b>35 Fibers 0 Solids</b>	<b>0 Max.</b>

\* Below procurement specifications, however, viscosity can be expected to drop when oil has been in use and this value is acceptable.

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<u>Trichloroethylene</u>	<u>Units</u>	<u>Sample</u>	<u>Specifications</u>
Appearance		Pass	Clear and free.
Color		Pass	Not red, blue, green, or purple dyed.
Odor		Pass	Characteristic.
Specific Gravity		1.476	1.454 to 1.476 @ 68°F.
Distillation	95 Percent	189	185.0 to 191.3
	°F		
End Point	°F	191	199.4 Max.
Water Content		Pass	Cloudless @ /14°F
Non-volatile			

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## REFERENCE DOCUMENTS

<b>Flight Test Plan - Missile No. 62D</b>	<b>AAC-27-057</b>
<b>Detailed Test Objectives (AFBMD/STL)</b>	<b>TR-60-0000-89063</b>
<b>Flight Test Directive (FTWG)</b>	<b>AA 60-0013</b>

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

<u>Reports</u>	<u>Approximate Issue Date</u> (time after test)
<b>Convair - Astronautics, San Diego, Calif.</b>	
<b>Flight Test Evaluation Report</b>	<b>14 Days</b>
<b>AFBMD/STL - Inglewood, Calif.</b>	
<b>Flight Summary Report</b>	<b>8-12 Weeks</b>
<b>General Electric, Syracuse, N. Y.</b>	
<b>Guidance System Preliminary Evaluation Report</b>	<b>10 Days</b>
<b>Guidance System Detailed Evaluation Report</b>	<b>4-8 Weeks</b>
<b>General Electric, Philadelphia, Pa.</b>	
<b>Evaluation Report</b>	<b>30 Days</b>
<b>Aviation Associates, Los Angeles, Calif.</b>	
<b>Final Test Report</b>	<b>30 Days</b>

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## SERIAL NUMBERS OF SYSTEM COMPONENTS

Ames Transponder, Serial No. 026-0003

Re-entry Vehicle, Serial No. 219

### Range Safety Command System

Range Safety Command Receiver No. 1, Serial No. AF-58-174

Range Safety Command Receiver No. 2, Serial No. AF-58-170

Range Safety Command Power and Signal Control Unit, Serial No. 12

### Propulsion System

Sustainer Engine, Serial No. NA 222106

Booster Engine, Serial No. NA 112106

Vernier No. 1, Serial No. NA 332211

Vernier No. 2, Serial No. NA 332212

### Electrical System

Missile Main Battery, Serial No. 908-0374

Inverter, Serial No. R-101

Power Changeover Switch, Serial No. 094

### Guidance System

Decoder, Serial No. 27 CG

Pulse Beacon, Serial No. 40 CG

Rate Beacon, Serial No. 6 CG

Impact Predictor System

Rate Beacon, Serial No. 61

Pulse Beacon, Serial No. 97

Beacon Trigger Generator, Serial No. 51

Telemetry System

Telemeter RF No. 1, Serial No. 9846

Telemeter RF No. 1, Battery, Serial No. 911-0027

Accessory Package, Serial No. 912-0001

Flight Control System

Gyro Computer, Serial No. 128

Servo Computer, Serial No. 151

Programmer, Serial No. 0035

Stabilization Filters, Serial No. 129

Propellant Utilization System

Matched Set, Serial No. 262

Computer Computer, Serial No. 96

Star Light System, Serial No. 4

Registration Device

Pod, Serial No. 7

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

AMR	Flight Range No.	Comments
100	0-11-57 090	Engine shut down at 29.9 seconds of flight. Missile destroyed at 50.1 seconds.
101	0-25-57 1412	Engine shut down at 47.7 seconds of flight. Missile destroyed at 76 seconds.
102	12-17-57 2140	Successful flight. Impinged approximately 490 mm downrange.
103	1-10-58 10	Successful flight. Impinged approximately 543 mm downrange.
104	2-7-58 202	Engine shut down prematurely at 117.8 seconds of flight due to flight control system failure. Missile broke up at 157 seconds.
105	2-20-58 440	Engine shut down prematurely at 124 seconds of flight due to flight control system failure. Missile broke up at 124.5 seconds.
106	4-8-58 634	Engine shut down prematurely at 168 seconds of flight due to B1 subsystem failure. Missile remained intact and impacted approximately 300 miles downrange.
107	6-3-58 1261	Successful flight. Impinged approximately 488 mm downrange.

