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APPENDIX E

PROPULSION SYSTEM HISTORY

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PROPULSION SYSTEM HISTORY

This appendix included the history of the YLR87-AJ-3 Rocket Engine Assembly P/N 1-232520-130, S/N AJE 01045. The acceptance performance is also included herein for reference purposes.

1. TMC Denver Operations

Engine shipped to Denver 26 May 1960, installed on VS-1 Missile S/N 60-3636 6 July 1960.

a. ECP's accomplished at Denver:

593	26 August 1960
600	26 August 1960
555	26 August 1960
606	26 August 1960
608	26 August 1960

b. Other ECP's completed per Engine Log:

490	553	
526	563	591
527	574	604
535	578	609
552	581	

c. Unscheduled Maintenance at Denver:

- 1) Dual point OSBV Kit installed 26 August 1960.
- 2) Post-fire inspection showed unusual discoloration of turbine housing after first test run. Housing was returned to AGC for inspection, this was in turn returned as satisfactory. Original turbine cleaned, inspected, and re-installed.
- 3) TPA Heaters removed for element change 22 September 1960.

d. Total firing time:

at AGC	47.55
at Denver	35.08
	<u>82.58</u> seconds.

2. Vandenberg Air Force Base Operations - Captive Test (TP-53, Run 3)

Missile arrived at Vandenberg Air Force Base 4 October 1960.

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- a. ECP's completed at Vandenberg Air Force Base prior to TP-52, Run 3:

ECP 603 GGV Settings, 22 November 1960.
 ECP 587B GGV Rocker Box Leak Check, 15 November 1960.
 ECP 624 Inspection of Lube Oil Pump and Reservoir,
 9 December 1960.
 ECP 630 Inspection of DCV's, 27 January 1961.
 ECP 634 Change TCOV's, 2 March 1961.
 ECP 637 Change Oil Coolers, 6 March 1961.

- b. Unscheduled Maintenance at Vandenberg Air Force Base:

- 1) GGVPV replaced due to broken connector, 8 November 1960.
- 2) N₂ Start System Check Valves replaced, 11 November 1960.
- 3) GGVPV replaced with acceptable type, 13 November 1960.
- 4) Inspection of TCVS 3 and TCVS 4 for proper leaf spring, 15 November 1960.
- 5) Repair of ~~stripped~~ TC Drain Plug Threads, 15 November 1960.
- 6) Hand wipe engine due to fuel spillage, 15 November 1960.
- 7) TPA Heater Resistance Check, 20 November 1960.
- 8) Inspection of dents in 2 T/C Coolants Tubes, 13 January 1961.
- 9) Dehydration of TPA's and LOX System, 3 March 1961.

- c. Silo Firing of First Stage Engine - 7 March 1961:

Total Firing Time to date

AGC	47.55
Denver	35.03
VAFB	8.00
	<u>90.58</u> seconds

Ref. Firing Report VS-1 TP-52, Run 3 for Engine Parameters.

- 3. Vandenberg Air Force Base Operations - Flight Test (TP-53, Run 3)

- a. ECP's accomplished prior to TP-53, Run 3:

ECP 622 Pc6 Line Change, 27 March 1961.
 ECP 632 TPA Heater Change, 29 March 1961.

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- ECP 634B TCOV Change, 27 March 1961.
- ECP 639 Gimbal Support Link Inspection, 21 March 1961.
- ECP 627 Change GGVPV and Filter, 19 April 1961.
- ECP 640A Turbine Flooded Seal Line Clamp, 22 April 1961.
- ECP 648 Inspection of Gearbox Pinion Gear, 26 April 1961.
- ECP 644 Gasket Replacement on Lube Oil Pumps, 27 April 1961.
- ECP's 642/646A Dual Gearbox Vent Valves, 28 April 1961.
- ECP 643 Replacement of Oil Reservoirs and Lube Oil Line, Cleaning, 28 April 1961.

b. **Unscheduled Maintenance at Vandenberg Air Force Base:**

- 1) S/A 1 Oil Cooler and Line replacement due to damage incurred during ECP 632 - 23 March 1961.
- 2) S/A 1 Lube Oil Pump replacement due to damage during ECP 644 - 27 April 1961.

c. **Post-fire and Pre-fire Procedures Conducted:**

- 1) Engine Inspection and Post-Fire Checks, 25 March 1961.
- 2) Fuel drained from Thrust Chambers, 9 March 1961.
- 3) Oil drained from Lube Oil System, 10 March 1961.
- 4) Installation of Suction Line Closure Plates and Bellows Suppressors, 10 March 1961.
- 5) Lubricate Gimbal Assembly, 6 and 24 April 1961.
- 6) Thrust Controller Check and Pc6, 25 March 1961 and 25 April 1961.
- 7) Thrust Chamber Pressure Switch Check, 25 March 1961 and 25 April 1961.
- 8) GGV Actuator Shaft Seal Leak Check, 29 March 1961 and 19 April 1961. Rechecked after ECP 627.
- 9) GGV Switch Functional Check, 29 March 1961.
- 10) TCV Switch Functional Check, 29 March 1961.
- 11) LOX System Decay Leak Test, 28 March 1961.
- 12) Fuel System Decay Leak Test, 25 March 1961.
- 13) Torque Check Turbopump Assembly, 25 March 1961 and 26 April 1961.

