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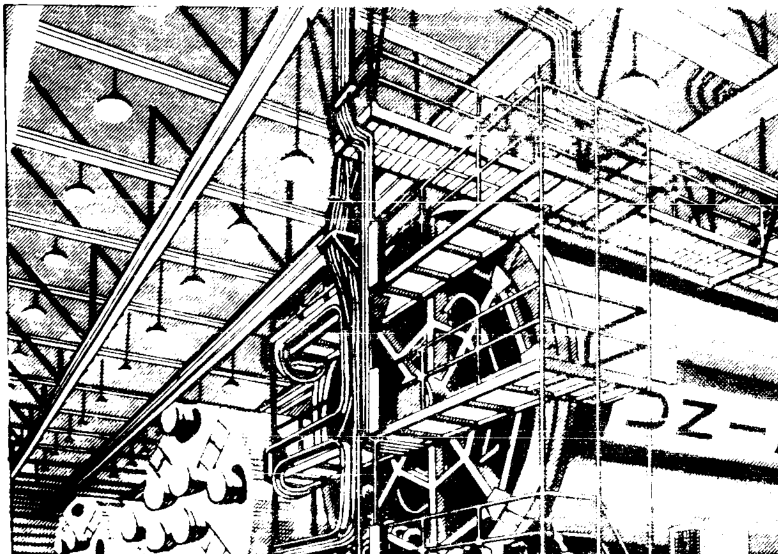
NASA CR 71166

SATURN S-IB STAGE

ASSEMBLY AND TEST REPORT

S-IB-1



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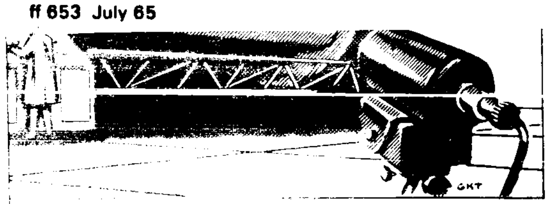

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SATURN
S-IB STAGE

ASSEMBLY AND TEST REPORT

S-IB-1

by

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and

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Product Inspection and Test Branch
Quality Control Department

SPACE DIVISION CHRYSLER CORPORATION

New Orleans, Louisiana 9 August 1965

ABSTRACT 208946

The object of this report is to provide interested personnel with an overall summary of the events and problems encountered during the manufacture of Saturn Stage S-IB-1. The report covers the stage from the start of subassembly installation (clustering) on 18 June 1964 until release of the stage for shipment to Kennedy Space Center, Florida, on 9 August 1965.

Author

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INTRODUCTION

Authorization.

This narrative report forms a part of the Quality Program Provisions for Space Systems Contractors as outlined by paragraph 14.2.4 of NASA Quality Publication NPC 200-2, April 1962 edition, under NASA Contract NAS 8-4016.

Coverage.

This report covers the period from subassembly installation through shipment and is divided into major sections covering the stage assembly, subassembly installation, optical alignment, subsystem testing, end-item testing, preparation for shipment and shipment, operating time, configuration, and weight and center of gravity. Information is also included on troubles and malfunctions encountered, corrective action taken or pending, and replacements made during installation, test, and final checkout.

Preparation.

This report was prepared by the Inspection Services Section of the Product Inspection and Test Branch, Quality Control Department, Chrysler Corporation Space Division, New Orleans, Louisiana. All data was extracted from entries on original quality control documents as recorded by quality control inspection and test personnel. These original quality control documents are retained in the files of the Inspection Services Section as a part of the S-IB-1 historical files.

SECTION I

SCOPE AND CONDENSED DATA

1.1 SCOPE OF REPORT.

1.1.1 This report summarizes the assembly and testing of the S-IB-1 stage of Saturn C-1B Space Vehicle SA-201 as manufactured by Chrysler Corporation Space Division-Michoud Operations (CCSD-M), New Orleans, Louisiana under National Aeronautics and Space Administration (NASA) Contract NAS 8-4016.

1.1.2 The coverage of this report begins with subassembly installation (clustering) at the NASA Michoud Assembly Facility (MAF) and ends with shipment to the launch site at Kennedy Space Center (KSC).

1.1.3 Included in the report is information on assembly and modification operations, stage alignment operations, prestatic and poststatic checkout, static firing, shipment, weight and center of gravity, operating time, and configuration.

1.2 CONDENSED DATA.

This paragraph is intended for use as a quick reference to specific information compiled during assembly and testing of stage S-IB-1.

1.2.1 SIGNIFICANT EVENTS.

Table 1-1 is a chronological record of significant events relative to the assembly and testing of stage S-IB-1.

Table 1-1. Significant Events, Stage S-IB-1

Date	Event
18 Jun 1964	Propellant Container Clustering Started
25 Nov 1964	Stage Buildup Completed
2 Feb 1965	Prestatic Checkout Completed
6 Mar 1965	Shipment to Static Test at MSFC
14 Mar 1965	Arrival at MSFC
15 Mar 1965	Installation in Static Test Stand
1 Apr 1965	Short Duration Firing
13 Apr 1965	Long Duration Firing
20 Apr 1965	Shipment to Michoud
24 Apr 1965	Arrival at Michoud
11 Jun 1965	Poststatic Alteration Completed
19 Jul 1965	Poststatic Checkout Completed
29 Jul 1965	Weight and Mass Characteristics Determined
9 Aug 1965	Shipment to Launch Complex at KSC

1.2.2 FLEXIBLE DUCTING DAMAGE SUMMARY.

Flexible ducting is identified as the lines or ducts on the S-IB stage that contain one or more expansion joints, gimbal joints, or sliding joints covered by a convoluted bellows. Dents and other damage to the bellows of flexible ducting, greater than listed acceptable limits, become potential trouble areas when subjected to the pressures encountered during propellant loading operations, static firing, and launch.

1.2.2.1 Criteria for Recording Damage. The criteria for recording flexible ducting bellows damage was as follows:

a. Record dents greater than 0.005-inch depth.

b. Record dents having sharp edges or build-up of metal regardless of depth.

c. Record scratches greater than 0.002-inch in depth.

d. Record scratched areas containing more than six scratches in 0.5-square-inch.

e. Record all gouges regardless of depth.

1.2.2.2 Description and Location of Damage. Flexible ducting damage greater than the minimum criteria detailed in paragraph 1.2.2.1 required review by a Material Review Board (MRB) and was submitted to MRB by issuing a Defective Material Notice (DMN). The final disposition was given by MRB on the DMN and is reflected in the disposition column of table 1-2 along with the DMN report number.

Table 1-2. Flexible Ducting Damage Summary, Stage S-IB-1

Part Number / Serial Number	Part Name and Location	Description of Damage (inches) Depth	Length	Width	Location of Damage	Disposition
20C00013 24B5676	Turbine exhaust assembly, engine 5, upstream from heat exchanger	0.008	0.093	0.093	One dent in bellows nearest the heat exchanger on the 10th convolution from the heat exchanger	Use as is. 16 Feb 1965 DMN M10257
20C00014 83B5516	Turbine exhaust duct, engine 7, downstream from heat exchanger				One dent in bellows farthest from the heat exchanger on the 1st convolution from the downstream end	Use as is. 19 Jul 1965 DMN M13401
20C00044 13B5790	Lox suction line, lox 3 to engine 2	0.005	0.063	0.063	One dent in bellows nearest the firewall on the 20th convolution from the firewall	Use as is. 29 Jan 1965 DMN M06576
		0.008	0.200	0.100	One dent in bellows nearest prevalve on the 1st convolution from the firewall end	30 Apr 1965 DMN M10578
20C00046 83B5465	Fuel suction line, fuel 2 to engine 2	0.046	0.250	0.156	One dent in bellows nearest the firewall on the 1st convolution from the firewall	Use as is. DMN M07556

Table 1-2. Flexible Ducting Damage Summary, Stage S-IB-1 (continued)

Part Number / Serial Number	Part Name and Location	Description of Damage (inches) Depth	Length	Width	Location of Damage	Disposition
20C00046 14B5566	Fuel suction line, fuel 1 to engine 5	0.001 to 0.002	0.063 to 0.250	--	Several small <u>scratches</u> in bellows nearest the prevalve on the 15th convolution from the firewall end	Use as is. 2 Feb 1965 DMN M10322
		0.020	0.100	--	One <u>dent</u> in bellows nearest the firewall on the 1st convolution from the firewall end	Use as is. DMN M07566
20C00046 14B5562	Fuel suction line, fuel 3 to engine 7	0.003	0.050	0.020	One <u>gouge</u> in bellows nearest the prevalve on the 2nd convolution from the firewall end	Use as is. 30 Apr 1965 DMN M10576
20C00070 B-1029	Gox Y-collector	0.002	0.094	0.031	One <u>scratch</u> in bellows on the fin 5 side in the 26th convolution from the Y end. Metal build-up and jugged edges observed	Use as is. 30 June 1965 DMN M08890

Table 1-2. Flexible Ducting Damage Summary, Stage S-IB-1 (continued)

Part Number / Serial Number	Part Name and Location	Description of Damage (inches)			Location of Damage	Disposition
		Depth	Length	Width		
20C00076 93B5166	Fuel wrapa-round line, engine 1	0.002	--	--	One <u>gouge</u> on the bellows nearest the turbopump in the 6th convolution from the end opposite the turbopump	Use as is. 2 Feb 1965 DMN M10315
		0.004	--	--	One cut on the bel-lows nearest the turbopump in the 7th convolution from the end oppo-site the turbopump	Use as is. 2 Feb 1965 DMN M10315
20C00076 93B5259	Fuel wrap-around line, engine 4	0.012	0.300	0.300	One <u>dent</u> on the center bellows in the 1st convolution from the firewall end	Use as is. 3 May 1965 DMN M10580
20C00077 9	Fuel wrap-around line, engine 7	--	--	--	Two <u>scratches</u> on the center bellows in the 1st convol-ution from the fire-wall end. Not accessible for depth measurements	Use as is. 2 Feb 1965 DMN M10321

Table 1-2. Flexible Ducting Damage Summary, Stage S-IB-1 (continued)

Part Number / Serial Number	Part Name and Location	Description of Damage (inches)			Location of Damage	Disposition
		Depth	Length	Width		
20C00077 12	Fuel wrap-around line, engine 8	0.003	0.200	0.025	Damage located on bellows nearest the turbopump in the 17th convolution from the end opposite the turbopump	Use as is. DMN A58037
60C20213 1	Lox wrap-around line, engine 1	0.006	--	--	One gouge on the bellows nearest the turbopump in the 12th convolution from the end opposite the turbopump	Use as is. 2 Feb 1965 DMN M10313
		0.002	--	--	Scratches on the bellows nearest the turbopump on each convolution. Scratches total more than 6 per 1/2-inch square	Use as is. 3 May 1965 DMN M10582
		0.004	0.625	0.030	One scratch on the bellows nearest the firewall in the 1st convolution (or the last convolution) from the firewall	Use as is. 3 May 1965 DMN M10582

Table 1-2. Flexible Ducting Damage Summary, Stage S-IB-1 (continued)

Part Number / Serial Number	Part Name and Location	Description of Damage (inches)			Location of Damage	Disposition
		Depth	Length	Width		
60C20213 3	Lox wrap-around line, engine 4	0.020	0.700	0.300	One <u>dent</u> on the bellows nearest the firewall in the 1st convolution from the end opposite the firewall	Use as is. 25 Jun 1965 DMN M10579
		0.003	0.250	--	One <u>scratch</u> on the center bellows in the 5th convolution from the turbopump end	Use as is. 25 June 1965 DMN M10579
60C20718 4	Lox wrap-around line, engine 5	0.008	0.313	0.250	One <u>dent</u> on the bellows nearest the firewall on the 1st convolution from the end opposite the firewall	Use as is. 3 May 1965 DMN M10581
		*	0.100	0.030	One <u>gouge</u> on the center bellows in the 4th convolution from the turbopump end. *Raised metal 0.003 high. Depth of gouge not recorded	Use as is. 3 May 1965 DMN M10581

Table 1-2. Flexible Ducting Damage Summary, Stage S-IB-1 (continued)

Part Number / Serial Number	Part Name and Location	Description of Damage (inches)			Location of Damage	Disposition
		Depth	Length	Width		
60C20718 2	Lox wrap-around line, engine 6	0.001	--	--	Numerous gouges on the bellows nearest the firewall in the 1st convolution from the firewall	Use as is. 2 Feb 1965 DMN M10317
60C20718 1	Lox wrap-around line, engine 7	--	--	--	Numerous closely-spaced parallel scratches on the bellows nearest the turbopump in the 16th and 17th convolutions from the end opposite the turbopump	Use as is. 2 Feb 1965 DMN M10319
402785-31 RN103V	Fuel high-pressure duct, engine 2	--	--	--	Dents on bellows next to turbopump in the 2nd and 3rd convolutions	Use as is. 6 Aug 1965 DMN M13472

1.2.3 S-IB STAGE ORIFICE SUMMARY.

Table 1-3 contains the orifice summary for stage S-IB-1 except for the engine orifices which are listed in the engine logbooks. Due to the late addition of the orifice summary requirement, some of the actual measured sizes of the orifices listed in table 1-3 were not available and only the drawing size is shown. In all cases the installed orifices are within the spceified drawing tolerances.

