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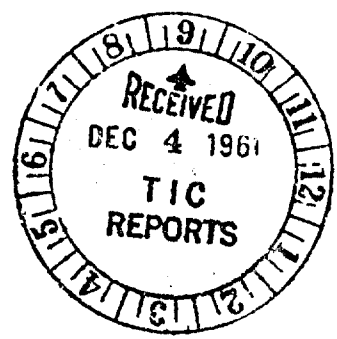
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(6) NASA/AGENA-B RANGER PROGRAM
LAUNCH PAD DAMAGE REPORT
for
ATLAS 117D/AGENA-B 10205-6002
RANGER SPACECRAFT RA-2
COMPLEX 12, AMR.

(15) Contract No. AF 104(647)-592



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Section I

SUMMARY

This report is submitted in accordance with the requirements of Contract AF 04(647)-592. It covers the damage to the launch pad and Aerospace Ground Equipment (AGE) at Complex 12, AMR, resulting from the launch of Ranger Spacecraft RA-2/Agna-B Vehicle 6002/Atlas Booster 117D on 18 November 1961.

A post-launch inspection of Complex 12 and all AGE revealed that no major structural or electrical damage occurred. The greatest amount of damage was sustained by the Lockheed Missiles and Space Company (LMSC) Pneumatic Control Cabinet (PCC). All of the anchor bolts for this unit were sheared and the bottom of the unit was moved east approximately 30 inches. All damage occurring at the launch pad is listed in Table 2-1 and discussed in Section II.

Repair work by LMSC was scheduled to be completed by 8 December. General Dynamics-Astronautics (GD-A) rehabilitation of the launch pad was scheduled to be completed on 7 December. Jet Propulsion Laboratory (JPL) had no repairs to perform.

Measures to further minimize damage during future launches will be incorporated where possible or feasible. A list of the preventive measures to be taken as a result of the launch of RA-2 is presented in Section III.

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Section II

DISCUSSION OF DAMAGE

The damage suffered by the AGE and launch pad during the launch of 18 November 1961 was relatively minor. AGE damage was, for the greater part, of a mechanical nature and was remedied by repair or replacement of the affected items. The extent of damage was determined during an inspection that was conducted as soon as possible after the launch. All damaged areas were photographed and as closely as possible, the causes of the damage were assessed.

Table 2-1 lists the damaged components of AGE at Complex 12, and was compiled from an LMSC post-launch inventory of the pad area and from the GD-A inspection rejection lists made up for pad repair. The table itemizes the component damage for each company, the probable cause of the damage, and the corrective action required to restore the equipment to its pre-launch condition. JPL equipment suffered no damage and is not included in the tabulation.

Figure 2-1 presents an overall view of Complex 12 and location of major AGE components. Figure 2-2, Detail "A", indicates the location of GD-A components relative to the launch area. Figure 2-2, Detail "B", shows the location of LMSC components in relation to the launch area.

LMSC DAMAGE

Liftoff exhaust blast damage was most extensive to the LMSC PCC. The hold-down bolts securing this cabinet to the ramp were sheared and the base of the cabinet moved eastward approximately 10 inches. The mounting base was bent and distorted. Pneumatic and electrical lines entering the top of the cabinet were damaged. The rigid pneumatic lines were bent and stretched between the top of the PCC and the overhead catwalk. The electrical power wires and