Previous crash at 8 seconds. Both booster chambers damaged, necessitating replacement.

Full diameter, but damaged B1 chamber, necessitating replacement.

Full diameter, but damaged prematurely, but considered satisfactory.

Definitely considered due to AFS shatters.

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SIGNIFICANT DATES DURING TESTING OF "B" SERIES FLIGHT MISSILE AT AMB

Serial	Date	Time	Event	Comments	
00	6-20-50	11	6-20-50	04-27-50 04-27-50 7-8-50	Missile tests up to 45 seconds of flight. Due to failure of the yaw rate gyro.
00	6-21-50	13	6-21-50	7-15-50	Successful flight. Reported approximately 2145 ms downrange.
00	6-22-50	11	7-20-50	8-20-50	Successful flight. Reported approximately 2085 ms downrange. First completely cleared fuel guidance system flight.
00	7-04-50	16	8-04-50	9-04-50	Successful flight. Reported approximately 2151 ms downrange.
00	7-17-50	13	8-18-50	9-18-50	B1 test program failed at 20.8 seconds after lift-off. Missile exploded two air-seals later.
00	8-7-50	11	9-12-50 09-08-50 09-10-50 09-24-50 09-25-50	10-11-50	Explosion of fuel supply caused abnormal pressure conditions and venturi shutdown. Missile impacted 600 to 700 ms short of intended impact point. First flight of multi-fuel booster test program.
100	9-04-50	16	11-04-50	11-24-50	Successful flight. Reported approximately 2045 ms downrange.
100	10-22-50	11	11-22-50 12-22-50 12-22-50 12-22-50	12-22-50	Successful flight. Missile glided into orbit.
100	12-04-50	14	12-04-50	12-22-50	Flight prematurely terminated due to unexplained difficulties starting at 180 seconds after lift-off. Missile impacted 130 ms downrange. There was no telemetry system aboard this missile.
100	9-22-50	11	12-23-50	1-20-50	Successful flight. Reported approximately 3123 ms downrange.
000					Automatic cutoff initiated by venturi over-speed/under-speed trip 1.96 seconds after BCG links break.
000					Automatic cutoff initiated by venturi over-speed/under-speed trip 1.08 seconds after BCG links break.
000					Prematurely terminated by an automatic cutoff 4.98 seconds after BCG links break.
000					Venturi ignition only.
000					Missile cutoff at 6.09 seconds.
000					After installation of "C" Series power pack in Hangar "J".
000					Automatic cutoff initiated by venturi over-speed/under-speed trip 1.0 seconds after BCG links break.
000					Full duration, but engine compartment fire delayed schedule approximately 10 days.

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**SIGNIFICANT DATES DURING TESTING OF "C" SERIES FLIGHT MODELS AT AMB**

Model	Flight Date	Comments
24	12-23-58 2004	Successful flight. Impacted approximately 3000 mph downrange.
25	1-27-59 10	Although impact was close to intended point, the guidance system did not function.
26	2-20-59 201	Missile exploded at 170 seconds due to a malfunction at staging. Probable cause was improper operation of the fuel staging valve.
27	2-10-59 201	Boosting engine shut down prematurely at 131 seconds of flight. Missile was viable for remainder of flight.
28	7-16-59 2100 7-21-59	Successful flight. Impacted in target area 3200 mph downrange. RVT-2 Re-entry Vehicle recovered.
29	8-20-59 2121	Successful flight. Impacted almost 2 miles long in MILB not due to residual thrust after vector cutoff. Re-entry Vehicle was recovered.
30	8-10-59 2004	Successful flight. Impacted in target area. Minimal cutoff for 1st. attempt to vector ignition phase. Second attempt successful by 1000 ft.
31	8-10-59 2004	Successful flight. Impacted in target area. Minimal cutoff for 1st. attempt to vector ignition phase. Second attempt successful by 1000 ft.
32	8-10-59 2004	Successful flight. Impacted in target area. Minimal cutoff for 1st. attempt to vector ignition phase. Second attempt successful by 1000 ft.