Table 1-3. Orifice Summary, Stage S-IB-1

Orifice Part Number	Drawing Size (inches)	Actual Size (inches)	Orifice Location
20C00982	0.018 (+0.002)		Calorimeter purge to measurement C506-4
			Calorimeter purge to measurement C506-7
20C00991	0.042 (+0.002)		Gearbox and lox pump seal purge manifold, engine 1
			Gearbox and lox pump seal purge manifold, engine 2
			Gearbox and lox pump seal purge manifold, engine 3
			Gearbox and lox pump seal purge manifold, engine 4
			Gearbox and lox pump seal purge manifold, engine 5
			Gearbox and lox pump seal purge manifold, engine 6
			Gearbox and lox pump seal purge manifold, engine 7
			Gearbox and lox pump seal purge manifold, engine 8
20C30199	0.102 (+0.002)	0.1032	Lox bubbling line at wraparound line elbow, engine 1
			Lox bubbling line at wraparound line elbow, engine 2
			Lox bubbling line at wraparound line elbow, engine 3
			Lox bubbling line at wraparound line elbow, engine 4

Table 1-3. Orifice Summary, Stage S-IB-1 (continued)

Orifice Part Number	Drawing Size (inches)	Actual Size (inches)	Orifice Location
20C30199 (continued)	0.102 (+0.002)	0.1030	Lox bubbling line at wraparound line elbow, engine 5
		0.1032	Lox bubbling line at wraparound line elbow, engine 6
		0.1030	Lox bubbling line at wraparound line elbow, engine 7
		0.1035	Lox bubbling line at wraparound line elbow, engine 8
20C30338	0.018 (+0.002)	0.018	Fuel bubbling line at wraparound line elbow, engine 1
			Fuel bubbling line at wraparound line elbow, engine 2
		0.019	Fuel bubbling line at wraparound line elbow, engine 3
			Fuel bubbling line at wraparound line elbow, engine 4
			Fuel bubbling line at wraparound line elbow, engine 5
			Fuel bubbling line at wraparound line elbow, engine 6
			Fuel bubbling line at wraparound line elbow, engine 7
			Fuel bubbling line at wraparound line elbow, engine 8
20C40107	0.250 (+0.005) (-0.001)		Instrument compartment no. 1, forward bulkhead
60C20455-1	19.000 (±0.005)		Center lox container sump

Table 1-3. Orifice Summary, Stage S-IB-1 (continued)

Orifice Part Number	Drawing Size (inches)	Actual Size (inches)	Orifice Location
60C04036-1	0.042 (+0.002) (-0.001)	0.0412	Control valve for fuel prevalve 1
		0.0412	Control valve for fuel prevalve 2
		0.0412	Control valve for fuel prevalve 3
		0.0412	Control valve for fuel prevalve 4
		0.0412	Control valve for fuel prevalve 5
		0.0412	Control valve for fuel prevalve 6
		0.0412	Control valve for fuel prevalve 7
		0.0412	Control valve for fuel prevalve 8
60C04037-1	0.0210 (+0.0025) (-0.0010)	0.022	Fuel prevalve 1 control pressure inlet
		0.022	Fuel prevalve 2 control pressure inlet
		0.022	Fuel prevalve 3 control pressure inlet
		0.0222	Fuel prevalve 4 control pressure inlet
		0.0222	Fuel prevalve 5 control pressure inlet
		0.0222	Fuel prevalve 6 control pressure inlet

Table 1-3. Orifice Summary, Stage S-IB-1 (continued)

Orifice Part Number	Drawing Size (inches)	Actual Size (inches)	Orifice Location
60C04037-1 (continued)	0.0210 (+0.0025) (-0.0010)	0.0222	Fuel prevalve 7 control pressure inlet
		0.0222	Fuel prevalve 8 control pressure inlet
60C20719	0.210 to 0.211		High-pressure inlet to fuel pressurizing manifold 20C00049
60C04044	0.1030 to 0.1045	0.104	Heat exchanger lox inlet, engine 1 (3 orifices)
		0.104	
		0.104	
		0.104	Heat exchanger lox inlet, engine 2 (3 orifices)
		0.104	
		0.104	
		0.104	Heat exchanger lox inlet, engine 3 (3 orifices)
		0.104	
		0.104	
		0.104	Heat exchanger lox inlet, engine 4 (3 orifices)
		0.104	

Table 1-3. Orifice Summary, Stage S-IB-1 (continued)

Orifice Part Number	Drawing Size (inches)	Actual Size (inches)	Orifice Location
60C04044 (continued)	0.1030 to 0.1045	0.104	Heat exchanger lox inlet, engine 4
		0.104	Heat exchanger lox inlet, engine 5 (3 orifices)
		0.104	
		0.104	
		0.104	Heat exchanger lox inlet, engine 6 (3 orifices)
		0.104	
		0.104	
		0.104	Heat exchanger lox inlet, engine 7 (3 orifices)
		0.104	
		0.104	
		0.104	Heat exchanger lox inlet, engine 8 (3 orifices)
		0.104	
		0.104	

Table 1-3. Orifice Summary, Stage S-IB-1 (continued)

Orifice Part Number	Drawing Size (inches)	Actual Size (inches)	Orifice Location
F61C1543-4	0.086 (±0.002)		Lox prevalve 1, control pressure inlet
			Lox prevalve 2, control pressure inlet
			Lox prevalve 3, control pressure inlet
			Lox prevalve 4, control pressure inlet
			Lox prevalve 5, control pressure inlet
			Lox prevalve 6, control pressure inlet
			Lox prevalve 7, control pressure inlet
			Lox prevalve 8, control pressure inlet

1.2.4 THRUST CHAMBER DAMAGE, H-1D ENGINES.

During rocket engine assembly, alignment, and testing, and when the engine thrust-chamber protective covering is not in place, the 292 tubes that comprise the thrust-chamber fuel jacket are exposed and occasionally are damaged. The majority of the damage consists of small dents in the tubing which may restrict the flow of the fuel used for cooling the thrust chamber. When fuel flow in a tube is reduced, the tube may burn out and the resulting fuel leak can cause severe damage to the engine as well as mission failure.

1.2.4.1 Criteria for Recording Damage. The following requirements were established for determining the degree of damage to be recorded and to determine when a disposition by NASA would be required.

a. Record all dents or pits inside the thrust chamber having a depth greater than 0.010 inch. Disposition of damage to be made by NASA.

b. Record all dents or pits outside the thrust chamber having a depth greater than 0.050 inch. Disposition of damage to be made by NASA.

c. Record all dents having sharp corners, raised metal, or creases. Disposition of damage to be made by NASA.

d. Record all nicks, scratches, and gouges having a depth greater than 0.004 inch. Disposition of damage to be made by NASA.

e. Record all areas of apparent tube erosion aft of the throat centerline.

1.2.4.2 Thrust Chamber Damage Location. Table 1-4 contains the locations of damaged areas found during inspection, and as recorded on Defective Material Notices (DMN). The engine logbooks supplied with each engine should be consulted for locations of damage in addition to that listed in table 1-4. Figure 1-1 is a diagram of the thrust chambers and is used with table 1-4 for determining the exact location of damage.

Positions A, B, C, and D in figure 1-1 represent the location of drain ports in the fuel return manifold with position A referenced to the rear turbopump support. The Distance Forward column in table 1-4 provides the distance forward from the fuel return manifold to the internal area of damage on all engines and to the external area of damage on inboard engines. For location of external damage on outboard engines the distance forward is measured from the forward edge of the aspirator instead of the fuel return manifold. The Distance Around column in table 1-4 provides the distance from positions A, B, C, or D to the area of damage. To locate a damaged area using table 1-4 and figure 1-1 the following sequence must be used.

a. Refer to the Int.-Ext. columns of table 1-4 to determine if the damaged area is inside (internal) or outside (external) of the thrust chamber.

b. Measure off the indicated distance forward from the fuel return manifold (or aspirator).

c. When the distance-forward point is reached, measure off the indicated distance around from the position shown (A, B, C, or D) to the damaged area.

Table 1-4. Thrust Chamber Tubing Damage Locations, S-IB-1

Engine		Surface		Distance Forward (inches)	Distance Around (inches)	Remarks	Disposition (NASA)
Pos.	Serial No.	Int	Ext				
1	H-7046	X		3.20	3.25 off B to C	One dent 0.020 deep with sharp radius. Repaired. DMN M10604.	Accepted after repair
		X		3.00	14.5 off B to C	One dent 0.014 deep. DMN M10612-A	Use as is
2	H-7047	X		3.40	3.60 off C to D	One dent 0.012 deep. Repaired. DMN M10605, item 1	Accepted after repair
		X		2.30	9.90 off B to C	One dent 0.024 deep. Repaired. DMN M10605, item 2	Accepted after repair
3	H-7048	X		23.5	5.50 off A to B	One dent 0.025 deep. Repaired. DMN M10606	Accepted after repair
		X		4.00	3.75 off B to C	One dent 0.021 deep. Repaired. DMN M10609-A, item 1	Accepted after repair
		X		4.50	32.3 off B to C	One dent 0.014 deep. Repaired. DMN M10609-A, item 2	Accepted after repair
		X		2.88	5.00 off C to D	One dent 0.014 deep. Repaired. DMN M10609-A, item 3	Accepted after repair

Table 1-4. Thrust Chamber Tubing Damage Locations, S-IB-1 (continued)

Engine		Surface		Distance Forward (inches)	Distance Around (inches)	Remarks	Disposition (NASA)
Pos.	Serial No.	Int	Ext				
4	H-7049	X		66.5	1.65 off C to D	One dent 0.045 deep. Repaired. DMN M10607, item 1	Accepted after repair
		X		54.6	1.60 off C to D	One dent 0.021 deep. Repaired. DMN M10607, item 2	Accepted after repair
5	H-4044					No damage over tolerance was found	
6	H-4045		X	17.0	8.00 off D to C	One nick 0.034 deep. with sharp radius Repaired. DMN M07773-A	Accepted after repair
		X		63.0	2.25 off C to D	One dent 0.015 deep. DMN M10610-A, item 1	Use as is
		X		3.50	2.00 off C to D	One dent 0.017 deep. Repaired. DMN M10610-A, item 2	Accepted after repair
7	H-4052	X		19.0	3.50 off C to ?	One dent 0.038 deep. DMN M07530	

Table 1-4. Thrust Chamber Tubing Damage Locations, S-IB-1 (continued)

Engine		Surface		Distance Forward (inches)	Distance Around (inches)	Remarks	Disposition (NASA)
Pos.	Serial No.	Int	Ext				
7	H-4052	X		71.0	13.0 off D to C 9.0 off C to D 11.0 off C to B	Erosion holes at forward end of tubes. Squawk K08360, items 18, 19, and 20	Accept
8	H-4047	X		62.0	1.50 off A to D	One dent 0.013 deep. DMN M10608-A, item 1	Use as is
		X		62.0	1.12 off A to D	One dent 0.016 deep. DMN M10608-A, item 2	Use as is
		X		4.75	On B	One dent 0.017 deep. Repaired. DMN M10608-A, item 3	Accepted after repair

NOTE:
All inspections for thrust chamber damage on engines were performed after static test of stage S-IB-1 and without removing engine combustion deposits. Undetected and unrecorded damage may be concealed by these deposits.