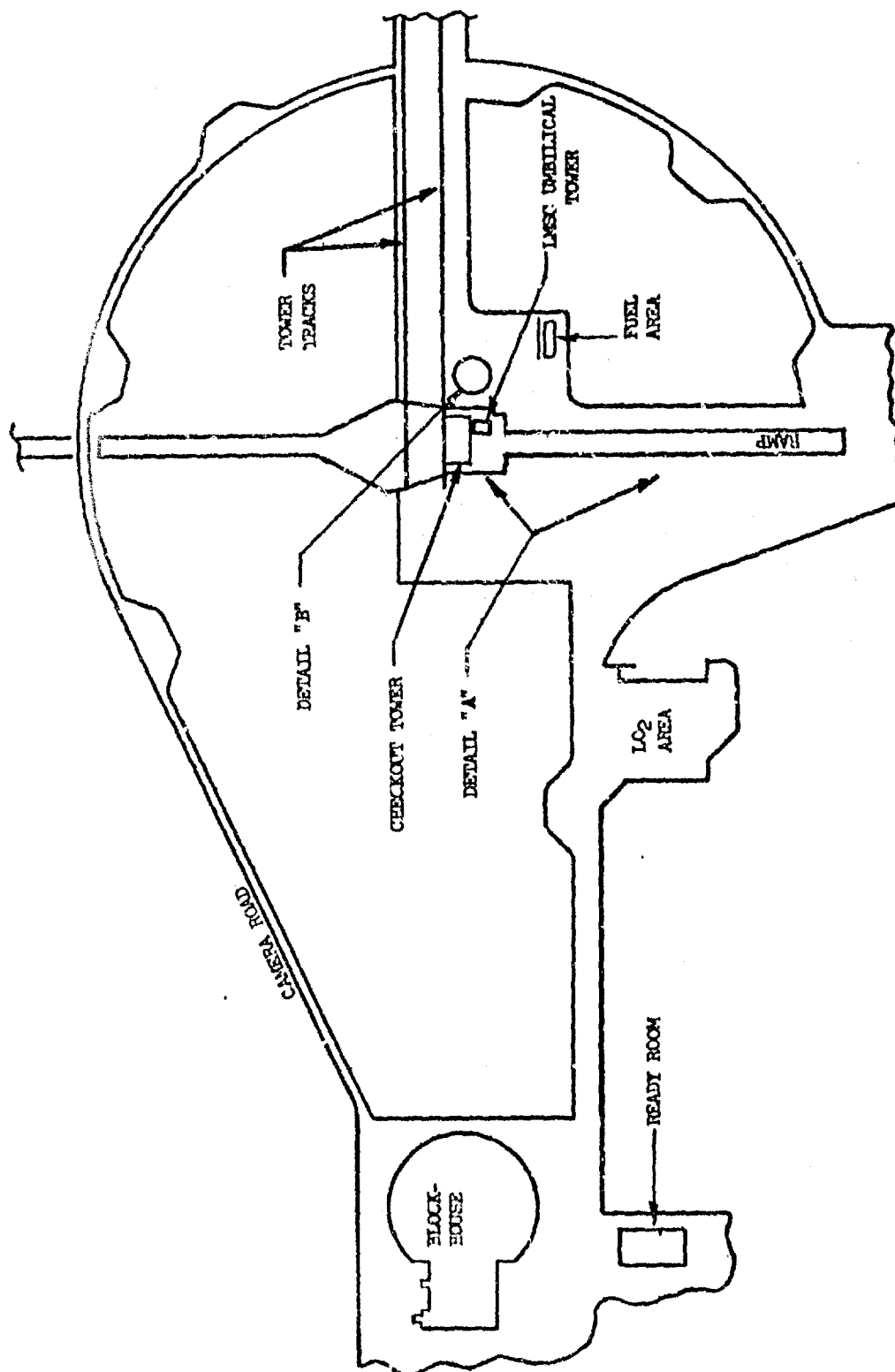


Figure 2-1. Major AGE Components, Complex 12

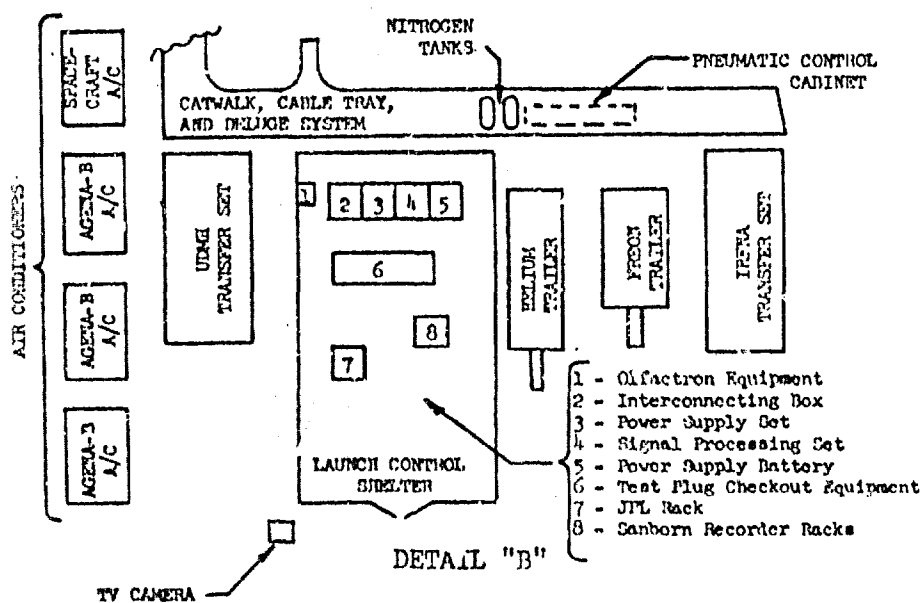
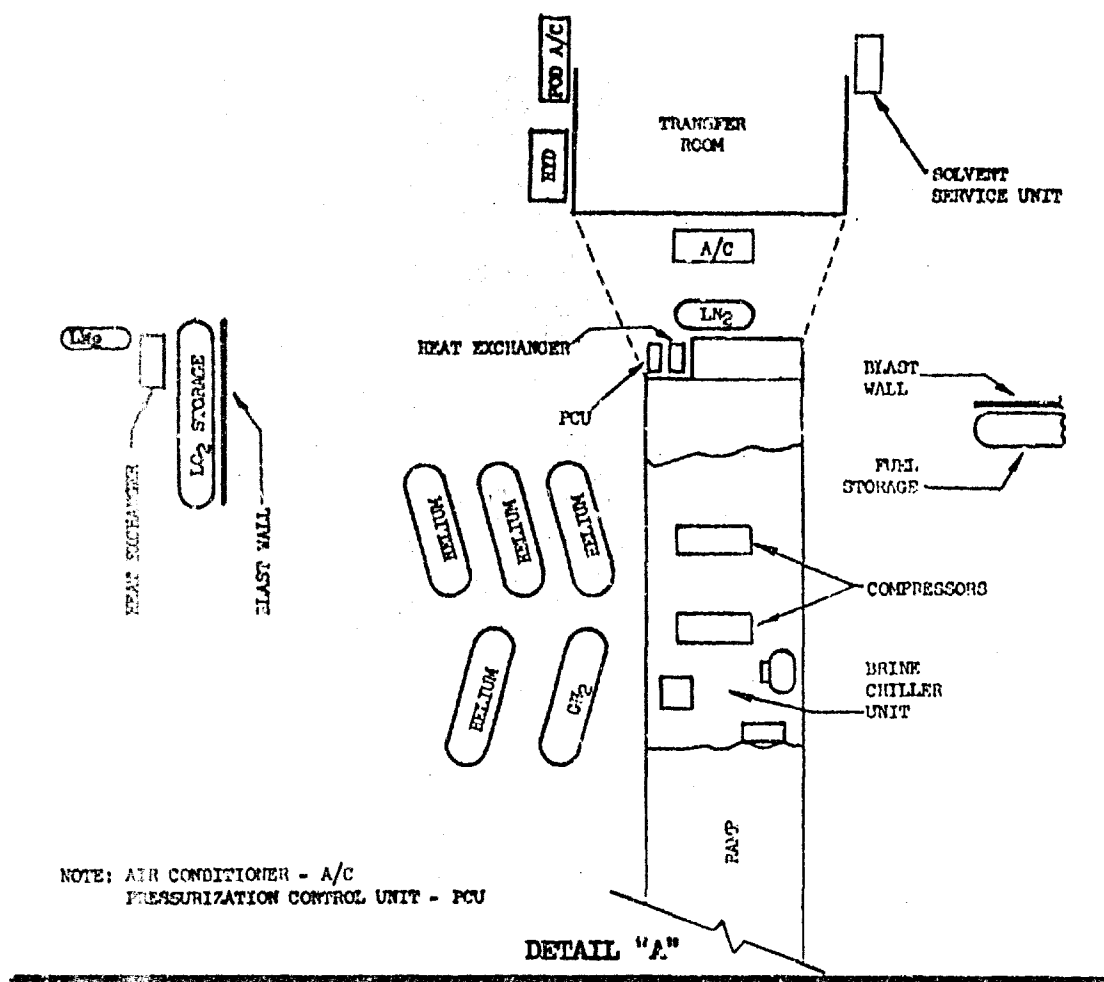


Figure 2-2. AGE Locations During Launch

receptacles were twisted and broken. These electrical and pneumatic lines will be repaired and/or replaced as necessary. The cabinet will be repositioned, reinforced with 6 inch channel iron, and anchored securely to the base of the catwalk supports.

The oxidizer transfer set west corner cabinet doors were bulged from blast effect. These doors were replacement items substituted for the doors damaged during the launch of RA-1 and were reinforced with additional locking devices. The additional locking devices operated satisfactorily in restraining the doors during exhaust blast conditions; however, bulging occurred between the locked areas. The original louvered doors have been repaired and will be reinstalled as replacements prior to the launch of RA-3. Louvered openings in the west end of the oxidizer transfer set cabinet were bent and blown loose. This condition also occurred during the launch of RA-1 and is not considered a problem. Repair consists of straightening and securing.