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

Serial	Flight Number	Date	Time	Altitude	Comments
100	100	6-14-59	1405		Reactor section exploded 27 seconds after launch due to failure to close airbrakes. LOS alt and drain valve. Missile destroyed at 37 seconds.
101	101	6-15-59	1704		Missile exploded at 65 seconds due to improper launcher operation which resulted in loss of fuel tank pressure.
102	102	6-16-59	1703		Missile exploded at 160 seconds due to a malfunction at staging. Probable cause was improper operation of the fuel staging valve.
103	103	7-20-59	2008		Successful flight. Impacted 4304 mms down range less than 1/2 mile from target in MILS net.
104	104	8-11-59	2008		Successful flight. Impacted in MILS net less than 1 mile from target.
105	105	9-9-59	2119		Successful flight although booster section failed to jettison. Project Mercury Cap-sole recovered.
106	106	9-16-59	2104		Successful flight. Impacted 2 miles short of target in MILS net due to failure of vernier sole hydraulics postings.
107	107	10-6-59	2120		Successful flight. Impacted in MILS net less than 1/2 mile from target.
108	108	10-9-59	2008		Successful flight. Impacted in MILS net less than 1/2 mile from target.
109	109	10-20-59	2304		Due to malfunction of V2 engine at staging, impacted approximately 14 miles short of target point.
110	110	11-6-59	4203		Unsuccessful. A/B IP failure prevented Station 5 IP system from acquiring the missile. Range safety cutoff caused R/V to impact approximately 250 miles short of target.
120	120	11-24-59	2105		Successful although re-entry vehicle did not separate. Impacted in MILS net.
130	130	11-26-59	4122		Atlas /Able IV lunar probe. Atlas portion of flight was successful. Portions of Able failed at 47 sec.

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Miscellaneous	Arrival	Complex	Erection	FRF	Flight	Range No.	Comments
31D	10-10-59	13	11-20-59	None	12-8-59	405	Successful flight. Impacted 1/2 mile from target in MILS net.
40D	11-20-59	13	12-10-59	None	12-10-59	16	Successful flight. Delivered a MB-3 Re-entry Vehicle within 3 mm of target point; over a 5000 mm range.
40D	12-8-59	13	12-20-59	None	1-6-60	32	Successful flight. Delivered a MB-3 Re-entry Vehicle within 3 miles of target point over a 5000mm range.
40D	12-17-59	13	1-11-60	None	1-24-60	54	Successful flight. RYZ6-A2 Re-entry Vehicle impacted approximately 1/2 mile from target in MILS net.
40D	1-6-60	13	1-20-60	None	2-11-60	120	Successful flight. MB-3 Re-entry Vehicle impacted less than 1 1/2 mm from target over a 5000 mm range.
37D	20-10-59	16	1-10-60	None	2-24-60	304	MIDAS I Booster shot. Atlas portion of flight was successful.
40D	12-8-59	11	12-21-59	62-6-60 2-23-60	603-6-60 3-8-60	17	Successful flight. First missile to use all-inertial guidance system.
31D	1-20-60	13	2-10-60	None	2-10-60	775	Destroyed by fire and explosion immediately after liftoff.
40D	2-19-60	11	3-10-60	None	4-7-60	301	Destroyed in the stand by fire and explosion during a launch attempt.
40D	2-3-60	13	4-11-60	None	609-12-60 5-20-60	1088	Successful flight. Delivered MB-3 Re-entry Vehicle within 4 mm of target point over an extended range of 7859 mm.
40D	1-25-60	16	3-2-60	None	5-20-60	619	MIDAS II Booster shot. Atlas portion of flight completely successful.
30D	2-20-60	11	5-13-60	None	6-11-60	615	Successful flight. Delivered MB-3 Re-entry Vehicle 4306 mm downrange within 2.3 mm of target. First flight with AIG system providing active guidance functions.

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

1. Launch started due to delay release from orbit limited maximum speed.

2. Test terminated by excessive engine combustion gas flow.

3. Malfunction longer for launch gear linkage replacement.

4. Error due to Guidance System Malfunction.

5. Engine will prior to release. Due to excessive output in Modulator.

6. Test terminated by excessive output from the primary ROC accelerometer.

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