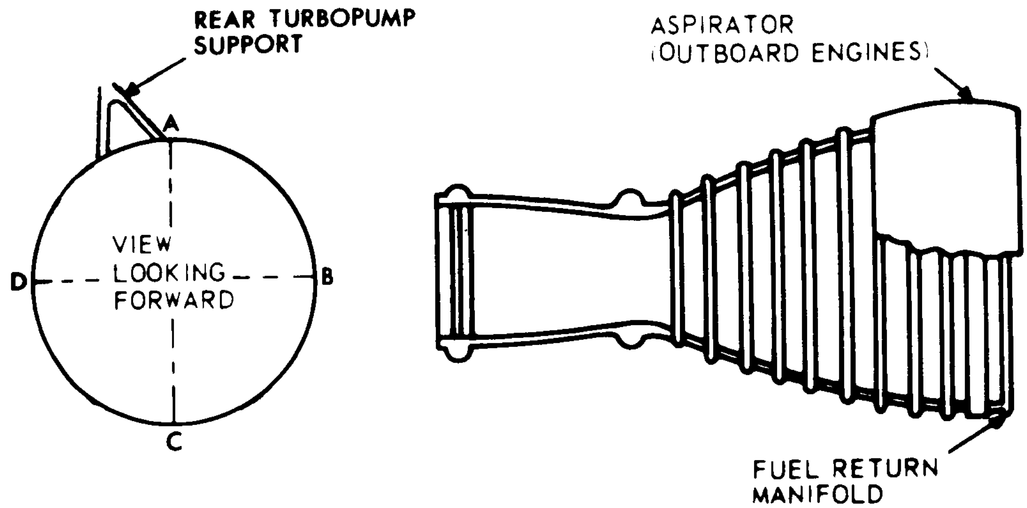

Figure 1-1. Thrust Chamber Tubing Damage Location Diagram

1.2.5 LIMITED-LIFE COMPONENTS DATA.

Limited-life components are parts and assemblies that deteriorate or otherwise change their characteristics through use (operating time or cycles) or through the passing of time (age control). Most limited-life components have a definitely established limit at which they must be replaced. The replacement time is determined by reliability studies and evaluation of previous component failures and should not be confused with design life. The actual time of replacement is established at a point where component reliability factors are high and probability-of-failure factors are near zero. Components not replaced at this point enter into a phase where reliability rapidly diminishes and probability of failure greatly increases.

1.2.5.1 Operating Time. Records are maintained on the operating time or number of operating cycles of certain critical components as defined by the CCSD engineering department. Table 1-5 identifies these components and provides the total unknown accumulated operating time or number of operating cycles. Component replacement is required when the accumulated time or cycles reaches the amount shown in the right-hand column of table 1-5; or, whenever it becomes known that the life will expire prior to mission completion.

Table 1-5. Total Operating Time and Cycles of Limited-Life Components.

Part Number	Serial Number	Component Name	Total Time thru 28 July 1965	Life Limit
20M85064	MX100735A	Auxiliary hydraulic pump, engine 1	127 minutes	3000 minutes
20M85064	MX100728A	Auxiliary hydraulic pump, engine 2.	156 minutes	3000 minutes
20M85064	MX69512	Auxiliary hydraulic pump, engine 3	277 minutes	3000 minutes
20M85064	MX85020	Auxiliary hydraulic pump, engine 4	556 minutes	3000 minutes
20M85065	1335447	Motor, auxiliary hydraulic pump, engine 1	31 cycles. See note 1	250 cycles
			74 minutes	3000 minutes
20M85065	1335457	Motor, auxiliary hydraulic pump, engine 2	51 cycles. See note 1	250 cycles
			142 minutes	3000 minutes

Table 1-5. Total Operating Time and Cycles of Limited-Life Components (continued)

Part Number	Serial Number	Component Name	Total Time thru 28 July 1965	Life Limit
20M85065	1335441	Motor, auxiliary hydraulic pump, engine 3	64 cycles. See note 1	250 cycles
			156 minutes	3000 cycles
20M85065	1297660	Motor, auxiliary hydraulic pump, engine 4	164 cycles. See note 1	250 cycles
			520 minutes	3000 minutes
50M10338	1020	Tape recorder (tape cycles only)	22 cycles. See note 2	80 cycles
50C12172	340	Receiver-decoder	18,621 minutes	See note 3
50C12172	354	Receiver-decoder	19,396 minutes	See note 3
50M10419	350	Voltage regulator	18,621 minutes	See note 3
50M10419	364	Voltage regulator	19,396 minutes	See note 3
50C12187-1	005	PCM/RF Assembly	3513 minutes	See note 3

Table 1-5. Total Operating Time and Cycles of Limited-Life Components (continued)

Part Number	Serial Number	Component Name	Total Time thru 28 July 1965	Life Limit
50C12196-5	001	RF Container Assembly (S1)	9019 minutes	See note 3
50C12196-7	001	RF Container Assembly (F1)	14,148 minutes	See note 3
50C12196-9	001	RF Container Assembly (F2)	12,971 minutes	See note 3

NOTES:

1. One cycle is defined as one start or one on/off cycle of the motor.

2. Represents tape cycles only. Total accumulated cycles applicable to the heads is unknown. One cycle is defined as one complete pass of the tape past the heads in the forward direction. Rewinds are not recorded. Partial passes in the forward direction are recorded until the total reaches one complete pass or cycle. Replace the heads and the tape before 400 cycles.

3. The total time given constitutes only the time accumulated by CCSD. Previous time is unknown; however, there is no specified life-limit.

4. Operating time/cycles added to components by agencies other than CCSD, prior to CCSD receipt of the component and at static test, may not have been recorded. Assume all components to have more accumulated/time cycles than shown in this table.

1.2.5.2 Age Control. Components containing synthetic rubber O-rings or other synthetic rubber parts in dynamic applications require that records be maintained on the age of the rubber. Since synthetic rubber parts deteriorate or change their characteristics with the passage of time in relation to their exposure to air, sunlight, and other environmental conditions, complete records on the age of components containing synthetic rubber are essential.

1.2.5.2.1 All age control records for stage S-IB-1 were maintained in accordance with Standard MSFC-STD-105A and Amendment 1. Amendment 1 to MSFC-STD-105A extends the installed life of all synthetic rubber to 16 quarters (4 years).

1.2.5.2.2 Table 1-6 identifies the limited-life components on stage S-IB-1 that contain age-controlled synthetic rubber parts. The two left-hand columns list the replacement date (R/D) and the assembly date (A/D). The A/D is given by the quarter and year in which the oldest rubber part was installed into the component. The R/D is the calendar date at which replacement of the rubber part in the component is required, and is the last date in the quarter for which the useful life of the rubber in the component expires. All entries in table 1-6 are in order by replacement date, then by part number and serial number. The last two columns of table 1-6 list the specifications to which the rubber was manufactured and the manufacturer's code for the component manufacturer as taken from Federal Supply Code for Manufacturers Cataloging Handbooks H4-1 and H4-2.

Table 1-6. Age Control Data, Limited-Life Components

R/D	A/D	Part Number	Serial Number	Component Name	Rubber Specification	Mfr Code
31 Dec 66	4Q62	20C30128	702	Valve assembly, solenoid operated	MIL-P-5516	99657
31 Mar 67	1Q63	20C30390	284.3 286.3	Nipple, quick disconnect	MIL-R-3065	79326
		20C40000	34	Check valve, instrument compartment cooling	MIL-P-5516	06458
30 Jun 67	2Q63	20C30134	CH023	Regulator assembly, 750 psi GN_2	MIL-P-5315	02272
		20C30136	2663	Nipple, quick disconnect	MIL-R-3065	79326
		20C30139	0010	Nipple, quick disconnect	MIL-R-3065	79326
		20C30165	272.3, 274.3, 276.3, 0008	Coupling assembly, 1-inch	MIL-R-3065	79326
		20C30390	0003, 0004	Nipple, quick disconnect	MIL-R-3065	79326
30 Sep 67	3Q63	30C30128	846, 850, 856, 862, 845	Valve assemblies, solenoid operated	MIL-P-5516	99657
		20C30138	0009, 0011	Nipple, quick disconnect	MIL-R-3065	79326

Table 1-6. Age Control Data, Limited-Life Components (continued)

R/D	A/D	Part Number	Serial Number	Component Name	Rubber Specification	Mfr Code
30 Sep 67 (continued)	3Q63	20C30141	0005	Nipple, quick disconnect	MIL-R-3065	79326
		20C30160	463	Valve assembly calorimeter purge	MIL-P-5315	99657
31 Dec 67	4Q63	20C30129	016	Filter, air	MIL-P-25732	95359
		20C30137	CH012	Valve assembly, 750 psi relief	Not available	02272
		20C30139	0038, 0039, 0040	Nipple, quick disconnect	MIL-R-3065	79326
		20C30391	008	Nipple quick disconnect	Not available	79326
		20C40000	45	Check valve, instrument compartment cooling	MIL-P-5516	06458
		20C85035	93023 93026 93028	Pumps, main hydraulic	MS28775 MS28778	75250
31 Mar 68	1Q64	20C00447	41, 42, 43, 44, 45, 47, 48, & 49	Swivel joint	MIL-R-6855	70709
		20C00448	66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, & 77	Swivel joint	MIL-R-6855	70709

Table 1-6. Age Control Data, Limited-Life Components (continued)

R/D	A/D	Part Number	Serial Number	Component Name	Rubber Specification	Mfr Code
31 Mar 68 (continued)	1Q64	20C30128	874, 876, 879, 881, 885	Valve assemblies, solenoid operated	MIL-P-5516	99657
		20C30131	158	Valve, fill and vent, GN_2	MIL-P-5516	99657
		20C30166	0004	Coupling assembly 1.25-inch	MIL-R-7362	79326
30 Jun 68	2Q64	20C30139	0008	Nipple, quick disconnect	MIL-R-3065	79326
		60C20268	154, 165	Valve assemblies, solenoid operated	MIL-P-5516	99657
30 Sep 68	3Q64	20C30133	RA0305	Nipple, quick disconnect	MIL-R-3065	79326
		20C85035	93044	Pump, main hydraulic engine 4	MS28775 MS28778	75250
		60C20003	570019	Depletion sensor, fuel 4 Sensor, fuel depletion	Not available	06255
		60C60001	300, 301, 306, 307, 308, 309	Servo actuator assemblies	MS28775	94697
31 Dec 68	4Q64	60C20003	570018	Fuel depletion sensor	Not available	06255
		60C20339	103, 104, 109, 110, 113, 115, 118	Valve assemblies, lox, ball rotor shut-off	MIL-P-5315	92003

Table 1-6. Age Control Data, Limited-Life Components (continued)

R/D	A/D	Part Number	Serial Number	Component Name	Rubber Specification	Mfr Code
31 Dec 68 (continued)	4Q64	60C20340	106, 109, 110, 112, 113, 114, 117	Valve assemblies, fuel, ball rotor shutoff	MIL-P-5315	92003
		60C20358	13 & 15	Valve assemblies, fuel vent	MIL-P-5315	83323
		60C26025-1	104	Valve assembly, lox fill and drain	MIL-P-5315	92003
		60C26025-3	105	Valve assembly, fuel fill and drain	MIL-P-5315	92003
31 Mar 69	1Q65	20C30131	176	Valve, sphere fill and vent, GN_2	MIL-P-5516	99657
30 Jun 69	2Q65	20C30122	107	Valve assembly, 7-inch, lox vent	MIL-P-5516	02602
		60C20339	142	Valve assembly, lox, ball rotor shutoff	MIL-P-5315	06255
		60C20340	133	Valve assembly, fuel, ball rotor shutoff	MIL-P-5315	92003
		60C60001	343 & 342	Servo actuator assemblies	MS28775	94697

1.2.6 COMPONENT REPLACEMENT RECORD.

Components replaced due to the specific failures and discrepancies covered in this report are listed in table 1-7. Where instrumentation components are involved, the measurement number is given in parenthesis in the Name column. The extreme right-hand column of table 1-7 contains a reference to the specific paragraph that documents the failure or discrepancy that caused the replacement. For a complete list of all serialized parts replaced, refer to the S-IB Stage Component Removal and Installation Record listed on the Reference Documents page at the rear of this report.