The Launch Pad Building (LPB) air conditioning ducts and transition piece on the outer west end of the building at the ground level were crushed and the insulation demolished. Corrective measures underway consist of removing the crushed area for repair and replacing the insulation.

The LPB sustained very slight damage. Vibration loosened one overhead fluorescent light diffuser and water spray from launch fire extinguishing efforts sprayed into the top west end of the building. These incidents also occurred during the previous launch.

The northwest corner and doors of the fuel transfer set were gouged and pierced in two places by a displaced object. This object is believed to have been a cable tray cover blown off from the attach point at the upper southwest corner of the LPB. The holes will be patched and the gouges burnished. The cable tray cover will be repaired and replaced.

The LMSC Agena and Spacecraft air conditioning trailers control compartment doors suffered damage to the piano hinges. These doors had been secured open by bungee cord during launch and the hinges were damaged by blast effects. The center piano hinge on the master control panel door on the Spacecraft air-conditioning trailer was torn and the rivets were pulled loose. The No. 3 Agena air-conditioning trailer master control panel piano hinges had numerous rivets pulled and loosened. The No. 2 air-conditioning trailer master control panel door piano hinge rivets were loosened. The No. 1 Agena air-conditioning trailer master control panel door was torn off at center piano hinge, but was restrained by the bungee cord. The door to the refrigerator control panel unit on this trailer had loosened rivets on the piano hinge. No discernible damage was sustained by the control panels. The doors will be removed and the hinges repaired and/or replaced.

The Lockheed umbilical tower sustained minor damage. The metal grid at the base of the tower covering the dumb waiter access was buckled and bent. The fixed air-conditioning ducts insulation attached to the base of the tower was charred on the east side of the tower. Minor flame charring was prevalent up to the 15 foot level of the tower. No further blast damage occurred in this area. The boom face protective mattress was torn loose on the upper east side. This occurred after umbilical release and did not circumvent umbilical release protection. Spacecraft umbilical P-100 had a small gouge at the outer edge and the "O" ring was severed. Also, the co-ax connection insert was chipped slightly. The Agena 10-inch air-conditioning duct outer protective covering from boom face to the vehicle was torn away and the quick disconnect was nicked at the mating surface to the Agena. The Spacecraft air-conditioning blanket was completely destroyed by flame and blast effects. Repair and/or replacement of these items is underway with completion scheduled for 8 December.

GD-A DAMAGE

Damage to the GD-A ground equipment was limited principally to the items in the direct line of the exhaust flame and blast. Replacement of many of these items is expected after each launch. Some of the replacements will be reworked and returned to the spares stock for future use.

The launcher was seared by exhaust flame but suffered no structural damage. Repair of the launcher will be accomplished by cleaning and repainting. GD-A repair work was initiated on 20 November. All damage to the GD-A equipment was expected and further preventive measures are not feasible.

JPL DAMAGE

The only item of AGE installed at the launch pad for JPL is one electronics rack in the Launch Pad Building. Since no damage occurred within the building, JPL equipment required no post-launch repair.

Table 2-1
ACE Launch Damage

Component	Part No.	Damage	Cause	Corrective Action
<u>INCO DAMAGE</u>				
Pneumatic Control Cabinet	1585466	a. Hold-down bolts sheared b. Mounting base bent and distorted c. Moved eastward approx 30 inches d. Electrical and pneumatic lines stretched, bent and distorted	Exhaust blast Exhaust blast Exhaust blast Exhaust blast	a. Replace b. Straighten and strengthen c. Reposition d. Rework and replace and test as necessary
Oxidizer Transfer Set	1585071	a. Chiller unit doors bulged b. End louvers bent and blown loose Crushed and insulation demolished	Exhaust blast Exhaust blast Exhaust blast	a. Replace with reworked original doors b. Straighten and secure Repair duct and replace insulation
Air Conditioning Ducts (LFB)		a. Light diffuser loosened b. Water spray in west end	a. Vibration b. Water spray	a. Reinstall b. Recaulk roof in tile area
Launch Pad Building		Gauged and pierced by cable tray cover	Exhaust blast	Patch and burnish FTS; repair and replace cable tray cover
Fuel Transfer Set (FTS)				
Spacecraft Air Conditioning Trailer Center Piano Hinge On Master Control Panel Door	1511925	Torn and rivets pulled loose	Vibration	Repair as necessary