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- 14) Remove Suction Line Closure Plates and Missile Prevalves, 30 March 1961.
- 15) Turbopump Heater Check, 21 March 1961 and 2 May 1961.
- 16) Fill Oil Reservoir, 28 April 1961.
- 17) Degrease Injector, 1 May 1961.
- 18) Install Ignitor Shield, 1 May 1961.
- 19) Install TC Ignitor, 0730, 3 May 1961.
- 20) Install GG Ignitor, 0730, 3 May 1961.
- 21) Check Ignitor Stray Voltage, 2 May 1961.
- 22) Adjust Density Compensator Valve, 19 April 1961 and for TP-53, Run 2 (Wet Mock), 2 May 1961.
- 23) Remove Protective Covers, 3 May 1961.
- 24) Remove TPA Dehydrator Plug, 2 May 1961.
- 25) Remove Gimbal Actuator Lock-Up Bar, 1 May 1961.
- 26) Perform Electrical Checkout, 2 May 1961.

d. Launch on 3 May 1961 at 1310 from SLTF Silo:

- 1) Engine run of 138 seconds to LOX Exhaustion Shutdown (M/R 2.316).
- 2) Missile was destructed at 180.5 seconds.

4. Engine Acceptance Performance Data

Run Mo. 3.5-01-HDA-036

Date: 15 April 1960

Location: Sacramento Test Stand

Engine: S/N AJE01045

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<u>Item</u>	<u>S/A1</u>	<u>S/A2</u>	<u>ENG.</u>
Calculated Thrust corrected to Standard Inlet Conditions	149,900	151,800	302,700
ISP	-	-	249.8
MR. Steady State	-	-	2.28
Thrust Chamber Set Point	578	586	-
Actual Thrust Chamber Pressure	578	592	-
TTi Steady State	1,377	1,350	-
Thrust Decay from Full to 10% Sec.	.241	.217	-
Thrust Decay from Full to Zero	.882	.880	-
DCV Setting	66°	66°	-
WO (TCA) #/Sec.	414.7	419.7	-
(GG)	3.16	3.43	-
TOTAL	417.9	423.2	-
W _F (TCA) #/Sec.	174.6	176.8	-
(GG)	8.08	9.07	-
(ENG)	182.7	185.9	-
POD	763	772	-
PFD	967	979	-
Specific Gravity			
OXID	1.131	1.132	-
FUEL	.808	.808	-
Thrust Co-efficient	1.400	1.403	-

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A P P E N D I X F

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REVIEW OF DATA FROM CAMERA FILM COVERING HOLD FIRE RACK 2070

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APPENDIX F

Review of Data from Camera Film Covering Hold Fire Rack 2070.

<u>Count Time</u>	<u>Time of Day</u>	<u>Action</u>
R-4 minutes and holding	1255	Camera started. Power on "ON".
	1255 to 1310	TOS ₁ and TOS ₂ lights were flickering on and off. TOS ₂ was more active than TOS ₁ .
*T-35.0 seconds	1310:08.7	Checkout in progress. Light "ON" and TOS ₂ "ON".
*T-34.4 seconds	1310:09.3	TOS ₂ "OFF".
*T-29.2 seconds	1310:14.5	Checkout in progress. Light "OFF".
*T+5.5 seconds	1310:49.2	TCVS ₁ and Hold ECS NO-GO lights "ON".
*T+8.0 seconds	1310:51.7	Lift-off or shutdown light "ON".
*T+78 seconds	1312:01	Camera "OFF".

This review of the film of the 2070 Pallet during TP-53, Run 3, indicates that the operation was normal throughout the T-Time Count, except for the operation of the Turbine Speed Monitors (OST) which did not indicate during the engine firing. At Umbilical Disconnect (1) TCVS indicated a hold ECS NO-GO. This is a normal function at loss of umbilicals. The loss of (1) TCVS disabled the ability of (2) TCVS from being displayed as a ECS NO-GO.

At this time no explanation is available for malfunctions of the OST units. The units were calibrated as a system from end to end per procedure 327R9030657B-2, Revision C. The only component not included was the NT pickup P/N 1-227973 which was simulated by an oscillator. The values spelled out in procedure 657B-2 conform to data provided with the NT pick-up. Final checkout and setup of the 2070 was made per procedure 327R9030640C-2.

Resolution of the problem would require actual testing of the equipment. At this time there are no plans to conduct such additional tests on the equipment.

*The above times were increased one second over the actual recorded times. There was apparently a one second malfunction within the camera used to record these data.



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