Table 1-7. Component Replacement Record

Part Number	Name	Serial Number & Date Removed	Serial Number & Date Installed	Paragraph Reference
20C00013	Turbine exhaust duct, engine 8	24B5677 2 Jun 65	83B5509 4 Jun 65	4.3.2.3
20C00013	Turbine exhaust duct, engine 7	24B5678 5 Jun 65	24B5679 10 Jun 65	4.3.2.2
20C00014	Turbine exhaust duct, engine 8	83B5510 3 Jun 65	83B5513 4 Jun 65	4.3.2.3
20C00044	Lox suction line, engine 7	13B5795 18 May 65	21 2 Jun 65	4.3.2.8
20C00059	Gox line assembly, engine 4	113B5008 4 Mar 65	F1051 4 Mar 65	4.3.2.7
20C00077	Fuel wraparound line, engine 8	83B5486 17 May 65	12 20 May 65	4.3.2.9
20C30042	Lox dump valve	216	201	5.3.2.19
20C30043	Fuel fill and drain valve	257	102	5.3.2.10
20C30043	Fuel dump valve	207	103	5.3.2.11.1
20C30043	Fuel dump valve	103	261	5.3.2.11.2
20C30122-1	7-inch lox vent valve	CH872 8 Dec 64	CH874 9 Jan 65	5.3.2.20
20C30122-1	7-inch lox vent valve	CH874 6 Jul 65	107 8 Jul 65	5.3.2.21
20C30128	Control valve, lox vent	701 21 Jun 65	885 24 Jun 65	5.3.2.22
20C30132	Check valve	999 21 Jun 65	1160 21 Jun 65	5.3.2.25

Table 1-7. Component Replacement Record (continued)

Part Number	Name	Serial Number & Date Removed	Serial Number & Date Installed	Paragraph Reference
20C40005	Flexible ducting	10 16 Jul 65	0002 16 Jul 65	5.3.2.30
20C40113	Flexible ducting	1 16 Jul 65	C0003 16 Jul 65	5.3.2.30
20C85009	Bleed valve, hydraulic	0009	135-1	6.6.2.13
20C85035	Main hydraulic pump, engine 4	93024 7 Jun 65	93044 8 Jun 65	4.3.2.12
20C85053	Hydraulic package, engine 4	117 7 Jun 65	121 8 Jun 65	4.3.2.11
20C85064	Auxiliary hydraulic pump	MX99281 10 Apr 65	MX100735A 10 Apr 65	6.6.2.10
20C85064	Auxiliary hydraulic pump	MX100724A 30 Mar 65	MX100728A 30 Mar 65	6.6.2.12
20C85065	Auxiliary hydraulic pump motor	1335440 10 Apr 65	1335447 10 Apr 65	6.6.2.10
20C85065	Auxiliary hydraulic pump motor	1335456 30 Mar 65	1335457 30 Mar 65	6.6.2.12
20C85079	Pressure transducer (D29-1)	1032 7 Apr 65	12292 7 Apr 65	6.6.2.9
20C85079	Pressure transducer (D29-2)	1029 2 Apr 65	1027 2 Apr 65	6.6.2.7
20C85079	Pressure transducer (D29-3)	1034 2 Apr 65	1056 5 Apr 65	6.6.2.8
40C20614-3	Timer assembly	SA-0322 12 Jul 65	SA-0358 12 Jul 65	5.3.1.1
50M10105	Accelerometer (E33-1)	233 8 Jun 65	186 10 Jun 65	4.3.3.6

Table 1-7. Component Replacement Record (continued)

Part Number	Name	Serial Number & Date Removed	Serial Number & Date Installed	Paragraph Reference
50C10105	Accelerometer (E33-3)	255 4 Mar 65	264 5 Mar 65	4.3.3.7
50C10105	Accelerometer (E33-3)	264 23 Jun 65	1081 26 Jun 65	5.3.3.14
50C10105	Accelerometer (E33-3)	1081 31 Jul 65	227 31 Jul 65	4.3.3.8
50C10131	Accelerometer (E251-9)	7841F 20 Dec 64	8738F 14 Jan 65	5.3.3.15.1
50C10131	Accelerometer (E251-9)	8738F 20 Jan 65	11990F 29 Jan 65	5.3.3.15.2
50C10205	Liquid level probe (L20-F4)	1089 1 Jun 65	941 3 Jun 65	4.3.3.12
50C10259	Pressure transducer (D500-11)	M2096 29 Dec 64	M2410 30 Dec 64	5.3.3.11
50C10285	Measurement calibrator	181 17 Dec 64	216 18 Dec 64	5.3.3.41
50C10285	Measurement calibrator	184 28 Jun 65	125 28 Jun 65	5.3.3.42
50M10306	Pressure transducer (D124-10)	3-8381 11 Jul 65	3-9323 12 Jul 65	5.3.3.10
50C10306	Pressure transducer (D502-11)	3-9346 5 Jan 65	3-9308 13 Jan 65	5.3.3.12
50C10338	Tape recorder	062 12 Jan 65	074 13 Jan 65	5.3.3.44.1
50C10338	Tape recorder	074 13 Jan 65	070 14 Jan 65	5.3.3.44.2
50C10338	Tape recorder	070 16 Jan 65	074 19 Jan 65	5.3.3.44.3

Table 1-7. Component Replacement Record (continued)

Part Number	Name	Serial Number & Date Removed	Serial Number & Date Installed	Paragraph Reference
50C10338	Tape recorder	074 28 Jan 65	070 15 Feb 65	5.3.3.44.4
50C10338	Tape recorder	070 30 Jun 65	074 1 Jul 65	5.3.3.45.1
50C10338	Tape recorder	074 3 Jul 65	1029 3 Jul 65	5.3.3.45.2
50C10338	Tape recorder	1029 6 Jul 65	070 8 Jul 65	5.3.3.45.3
50C10338	Tape recorder	070 15 Jul 65	1029 24 Jul 65	5.3.3.45.4
50C10382	AC amplifier (B501-4)	C190 27 Apr 65	C305 27 Apr 65	4.3.3.1
50C10388	DC amplifier (D1-8)	14244 30 Apr 65	0335 24 Jun 65	4.3.3.4 6.6.3.7
50C10388	DC amplifier (S523-11)	0110 22 Jan 65	0259 27 Jan 65	5.3.3.38
50C10388	DC amplifier (S553-20)	14290 22 Dec 64	0319 30 Dec 64	5.3.3.39
50C10388	DC amplifier (S561-22)	14296 24 Jun 65	0123 26 Jun 65	5.3.3.40
50C10394	DC amplifier (C59-1)	1513 18 Jun 65	2047 19 Jun 65	5.3.3.3
50C10394	DC amplifier (C89-2)	1597 18 Jun 65	2050 19 Jun 65	5.3.3.5
50C10394	DC amplifier (C264-1)	1587 21 Jan 65	1674 26 Jan 65	5.3.3.6
50C10394	DC amplifier (M19-12)	1174 28 Jun 65	1774 1 Jul 65	5.3.3.36

Table 1-7. Component Replacement Record (continued)

Part Number	Name	Serial Number & Date Removed	Serial Number & Date Installed	Paragraph Reference
50C10395	Accelerometer (E11-8)	547 11 Feb 65	597 18 Feb 65	4.3.3.5
50M10395	Accelerometer (E12-8)	536 1 Jul 65	1022 3 Jul 65	5.3.3.13
50C10397	Pressure transducer (D14-2)	3-7865 22 Jun 65	6-6286 24 Jun 65	5.3.3.8
50C10401	Emitter follower (E339-11)	0011	14A	5.3.3.17
50C10401	Emitter follower (E501-4)	0013 12 Dec 64	0016 28 Dec 64	5.3.3.19
50C10402	Zone box (C551-16)	2169 16 Jul 65	2265 16 Jul 65	5.3.3.52
50C10403	Zone box (C9-5)	2055 16 Jul 65	120 16 Jul 65	5.3.3.52
50C10403	Zone box (C9-7)	2154 16 Jul 65	116 16 Jul 65	5.3.3.52
50C10403	Zone box (C9-3)	2011 16 Jul 65	162 16 Jul 65	5.3.3.52
50C10403	Zone box (C61-5)	2136 16 Jul 65	164 16 Jul 65	5.3.3.52
50C10403	Zone box (C61-6)	2153 16 Jul 65	147 16 Jul 65	5.3.3.52
50C10403	Zone box (C61-7)	2129 16 Jul 65	137 16 Jul 65	5.3.3.52
50C10403	Zone box (C89-7)	2119 16 Jul 65	158 16 Jul 65	5.3.3.52
50C10403	Zone box (C266-3)	2071 16 Jul 65	126 16 Jul 65	5.3.3.52

Table 1-7. Component Replacement Record (continued)

Part Number	Name	Serial Number & Date Removed	Serial Number & Date Installed	Paragraph Reference
50C10403	Zone box (C501-2)	2151 16 Jul 65	134 16 Jul 65	5.3.3.52
50C10403	Zone box (C515-3)	2138 16 Jul 65	157 16 Jul 65	5.3.3.52
50C10403	Zone box (C516-3)	2132 16 Jul 65	160 16 Jul 65	5.3.3.52
50C10403	Zone box (C531-20)	2250 16 Jul 65	136 16 Jul 65	5.3.3.52
50C10403	Zone box (C532-20)	2236 16 Jul 65	109 16 Jul 65	5.3.3.52
50C10403	Zone box (C533-20)	2226 16 Jul 65	111 16 Jul 65	5.3.3.52
50C10403	Zone box (C533-22)	2134 16 Jul 65	124 16 Jul 65	5.3.3.52
50C10403	Zone box (C533-22)	124 16 Jul 65	128 16 Jul 65	5.3.3.52
50C10403	Zone box (C535-20)	2219 16 Jul 65	144 16 Jul 65	5.3.3.52
50C10403-1	Zone box (C552-22)	2228 16 Jul 65	140 16 Jul 65	5.3.3.52
50C10404-1	Zone box (C1-1)	1732 16 Jul 65	227 16 Jul 65	5.3.3.52
50C10404-1	Zone box (C1-4)	1727 16 Jul 65	228 16 Jul 65	5.3.3.52
50C10404-1	Zone box (C1-5)	1731 16 Jul 65	219 17 Jul 65	5.3.3.52
50C10404-1	Zone box (C1-7)	1784 20 Jun 65	176 22 Jun 65	5.3.3.2

Table 1-7. Component Replacement Record (continued)