Table 2-1 (Continued)

Component	Part No.	Damage	Cause	Corrective Action
Agena Air Conditioning Trailers 1. Unit No. 3 master control panel door piano hinges 2. Unit No. 2 master control panel door piano hinges 3. Unit No. 1 a. Master control panel door b. Refrigerator control panel door piano hinge Umbilical Tower and Boom Structure	1511925	Numerous rivets pulled and loosened	Vibration	Repair as necessary
	1511925	Numerous rivets pulled and loosened	Vibration	Repair as necessary
	1511925	a. Door torn off at center piano hinge b. Numerous rivets pulled and loosened	Vibration and blast	a. Repair as necessary b. Repair as necessary
		a. Paint charred up to 16 foot level b. Boom face protective mattress torn loose and flame seared c. Dumb waiter access covering buckled d. Fixed air conditioning ducts insulation charred	a. Exhaust flame b. Exhaust flame and blast c. Exhaust blast 1. Exhaust flame	a. Repaint as necessary b. Replace covering and reinstall c. Straighten in place d. Repair
Spacecraft Umbilical Plug F-100	1062493-3	a. Small gouge on outer edge	a. Retraction	a. Burnish
		b. "O" ring severed	b. Retraction	b. Replace
		c. Co-ax connector chipped slightly	c. Retraction	c. Repair as necessary

Table 2-1 (Continued)

Component	Part No.	Damage	Cause	Corrective Action
Agena 10-inch Vehicle Air Conditioning Duct and Quick Disconnect Coupling	1062024	a. Protective covering torn away	a. Exhaust flame and blast	a. Replace covering
	1060916	b. Metal rolled at mating surface to Agena	b. Retraction	b. Dismantle and repair
Spacecraft Air Conditioning Blanket		Completely destroyed	Exhaust flame and blast	Replace
<u>GD-A DAMAGE</u>				
Fuel Sensing Quick Disconnect, Quads III and IV	27-0812 9-3	Subjected to excess heat	Exhaust flame	Replace
Fuel Sensing Quick Disconnect, Quad I	27-0812 9-3	Subjected to excess heat	Exhaust flame	Replace
Liquid Oxygen Pressurization Quick Disconnect, 2 ea, Quads III and IV	27-0812 -11	Subjected to excess heat	Exhaust flame	Replace
Hydraulic Quick Disconnect 4 ea, Quads I and II	27-0355 8-1	Subjected to excess heat	Exhaust flame	Replace
	27-0855 7-1	Subjected to excess heat	Exhaust flame	Replace
Liquid Nitrogen Quick Disconnect, Quad I	27-8027 9-801	Subjected to excess heat	Exhaust flame	Replace
	27-2900 4-9	Subjected to excess heat	Exhaust flame	Replace

Table 2-1 (Continued)

Component	Part No.	Damage	Cause	Corrective Action
Fuel Tank Pressurization Quick Disconnect, Quads I and II	27-0869 4-5	Subjected to excess heat	Exhaust flame	Replace
Quick Disconnect, 2 ea, Quads III and IV	27-0812 0-5	Subjected to excess heat	Exhaust flame	Replace
Quick Disconnect, 2 ea, Quads III and IV	27-2900 5-9	Subjected to excess heat	Exhaust flame	Replace
Quick Disconnect, Quads III and IV	27-2901 0-9	Subjected to excess heat	Exhaust flame	Replace
Quick Disconnect, 2 ea, Quad I	27-2900 3-9	Subjected to excess heat	Exhaust flame	Replace
Liquid Nitrogen Dump Duct Installation	27-8009 8-801	Subjected to excess heat	Exhaust flame	Replace
Thrust Section Hot Air Duct	27-8003 9-1	Subjected to excess heat	Exhaust flame	Replace
Pad Cooling Duct Installation, 2 ea	27-8001 -817 27-8001 1-819	Subjected to excess heat	Exhaust flame	Replace
2 in. Liquid Oxygen Line Check Valve, Quad IV	27-0291 0-1	Subjected to excess heat	Exhaust flame	Replace
Liquid Oxygen Fill and Drain Valve, Quad IV	27-0210 2-31	Subjected to excess heat	Exhaust flame	Replace
Fuel Fill and Drain Valve, Quad III	27-0210 1-23	Subjected to excess heat	Exhaust flame	Replace
Fuel Flexible Duct, Quad III	27-2900 6-3	Subjected to excess heat	Exhaust flame	Replace