Part Number	Name	Serial Number & Date Removed	Serial Number & Date Installed	Paragraph Reference
50C10404-1	Zone box (C1-8)	1730 16 Jul 65	229 16 Jul 65	5.3.3.52
50C10404	Zone box (C59-1)	1738 16 Jul 65	217 16 Jul 65	5.3.3.52
50C10406	Accelerometer (E503-9)	351 11 Jan 65	438 19 Jan 65	5.3.3.20.1
50C10406	Accelerometer (E503-9)	438 15 Jan 65	435 16 Jan 65	5.3.3.20.2
50C10406	Accelerometer (E339-11)	422 18 Dec 64	433 28 Dec 64	5.3.3.16
50C10676	Rate gyro (R502-11)	264 3 Jul 65	280 3 Jul 65	5.3.3.37
50C10695	Frequency divider (T12-7)	23564 7 Apr 65	23565 7 Apr 65	6.6.3.6
50C10699	Liquid level adapter (L42- F2)	20 20 Jan 65	39 21 Jan 65	5.3.3.30
50C10699	Liquid level adapter (L42-F2)	35 30 Jun 65	51 30 Jun 65	5.3.3.31
50M10699	Liquid level adapter (L43-F3)	18 7 Jul 65	40 7 Jul 65	5.3.3.32
50C10699	Liquid level adapter (L46-O1)	30 29 Jun 65	24 30 Jun 65	5.3.3.34.1
50C10699	Liquid level adapter (L46-O1)	24 29 Jun 65	50 30 Jun 65	5.3.3.34.2
50C10699	Liquid level adapter (L49-O4)	16 28 Jan 65	42 29 Jan 65	5.3.3.35
50C12173	Power divider	00002 16 Jun 65	SA0166 17 Jun 65	5.3.3.50

Table 1-7. Component Replacement Record (continued)

Part Number	Name	Serial Number & Date Removed	Serial Number & Date Installed	Paragraph Reference
50M12180	Pressure transducer (D41-9)	4-7805 18 Jun 65	7-5032 20 Jun 65	5.3.3.9
50C12187-1	PCM/RF assembly	002 23 Mar 65	001 23 Mar 65	6.6.3.4.1
50C12187-1	PCM/RF assembly	001 29 Mar 65	005 29 Mar 65	6.6.3.4.2
50C12295-1	Liquid level rack (L19-OC)	306049 27 Mar 65	401005 29 Mar 65	6.6.3.3
50C12295-1	Liquid level rack (L19-O1)	401006 9 Dec 64	310004 9 Dec 64	5.3.3.29
50C12295-1	Liquid level rack (L19-O3)	402011 27 Mar 65	302030 27 Mar 65	6.6.3.3
50C12295-1	Liquid level rack (L20-F1)	402013 27 Mar 65	405023 27 Mar 65	6.6.3.3
50C12295-1	Liquid level rack (L20-F4)	403018 27 Mar 65	401006 27 Mar 65	6.6.3.3
50C12313	Measuring rack selector	17 3 Dec 64	18 4 Dec 64	5.3.3.43
50C60036-3	Dual output amplifier	113 8 Jul 65	00137	5.3.3.48
60C20339	Lox prevalve, engine 2	105 26 Mar 65	119 27 Mar 65	6.6.2.6.1
60C20339	Lox prevalve, engine 2	119 4 Apr 65	109 4 Apr 65	6.6.2.6.2
60C20339	Lox prevalve, engine 3	117 31 Dec 64	110 7 Jan 65	5.3.2.14
60C20339	Lox prevalve engine 4	108 31 Dec 64	114 8 Jan 65	5.3.2.15

Table 1-7. Component Replacement Record (continued)

Part Number	Name	Serial Number & Date Removed	Serial Number & Date Installed	Paragraph Reference
60C20339	Lox prevalve, engine 4	114 25 Mar 65	118 26 Mar 65	6.6.2.5
60C20339	Lox prevalve engine 5	107 31 Dec 64	115 8 Jan 65	5.3.2.16
60C20339	Lox prevalve, engine 7	106 31 Dec 64	102 8 Jan 65	5.3.2.17.1
60C20339	Lox prevalve, engine 7	102 22 Jan 65	116 23 Jan 65	5.3.2.17.2
60C20339	Lox prevalve, engine 7	116 26 Jun 65	142 26 Jun 65	5.3.2.18
60C20340	Fuel prevalve engine 1	110 31 Dec 64	117 7 Jan 65	5.3.2.3.1
60C20340	Fuel prevalve, engine 2	102 8 Dec 64	118 7 Jan 65	5.3.2.4.1
60C20340	Fuel prevalve, engine 2	118 26 Jun 65	133 26 Jun 65	5.3.2.4.2
60C20340	Fuel prevalve, engine 3	111 31 Dec 64	112 7 Jan 65	5.3.2.5.2
60C20340	Fuel prevalve, engine 6	103 31 Dec 64	116 7 Jan 65	5.3.2.7.1
60C20340	Fuel prevalve, engine 6	116 21 Jan 65	110 21 Jan 65	5.3.2.7.2
60C20340	Fuel prevalve, engine 7	105 8 Dec 64	114 9 Jan 65	5.3.2.8
60C20340	Fuel prevalve, engine 8	108 8 Dec 64	113 11 Jan 65	5.3.2.9
60C20417	Rocket engine, position 7	H-4046 27 Apr 65	H-4052 3 May 65	4.3.2.1

Table 1-7. Component Replacement Record (continued)

Part Number	Name	Serial Number & Date Removed	Serial Number & Date Installed	Paragraph Reference
60C20452	Pressure switch, GN_2	25251 15 Jun 65	25270 16 Jun 65	5.3.2.1
60C40056A	Power supply	02 30 Jun 65	04 2 Jul 65	5.3.3.51
60C50066-1	Accelerometer (E508-2)	11651F 12 Jan 65	11657F 19 Jan 65	5.3.3.24
60C50066-1	Accelerometer (E508-2)	11657F 6 Jun 65	12525F 14 Jul 65	5.3.3.25
60C20875-1	Flex hose	44B5842 Unknown	Not Recorded	4.3.2.6
60C50066-1	Accelerometer (E509-9)	11662F 3 Jul 65	12098F 14 Jul 65	5.3.3.26
60C50066-1	Accelerometer (E510-9)	11663F 3 Jul 65	12091F 14 Jul 65	5.3.3.27
60C50079-1	PCM/DDAS assembly	003 3 Jul 65	005 3 Jul 65	5.3.3.47
60C60001	Servo actuator assy	302 19 Feb 65	306 19 Feb 65	4.3.2.10
60C60001	Servo actuator assy	303 7 Jun 65	342 8 Jun 65	4.3.2.13
60C60001	Servo actuator assy	305 19 Feb 65	309 19 Feb 65	4.3.2.10
60C60001	Servo actuator assy	304 7 Jun 65	343 8 Jun 65	4.3.2.13

1.2.7 MISCELLANEOUS DATA.

1.2.7.1 Items Requiring Retest at KSC. The components listed in table 1-8 were reworked or replaced after completion of poststatic checkout. Prelaunch checkout verification is required on these components and/or their stage subsystems (reference DMN M08864 and DMN M08865).

Table 1-8. Items Requiring Retest at KSC

Part Number Serial Number	Name	Remarks
10C11357-1 NSN	Tube assembly, engine 1	Retorqued
20C00500 64B5021	Flex hose assembly	Reworked and reinstalled
20C00500 64B5022	Flex hose assembly	Reworked and reinstalled
20C00524	Flex hose assembly, engine 2	Retorqued
50C01184 C0039	Measuring rack, fuel bay 1	Removed to incorporate modification
50C01184 C0041	Measuring rack, fuel bay 2	Removed to incorporate modification
50C10099-1 RA-0823	Temperature gauge (C61-1)	Replaced
50C10105 227	Accelerometer (E33-3)	Replaced
50C10338 1029	Tape recorder	Replaced
50C10340 RA-647	Temperature gauge (C9-6)	Replaced

Table 1-8. Items Requiring Retest at KSC (continued)

Part Number Serial Number	Name	Remarks
50C10394 1522	DC amplifier (C78-8)	Recalibrated
50C10413	Temperature gauge (C89-3)	
50C12088-5 001	Multiplexer	Removed for incorporation of modification
60C04027-1 NSN	Tube assembly, engine 2	Replaced
60C10199-1 NSN	Tube assembly	Installed
60C10259-1 NSN	Tube assembly	Replaced
60C10261-1 NSN	Tube assembly, fuel bay 1	Replaced
60C10561-1 NSN	Tube assembly	Retorqued
60C10566-1 NSN	Tube assembly	Replaced
60C10579-1 NSN	Tube assembly	Replaced
60C10573-1 NSN	Tube assembly	Replaced
60C10580-1 NSN	Tube assembly, center lox fwd	Retorqued
60C10640-1 NSN	Tube assembly, engine 8	Retorqued

Table 1-8. Items Requiring Retest at KSC (continued)

Part Number Serial Number	Name	Remarks
60C10646-1 NSN	Tube assembly, fuel 4 sphere	Reinstalled and retorqued
60C10946-1 NSN	Tube assembly	Removed and reinstalled
60C10949-1 NSN	Tube assembly	Removed and reinstalled
60C11045-1 NSN	Tube assembly	Replaced
60C11046-1 NSN	Tube assembly	Removed and reinstalled
60C11047-1 NSN	Tube assembly	Removed and reinstalled
60C11480-1 NSN	Tube assembly	Retorqued
60C11482-1 NSN	Tube assembly	Removed and reinstalled
60C11483-1 NSN	Tube assembly	Removed and reinstalled
60C11484-1 NSN	Tube assembly	Replaced
60C11486-1 NSN	Tube assembly	Replaced
60C11489-1 NSN	Tube assembly	Replaced
60C40190 C0001	Main distributor 12A1	Removed for incorporation of modification

Table 1-8. Items Requiring Retest at KSC (continued)

Part Number Serial Number	Name	Remarks
60C50079-1 005	PCM/DDAS assembly	Reworked
60C50081-7 001	Multiplexer assembly 13A484	Reworked
60C50087-1 001	Multiplexer assembly 13A450	Reworked
60C50087-3 001	Multiplexer assembly 13A492	Reworked
501924 6331162	Heater cable assembly, engine 7	Replaced
502317 NSN	Cable assembly, engine 1	Replaced
NA5-28151	Gearcase pressurizing check valves, engines 1 through 8	

1.2.7.2 Uncorrected Discrepancies. At static test operations, the clearances in the areas of engines 3, 4, and 7 were found to deviate from specified requirements due to tolerance buildup in the tail section of stage S-IB-1. CCSD design engineering has requested that clearance checks be made at KSC with the stage in the vertical position. Following review of deviations on stage S-IB-1 and on several previous stages, CCSD design engineering then will issue corrective action and rework instructions if necessary (reference DMN H30257).

SECTION II

ASSEMBLY AND MODIFICATION

2.1 SCOPE.

This section comprises data covering installation of major assemblies, subassemblies, and components into the S-IB stage. The data in this section is arranged according to the actual operational sequence performed during assembly. Also included is data pertaining to incorporation of modifications.

2.2 CLUSTERING.

2.2.1 SEQUENCE OF OPERATIONS.

The clustering sequence for the propellant container assembly 60C10003 (figure 2-1) is listed in table 2-1 with the date each major clustering operation was completed.

Table 2-1. Clustering Sequence

Date Completed	Operation
22 June 1964	Position tail unit assembly 60C10013-1 in main assembly cluster fixture.
22 June 1964	Attach 105-inch lox container 60C10014-1 to tail unit assembly 60C10013-1.
8 July 1964	Attach spider beam assembly 60C10015-1 to 105-inch lox container 60C10014-1.
9 July 1964	Completion of final tie-in between 105-inch lox container 60C10014-1 and tail unit assembly 60C10013-1. Installation of lox density and prevalve control lines. This operation completes container assembly 60C10004-1.

Table 2-1. Clustering Sequence (continued)

Date Completed	Operation
9 July 1965	Install No. 3 lox container 60C10007-1 into container assembly 60C10004-1.
10 July 1964	Install No. 1 lox container 60C10005-1 into container assembly 60C10004-1.
10 July 1964	Install No. 4 lox container 60C10008-1 into container assembly 60C10004-1.
14 July 1964	Install No. 2 lox container 60C10006-1 into container assembly 60C10004-1.
16 July 1964	Install No. 3 fuel container 60C10011-1 into container assembly 60C10004-1.
16 July 1964	Install No. 1 fuel container 60C10009-1 into container assembly 60C10004-1.
16 July 1964	Install No. 2 fuel container 60C10010-1 into container assembly 60C10004-1.
24 July 1964	Install No. 4 fuel container 60C10012-1 into container assembly 60C10004-1.

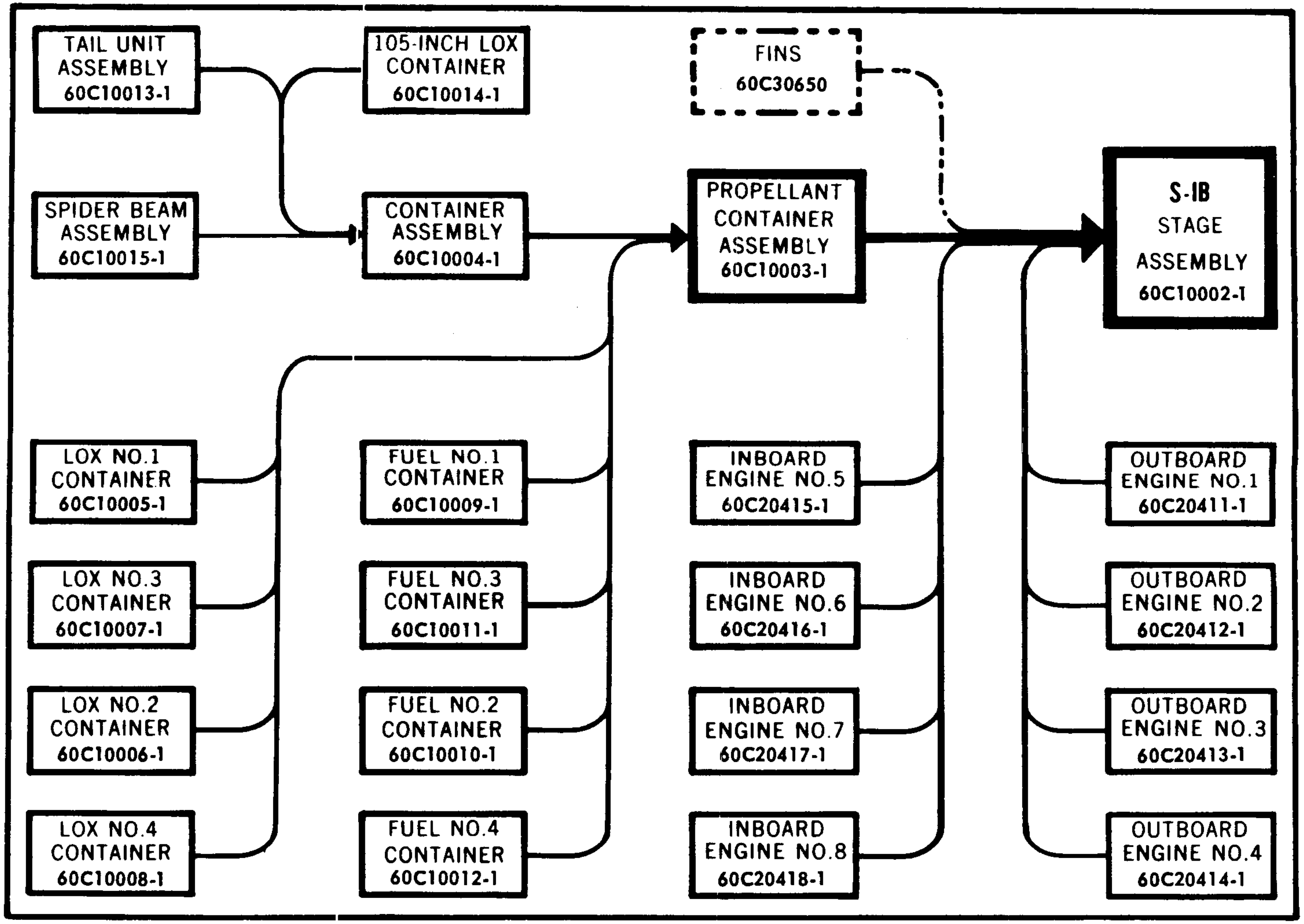

Figure 2-1. Assembly Sequence Flow Diagram

2.2.2 MODIFICATIONS:

Modifications that were applicable to the clustering operation consisted of the incorporation of the following engineering orders (EO's) and engineering change proposals (ECP's):

20A-30C05500	28-60C10003-1
22-30C05500	ET10115-1-60C10003-1
23-30C05500	ET10193-1-60C10003-1
25-30C05500	1-60C10004-1
26-30C05500	3-60C10004-1
28-30C05500	4-60C10004-1
29-30C05500	8-60C10004-1
30-30C05500	11-60C10004-1
EP30173-1-30C05500	12-60C10004-1
ET60047-1-30C05500	15-60C10004-1
ET60081-1-30C05500	18-60C10004-1
39-60C10002-1	ET60035-1-60C10016-1
50-60C10002-1	4-60C50070
12-60C10003-1	4-60C50070-3

2.3 TAIL AREA INSTALLATION, PHASE I.

2.3.1 COMPONENTS INSTALLED.

Components installed in the tail area during phase I were the lox and fuel prevalves, lox and fuel interconnect lines, pneumatic tubing, lox replenishing and high pressure sphere tubing, nitrogen purge and water quench tubing, and the torque boxes were filled with polyurethane foam at this time.

2.3.2 MODIFICATIONS.

Modifications that were applicable to tail area installation, phase I, consisted of the incorporation of the following EO's and ECP's:

11-60C10003-1	30-60C10003-1
24-60C10003-1	ET10204-1-60C10003-1
29-60C10003-1	ET60043-1-60C10003-1

2.4 UPPER TANK AREA INSTALLATION, PHASE I.

2.4.1 COMPONENTS INSTALLED.

Components installed in the upper tank area during phase I were the instrument compartment cooling ducts, gox interconnect lines, gox vent and relief lines, fuel pressurizing manifold and fuel vent lines, and the flight and measuring tube assemblies.

2.4.2 MODIFICATIONS.

Modifications that were applicable to upper tail area installation, phase I, consisted of the incorporation of the following EO's and ECP's:

6-20C00016	31-60C10003-1
10-20C00050	36-60C10003-1
10-20C30122-1	39-60C10003-1
4-60C10003-1	41-60C10003-1
16-60C10003-1	ET10180-3-60C10003-1
22-60C10003-1	M2130-5-60C10003-1

2.5 INSTRUMENT COMPARTMENT INSTALLATION.

2.5.1 COMPONENTS INSTALLED, UNIT 13.

Components installed in unit 13 were the mounting brackets for flight components, the unit-13 electrical cables and harnesses, telemeters and associated components, tape recorder, and destruct system components.

2.5.2 COMPONENTS INSTALLED, UNIT 12.

Components installed in unit 12 were the mounting brackets for flight components, the unit-12 electrical cables and harnesses, and the measuring rack modules.

2.5.3 MODIFICATIONS.

Modifications that were applicable to instrument compartment installation consisted of the incorporation of the following EO's and ECP's:

UNIT 13

A11740-1-50C01927-1
ET50263-17-50C01927-1
1-50C01930-1
ET50263-8-50C01937-1
ET50263-12-50C01939-1
ET50263-18-50C01946-1
ET50263-14-50C01947-1
ET50263-11-50C01950-1
ET50263-13-50C01957-1
ET50263-9-50C-1959-1
ET50312-1-50C01959-1
ET50263-11-50C01961-1
ET50263-29-50C03280-1
ET50263-29-50C03282-1
ET50263-30-50C03283-1
ET50263-28-50C03290-1
ET50263-26-50C03291-1
ET50263-27-50C03292-1
1-50C03349-1
A11740-1-50C10421-1
3-50C10680-1
ET50263-31-50C10680-1
ET50263-6-50C11102-1
ET50317-1-50C11102-2
ET50317-1-50C11103-1
ET50263-5-50C11104-1
ET50263-5-50C11105-1
ET50263-2-50C11106-1
ET50263-16-50C11108-1
ET50263-4-50C11111-1
ET50263-1-50C12192-3
ET50263-1-50C12192-5
ET50263-1-50C12192-7
1-50C12196-5
ET50304-1-50C12196-5
1-50C12196-7
ET50304-1-50C12196-7
1-50C12196-9
ET50304-1-50C12196-9
40-60C10016-1
2-60C10229-1
4-60C10229-1
6-60C10229-1
11-60C10229-1
17-60C10229-1
ET10260-2-60C10229-1
1-60C10233-1
3-60C10233-1
5-60C10233-1
6-60C10233-1
10-60C10233-1
13-60C10233-1
14-60C10233-1
18-60C10233-1
19-60C10233-1
24-60C10233-1
5-60C10356
4-60C40246
5-60C40246
2-60C50081-7
1-60C50087-1
1-60C50088-1
ET50263-24-210414
ET50612-3-210414
ET50263-24-210415
ET50612-3-210415
ET50263-25-210416
ET50263-19-210417

UNIT 13 (continued)

ET50263-25-210418
ET50263-20-510369
ET50612-1-310369
ET50263-22-310413
ET50486-3-310586
ET50486-1-410446
ET50486-11-510052
ET50486-2-510105-1
ET50263-21-710017-15
ET50612-2-710018
ET50263-32-CH200171
ET50263-33-CH200172
ET50263-35-CH300158-3
ET50263-34-CH400398

UNIT 12

1-50C01188
1-50C01189
1-50C01190
2-50C01407
2-50C01411
2-50C01412
4-50C01414
64-60C10002-1
1A-60C10228-1
4-60C10228-1
8-60C10228-1
14-60C10228-1
8-60C10229-1
6-60C10234-1
9-60C10234-1
12-60C10234-1
13-60C10234-1
14-60C10234-1
15-60C10234-1
18-60C10234-1
20-60C10234-1
21-60C10234-1
5-60C10354
7-60C10354
8-60C10354
5-60C40190-1
13-60C40208
15-60C40208
16-60C40208
17-60C40208
18-60C40208
21-60C40208
7-60C40209
8-60C40209
15-60C40210
16-60C40210
8-60C40245
11-60C40245
1-60C40285
1-60C50052-5
4-60C50052-5
ET50125-1-60C50052-5
2-60C50053-3
ET50125-1-60C50053-3
4-60C50054-3
5-60C50054-3
ET50115-1-60C50054-3
ET50125-1-60C50054-3
ET50213-2-60C50054-3
ET50125-1-60C50055-5
ET50125-1-60C50056-5
ET50125-1-60C50077

2.6 INBOARD ENGINE INSTALLATION.

2.6.1 COMPONENTS INSTALLED.

2.6.1.1 Inboard engines were temporarily installed on stage S-IB-1 in order to facilitate installation of the fuel and lox wraparound lines. The engines were then removed and shipped to the Rocketdyne facility at Neosho, Missouri for lox dome retrofit modification (para 2.6.2.1).

2.6.1.2 Installation of each of the inboard engines was accomplished without incident on the dates indicated in the following list.

a. Engine 60C20415, serial number H-4044 at position 5 on February 12, 1965.

b. Engine 60C20416, serial number H-4045 at position 6 on February 15, 1965.

c. Engine 60C20417, serial number H-4046 at position 7 on February 15, 1965. An internal thrust-chamber tube leak during static testing prompted replacement of engine 7 upon return to CCSD-Michoud (refer to paragraph 6.6.2.18) with serial number H-4052.

d. Engine 60C20418, serial number H-4047 at position 8 on February 15, 1965.

2.6.2 MODIFICATIONS.

2.6.2.1 Lox Dome Retrofit Modification. Information compiled on earlier S-1 stages and rocket engines revealed that the lox dome on H-1 engines displayed a tendency to develop stress corrosion with possible cracking. The modification consisted of replacing the 205182 lox dome assemblies with new 207152 lox dome assemblies made from a forging of 7075-T73 aluminum. The engines were test fired by Rocketdyne at Neosho, then returned to CCSD-Michoud for reinstallation on stage S-IB-1.