Table 2-1 (Continued)

Component	Part No.	Damage	Cause	Corrective Action
Liquid Oxygen Flexible Duct, Quad IV	27-2900 6-801	Subjected to excess heat	Exhaust flame	Replace
Micro Switch, 2 ea, Quads III and IV	2-MLI- EI	Subjected to excess heat	Exhaust flame	Replace
Umbilical Cable, P409-609, Quad IV	7-06348 -1	Subjected to excess heat	Exhaust flame	Replace
Umbilical Cable, P1004, Quads I and IV	7-06234 -801	Subjected to excess heat	Exhaust flame	Replace
Umbilical Cable, P1005, Quad I	27-0611 6-5	Subjected to excess heat	Exhaust flame	Replace
Umbilical Cable, P1003, Quads I and IV	7-06231 -807	Subjected to excess heat	Exhaust flame	Replace
Fuel Fill and Drain Harness, Quad III	27-0667 7-1	Subjected to excess heat	Exhaust flame	Replace
Holddown Release Harness, Quads I and II	27-0666 4-1	Subjected to excess heat	Exhaust flame	Replace
Holddown Solenoid Harness, Quad III	7-66632 -1	Subjected to excess heat	Exhaust flame	Replace
Holddown Release Harness	27-1863 4-3	Subjected to excess heat	Exhaust flame	Replace
Holddown Release Harness, Quads III and IV	27-0666 4-3	Subjected to excess heat	Exhaust flame	Replace
Release Backup Harness	TVA-259 27 D	Subjected to excess heat	Exhaust flame	Replace
Purge Box Harness, Quad I	27-0666 9-1	Subjected to excess heat	Exhaust flame	Replace

Table 2-1 (Continued)

Component	Part No.	Damage	Cause	Corrective Action
Harness, 2 ea, Quads III and IV	7-57547	Subjected to excess heat	Exhaust flame	Replace
Micro Switch, Quad I	1-MLI-E 1	Subjected to excess heat	Exhaust flame	Replace
Umbilical Cables, 4 ea F1001, Quads I and IV	27-0661 2-801	Subjected to excess heat	Exhaust flame	Replace
F1002, Quads I and IV	27-0614 3-5	Subjected to excess heat	Exhaust flame	Replace
P4001, Quad III	7-19713 -3	Subjected to excess heat	Exhaust flame	Replace
F1007, Quads II and III	27-0611 7-801	Subjected to excess heat	Exhaust flame	Replace
Harness, Quad I	7-67510 A	Subjected to excess heat	Exhaust flame	Replace
Harness, Quad II	7-67140	Subjected to excess heat	Exhaust flame	Replace
Harness, Quads III and IV	27-0654 3-1	Subjected to excess heat	Exhaust flame	Replace
Harness, Quad II	27-0651 5-1	Subjected to excess heat	Exhaust flame	Replace
Harness, Quads I and IV	27-6925 3-801	Subjected to excess heat	Exhaust flame	Replace
Harness, Quads II and III	27-6925 3-5	Subjected to excess heat	Exhaust flame	Replace
Harness	27-0643 8-1	Subjected to excess heat	Exhaust flame	Replace

Table 2-1 (Continued)

Component	Part No.	Damage	Cause	Corrective Action
"A" Frame Potentiometer, 2 ea Holddown and Release Cylinder Transducer Safety Net	8675900 -535	Subjected to excess heat	Exhaust flame	Replace
	7-16314 -3	Subjected to excess heat	Exhaust flame	Replace
	7-09281 -1	Subjected to excess heat	Exhaust flame	Replace

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Section III
CONCLUSIONS AND RECOMMENDATIONS

The relatively minor launch pad damage resulting from this test demonstrated that the AGE and pad equipment are generally capable of withstanding the effects of a normal launch. No major redesign or modification is required to prevent future damage.

LMSC will take the following preventive actions before the next launch attempt to minimize or eliminate future damage to the items listed:

- a. Pneumatic Control Cabinet-
 - 1. Reinforce mounting base with 6 inch channel iron.
 - 2. Anchor base to catwalk support flanges.
- b. Launch Pad Building Air-conditioning Ducts-
Reinforce existing mounting brackets.
- c. Type 15 Air-conditioning Trailers-
Additional methods of securing control panel doors are under consideration.
- d. Boom Face Protective Matress-
Strengthen existing bungee tiedowns.

Much of the damage experienced on this launch was considered to be unavoidable. Items subject to unavoidable damage are classed as expendable and are replaced from spares.

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