2.6.2.2 Other Modifications. Modifications that were applicable to inboard engine installation consisted of the incorporation of the following EO's and ECP's:

28-60C10002-1	42-60C10003-1
43-60C10002-1	21-60C10016-1
EP10101-60C10002-1	15-60C10225-1
ET10094-1-60C10002-1	7-60C20417-1

2.7 TAIL AREA INSTALLATION, PHASE II.

2.7.1 COMPONENTS INSTALLED.

Components installed in the tail area during phase II were the inboard-engine turbine exhaust ducts and heat exchangers, electrical equipment and measurement components, inboard-engine gox line assemblies, heat exchanger lox supply lines, inboard-engine purge, fuel and lox bubbling lines, and the tail area (area 9) electrical cables.

2.7.2 MODIFICATIONS.

Modifications that were applicable to tail area installation, phase II consisted of the incorporation of the following EO's and ECP's:

22-60C10002-1	ET10094-1-60C10002-1
25-60C10002-1	ET10191-1-60C10002-1
26-60C10002-1	ET10268-1-60C10013
27-60C10002-1	10-60C10016-1
37-60C10002-1	21-60C10016-1
38-60C10002-1	ET10233-1-60C10016
44-60C10002-1	8-60C10225-1
46-60C10002-1	3-60C10597-1
51-60C10002-1	ET10233-1-60C10597-1
52-60C10002-1	1-60C11101-1
58-60C10002-1	2-60C11257
62-60C10002-1	1-60C11326-1
72-60C10002-1	2-60C11326-1
80-60C10002-1	3-60C11326-1
83-60C10002-1	18-60C40240

2.8 OUTBOARD ENGINE INSTALLATION.

2.8.1 COMPONENTS INSTALLED.

2.8.1.1 Outboard engines were temporarily installed on stage S-IB-1 in order to facilitate installation of the fuel and lox wraparound lines. The engines were then removed and shipped to the Rocketdyne facility at Neosho, Missouri for lox dome retrofit modification (para 2.8.2.1).

2.8.1.2 Installation of each of the outboard engines was accomplished without incident on the dates indicated in the following list.

a. Engine 60C20411, serial number H-7046 at position 1 on February 8, 1965.

b. Engine 60C20412, serial number H-7047 at position 2 on February 10, 1965.

c. Engine 60C20413, serial number H-7048 at position 3 on February 9, 1965.

d. Engine 60C20414, serial number H-7049 at position 4 on February 10, 1965.

2.8.2 MODIFICATIONS.

2.8.2.1 Lox Dome Retrofit Modification. Information compiled on earlier S-1 stages and rocket engines revealed that the lox dome on H-1 engines displayed a tendency to develop stress corrosion with possible cracking. The modification consisted of replacing the 205182 lox dome assemblies with new 207152 lox dome assemblies made from a forging of 7075-T73 aluminum. The engines were test fired by Rocketdyne at Neosho, then returned to CCSD-Michoud for reinstallation on stage S-IB-1.

2.8.2.2 Other Modifications. Modifications that were applicable to outboard engine installation consisted of the incorporation of the following EO's:

28-60C10002-1	42-60C10003-1
57-60C10002-1	21-60C10016-1
20-60C10003-1	15-60C10225-1

2.9 UPPER TANK AREA INSTALLATION, PHASE II.

2.9.1 COMPONENTS INSTALLED.

Components installed in the upper tank area during phase II were the eight antenna panels and cable assemblies (the antennas are not installed for static test shipment configuration), static test tubing, flight electrical equipment in area 11, strain gages on the spider beam, and area-11 electrical cables and harnesses.

2.9.2 MODIFICATIONS.

Modifications that were applicable to the upper tail area installation, phase II consisted of the incorporation of the following EO's and ECP's:

14-10C10844-1	17-60C10002-1
14-10C10844-3	42-60C10002-1
14-10C10844-5	ET10196-2-60C10002-1
14-10C10844-7	9-60C10015-1
10-10C10849-1	10-60C10015-1
A11721-1-50C10399	11-60C10015-1

(continued from page 2-10)

3-60C10016-1
4-60C10016-1
6-60C10016-1
9-60C10016-1
17-60C10016-1
20-60C10016-1
22-60C10016-1
27-60C10016-1
32-60C10016-1
40-60C10016-1
ET10223-1-60C10016-1
1-60C10227-1
2-60C10227-1
3-60C10227-1
4-60C10227-1
5-60C10227-1
7-60C10227-1
8-60C10227-1
9-60C10227-1
10-60C10227-1
14-60C10227-1
15-60C10227-1
16-60C10227-1
17-60C10227-1
19-60C10227-1
20-60C10227-1
22-60C10227-1
23-60C10227-1
24-60C10227-1
26-60C10227-1
21-60C10227-7
3-60C10351
4-60C10352
5-60C10352
8-60C10352
9-60C10352
13-60C10352
14-60C10352
15-60C10352
1-60C10846-1
3-60C10846-1
2-60C11043-1
3-60C11043-1
7-60C40244
10-60C40244
5-60C40284
2-60C50069-1
2-60C50069-3

2.10 TAIL AREA INSTALLATION, PHASE III.

2.10.1 COMPONENTS INSTALLED.

Components installed in the tail area during phase III were the engine rough-combustion monitor, outboard-engine gox lines, nitrogen purge systems to outboard engines, electrical cables to the engines, inboard engine flexible flame curtains, electrical flight distributors, and the measuring rack modules.

2.10.2 MODIFICATIONS.

Modifications that were applicable to tail area installation, phase III consisted of the incorporation of the following EO's and ECP's:

EP60154-1-50C10388-25
EP60154-1-50C10388-27
ET60154-1-50C10388-29
EP60154-1-50C10388-59
21-60C10002-1
24-60C10002-1
32-60C10002-1
41-60C10002-1
33-60C10003-1
16-60C10004-1
18-60C10004-1
20-60C10004-1
21-60C10004-1
22-60C10009-1
23-60C10009-1
ET10269-1-60C10009-1
8-60C10015
10-60C10016-1
30-60C10016-1
35-60C10016-1
7-60C10225-1
8-60C10225-1
10-60C10225-1
14-60C10225-1
15-60C10225-1
ET10148-1-60C10225-1
18-60C10227-1
6-60C10306
7-60C10306
8-60C10306
9-60C10306
1-60C10645-1
2-60C11084-1
3-60C11084-1
3-60C40203
5-60C40203
9-60C40206
10-60C40207
11-60C40207
7-60C41054-1
64-60C50005
66-60C50005
2-60C50034-5
3-60C50034-5
ET50110-1-60C50034-5
1-60C50035-5
2-60C50035-5
1-60C50038-5
2-60C50038-5
1-60C50040-5
3-60C50040-5
1-60C50043-1
2-60C50043-1
3-60C50043-5
2-60C50044-5
3-60C50044-5
ET-50132-1-60C50044-5
1-60C50045-5
2-60C50045-5
1-60C50046-5
2-60C50046-5
1-60C50047-5
2-60C50047-5
2-60C50048-5
3-60C50048-5
ET50110-1-60C50048-5
1-60C50049-5
2-60C50049-5
1-60C50050-3
2-60C50050-3
3-60C50050-3

2.11 PREPARATION FOR SHIPMENT TO MSFC.

Preparing stage assembly S-IB-1 for shipment to MSFC-Huntsville consisted of the following operations:

a. Cleaning the entire stage and painting where necessary.

b. Installing components for environmental protection.

c. Installing erection hardware.

d. Installing shipping and barge instrumentation.

e. Installing components for road-shipment preservation.

Upon completion of the above operations stage S-IB-1 was moved from the preparation-for-shipment area in the Michoud Assembly Facility (MAF) to the exit door. At this point the transportation branch of the CCSD Systems Test Department assumed responsibility for the stage and transported the stage to the barge for loading. The stage was loaded on the barge and shipped to MSFC-Huntsville on 6 March 1965.

2.11.1 CLEANING AND PAINTING.

2.11.1.1 Cleaning. Functions performed for cleaning the S-IB-1 stage after functional checkout and before shipment consisted of thoroughly cleaning and vacuuming the instrument compartments, top tank area, and all tail section compartments. Removal of loose particles and dirt from corners and recesses was accomplished by multiple rotations of the stage. These rotations were coordinated with all cleaning operations in order to reduce the possibility of damage to the stage through movement. The exterior surfaces of the stage were cleaned using a non-ionic detergent, and all areas that required paint touchup were noted at this time.

2.11.1.2 Painting. Touchup of all interior compartments of the stage was accomplished by replacing zinc-chromate at worn areas as required. Areas that were noted during the cleaning of the exterior surfaces of the stage as needing paint touchup were touched up at this time. Due to the amount of personnel in and around the stage during prestatic checkout, painting of the tail section was not performed until just prior to shipment. The tail section was masked off and spray painted with enamel paint as specified by paint pattern drawing 60C10349, and then air dried. Adhesive marks left from the masking tape were removed after painting.

2.11.2 COMPONENTS INSTALLED.

2.11.2.1 Installation of Environmental Protection.

2.11.2.1.1 Environmental protection of stage S-IB-1 was provided in accordance with MSFC specification 10419900. The requirements of this specification are not considered a primary part of this operation unless directly related to preparation for shipment.

2.11.2.1.2 Desiccant was replaced whenever the humidity indicators indicated a relative humidity of 40 percent or higher. The protective shrouds for flexible ducting bellows at sliding and gimbal joints were removed and the joints were thoroughly cleaned and checked to assure that all foreign materials were removed from the bellows convolutions. After cleaning, the shrouds were replaced and closed with tape. The vent openings in all tanks were closed with vapor barrier material conforming to specification MIL-B-131 and secured with tape. Static test cover 60C10193-1 was installed over the barrel opening in the firewall. The cover was prefitted in an earlier assembly operation and was installed per drawing 60C10016. Protective plugs or caps were installed on all unmated plugs, connectors, unions, and hoses. Remaining environmental protection items were installed as specified on drawing 60C10097.

2.11.2.2 <u>Installation of Erection Hardware</u>. After installation of environmental protection items, the hardware that is necessary for erection of the stage in the static test stand was installed. This was accomplished as shown on drawing 60C10704.

2.11.2.3 Shipping and Barge Instrumentation. This operation consisted of the installation of meters, temperature sensors, humidity sensors, and a special instrument cover (30C00067-1) on lox tank 3. This cover contains temperature and humidity sensors. Constant monitoring of vehicle environmental conditions during shipment is the primary purpose of the shipping and barge instrumentation.

2.11.2.4 Road-Shipment Preservation. Road-shipment preservation primarily consisted of the installation of the barge polyethylene covers that shroud the entire stage. All sharp projections, corners, and objects that could cause damage to the cover during installation or removal were padded. Immediately prior to shipment of the stage, all desiccant-retainer compartments were recharged with activated silica-gel and desiccant-retainers were installed in the forward and aft ends of the stage. The sequence of installation was planned so as to avoid prolonged exposure of silica-gel desiccant units.

2.11.3 MODIFICATIONS.

Modifications that were applicable to preparation for shipment to static test consisted of the incorporation of the following EO's:

4-60C00206-1	2-60C11143-1
5-60C00206-1	3-60C---43-1
49-60C10016-1	4-60C11143-1
1-60C10349	5-60C11143-1
1-60C10698	6-60C11143-1
4-60C11137-1	7-60C11143-1

2.12 POSTSTATIC ALTERATIONS.

2.12.1 CONVERSION TO FLIGHT CONFIGURATION.

Following static test operations, stage S-IB-1 was converted from static test configuration (60C10016) to flight configuration (60C10002). All nonflight static test components were removed from the stage, and flight components not installed for static test were installed.

2.12.2 MODIFICATIONS.

Modifications that were applicable to poststatic alterations consisted of the incorporation of the following EO's:

3-10C11441-1	57-60C10016-1
2-20C85061	4-60C11084-1
1-50C10402-1	7-60C20411-1
1-50C10403-1	9-60C20412-1
1-50C10404-1	7-60C20413-1
1-60C10001-1	9-60C20414-1
73-60C10002-1	4-60C20415-1
76-60C10002-1	5-60C20416-1
84-60C10002-1	4-60C20417-1
85-60C10002-1	4-60C20418-1
88-60C10002-1	8-60C20423-1
31-60C10013-1	6-60C20425-1

2.13 PREPARATION FOR SHIPMENT TO KSC.

Preparation for shipment operations to KSC essentially were the same as preparation for shipment operations for shipment to MSFC-Huntsville (refer to paragraph 2.11). After preparation for shipment operations were completed, stage S-IB-1 was moved to the Michoud plant exit door. CCSD Systems Test Department, transportation branch, assumed control and responsibility at this point and transported the stage to the barge for loading. The stage was loaded on the barge and shipped to Kennedy Space Center on 9 August 1965.

2.13.1 COMPONENTS INSTALLED.

Components installed on stage S-IB-1 during preparation for shipment to KSC consisted of the remaining flight items not installed during poststatic alterations, and nonflight items used in preparing the stage for shipment.

2.13.1.1 Flight Items. In order to facilitate final checkout operations and subsequent inspections, certain flight items were not installed until the stage was near completion. These items were the outboard engine flame curtains, engine heat shield assemblies (installed by Rocketdyne personnel), turbine exhaust fairing assemblies, instrument compartment door assemblies, seal plate assemblies above the spider beam, and the heat shield panels.

2.13.1.2 Nonflight Items. Numerous nonflight items such as dust caps, breather assemblies, and protective covers were installed. These items were tagged with adhesive-backed and tie-on tags conforming to specification 10M1682 which indicates that all nonflight items be tagged to assure that none are overlooked prior to launch. The tags are brightly colored and are used as visual aids in locating all items that require removal before launch. The installation of erection hardware, environmental protection, shipping and barge instrumentation, and roadshipment preservation was the same as shipment to MSFC (refer to paragraph 2.11.2).

2.13.2 MODIFICATIONS.

Modifications that were applicable to preparation for shipment to KSC consisted of the incorporation of the following EO's:

15-30C00010-1
4-60C10001-1
2-60C11085-1

2.13.3 DETERMINATION OF WEIGHT AND LONGITUDINAL CENTER OF GRAVITY.

Determination of weight and longitudinal center of gravity of stage S-IB-1 was performed on 29 July 1965 and was directed and coordinated by the CCSD weight and balance control group.

2.13.3.1 Preparation for Weighing. For the weighing operation, stage S-IB-1 was moved from the preparation-for-shipment area into the weighing bay where the weighing equipment is located. All nonflight items were removed except those essential to the weighing operation or to the maintenance and handling of the stage. Flight items that were designated as ship-loose components were temporarily installed. With the stage in the proper configuration and aligned with the weighing equipment, the weighing operations were performed.

2.13.3.2 Weighing. Weighing was accomplished by suspending the S-IB stage from four load cells; two located on each side of the stage forward (station 954.8) and aft (station 118.8). The actual weight was obtained by inserting correction factors into the reading from each load cell and then adding the four corrected readings together. Prior to weighing the stage, the correction factors for each load cell were obtained by lifting calibrated masses; each having a weight approximating that placed on each load cell by the stage. The weighing operation normally is repeated three or more times and the results of all load cell readings are averaged to establish final weight. For actual weighing operation values, refer to the S-IB-1 Weight and Balance History Log listed on the reference documents page at the rear of this report.

2.13.3.3 Determination of Longitudinal Center of Gravity. Determination of longitudinal center of gravity occurred during the weighing operation using the method shown by the following steps:

a. With the stage in a horizontal plane, the readings from the four load cells (W_1, W_2, W_3, and W_4) were recorded and correction factors inserted.

b. The corrected readings from forward load cells W_1 and W_2 were added together. The addition was repeated for the corrected readings from aft load cells W_3 and W_4.

c. Since the reaction planes of opposing fore and aft load cells lie on the centerlines of the stage tooling rings at station 954.8 and station 118.8 (constants), the longitudinal center of gravity (CG) is obtained by summation of weights (W) and moments (M) as follows:

$$(W_1 + W_2)954.8 = M_1$$

$$(W_3 + W_4)118.8 = M_2$$

$$\frac{M_1 + M_2}{W_1 + W_2 + W_3 + W_4} = \text{(CG location in inches forward from the stage gimbal point)}$$

2.14 FINAL CONFIGURATION DATA.

2.14.1 DOCUMENTS DEFINING STAGE CONFIGURATION.

The documents listed in the following paragraphs were shipped with stage S-IB-1 to KSC and should be used to determine exact stage configuration.

2.14.1.1 Engineering Parts List, S-IB-1. The engineering parts list contains all part numbers and engineering orders applicable to stage S-IB-1 and is redlined to define the configuration of the stage at time of shipment to KSC.

2.14.1.2 List of Unincorporated Engineering Orders. This list contains all approved class-I engineering orders that were not fully incorporated into stage S-IB-1 at time of shipment to KSC and also lists any incorporated engineering orders requiring test or retest at KSC.

2.14.1.3 Red-Lined Drawings. Stage electrical schematics, wiring lists, and cable interconnection diagrams shipped with the stage are red-lined to reflect the actual stage configuration to show changes resulting from the incorporation of engineering orders.

2.14.1.4 Shipped-Loose List. Drawing 60C11819 defines the components that are not installed on stage S-IB-1 when shipped but are intentionally shipped-loose for installation at KSC.

2.14.1.5 MSFC Form 71. The primary shipping document is MSFC Form 71. This form may be consulted for lists of GFP items, shipped-loose items, uncorrected discrepancies, and other similar data.

2.14.1.6 List of Approved Deviations. This list comprises those items on stage S-IB-1 that do not conform to their applicable drawing or specification but are considered acceptable for use without further change or correction. The list is compiled from Defective Material Notices (DMN) and Functional Failure Analysis Data Sheets (FFADS) that have been submitted to a NASA/CCSD-staffed material review board (MRB) where an accept (use as is) or repair disposition was given. A copy of these DMN's and FFADS's is included with the deviation list.

2.14.2 MODIFICATIONS TO BE INCORPORATED AT KSC.

Modifications that are to be incorporated at Kennedy Space Center consist of the incorporation of the following EO's:

30-60C10009-1	4-60C30131-2
20-60C10010-1	4-60C30131-3
6-60C10219-1	4-60C50035-5
1-60C11819	5-60C50044-5

SECTION III

ALIGNMENT

3.1 SCOPE.

This section comprises an analysis of optical alignment data on engine rotational deflection tests, engine to stage alignment, installation and alignment of erection targets, stage assembly alignment, and installation and alignment of accelerometer and rate gyro brackets. All alignment was checked with respect to the basic stage centerline (H-G, figure 3-1) and fin plane references as defined on MSFC drawing 60C10017.

3.2 ENGINE ALIGNMENT DATA.

The engine alignment data contained in this section is comprised of data collected during CCSD engine alignment operations. Engine alignment data from North American Aviation (Rocketdyne) is located in the engine logbook supplied with each engine.

3.2.1 ENGINE ROTATIONAL DEFLECTION TESTS.

3.2.1.1 The engine rotational deflection tests consist of unlocking the hydraulic actuators on each outboard engine, axially rotating the stage assembly through 360 degrees while in a horizontal position, and recording the gimbal-joint deflection at intervals of 45 degrees. The maximum allowable gimbal-joint deflection is 15 degrees.

3.2.1.2 The engine rotational deflection tests on stage S-IB-1 were conducted and accepted on February 22, 1965. The maximum gimbal-joint deflection recorded on stage S-IB-1 was 11 degrees which occurred on the lox wraparound gimbal-joint, middle bellows, on engine 2 and on the lox wraparound gimbal-joint nearest the engine, on engine 1 when fin 1 was at 45 degrees counterclockwise (aft looking forward).

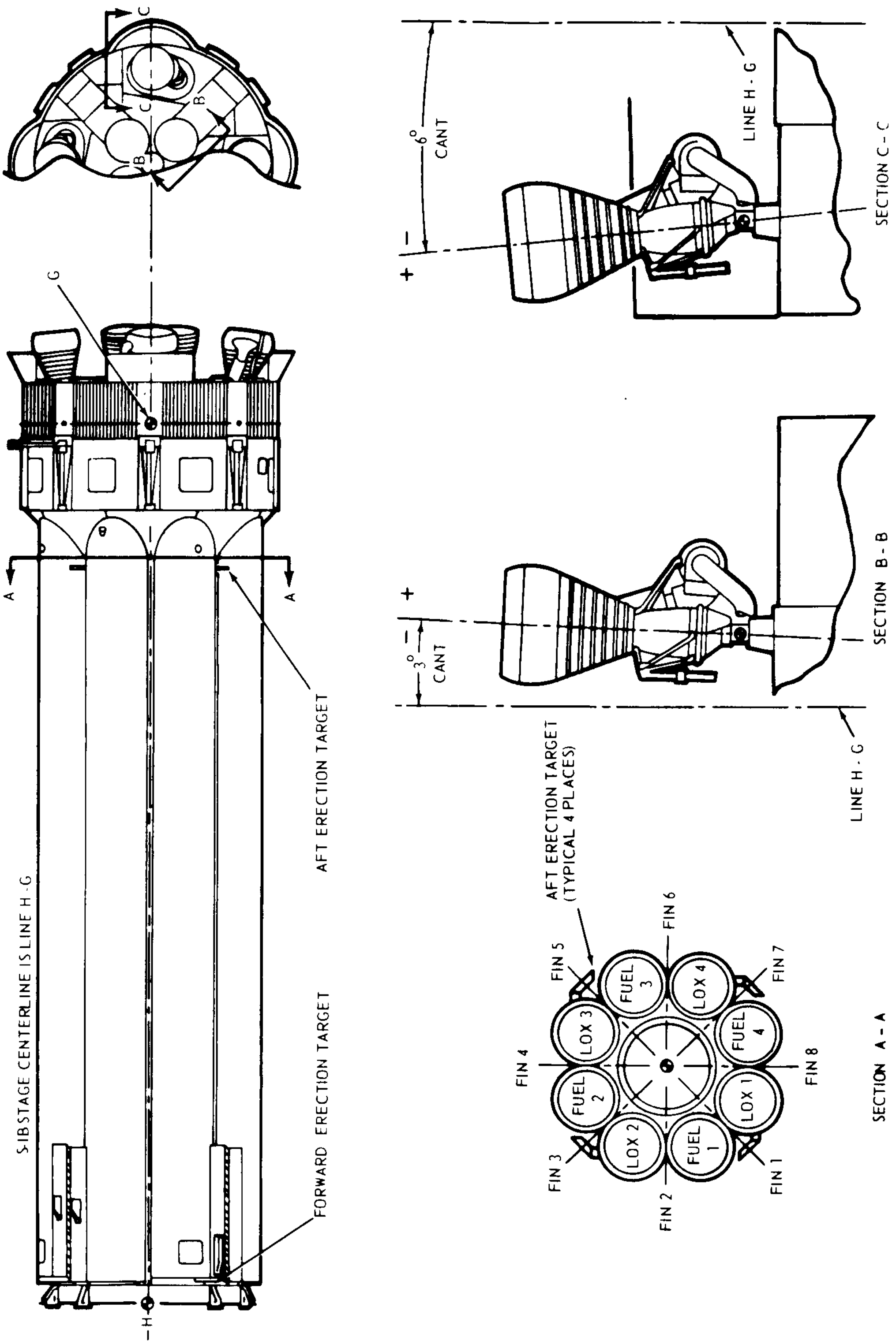

Figure 3-1. S-IB Stage Alignment Data

3.2.2 ENGINE ACTUATOR LENGTHS

The actuator lengths (dummy strut or turnbuckle lengths on inboard engines) were checked for conformance to specifications during receiving inspection of each engine and adjustments were made where required. Table 3-1 lists the actual measured actuator lengths in inches and locates each actuator position relative to the lox turbopump or fuel turbopump.

Table 3-1. Actuator and Turnbuckle Lengths

Engine		Actuator		Engine		Turnbuckle	
Pos.	Serial No	Lox	Fuel	Pos.	Serial No.	Lox	Fuel
1	H-7046	40.054	40.045	5	H-4044	32.832	32.586
2	H-7047	40.060	40.074	6	H-4045	32.826	32.567
3	H-7048	40.083	40.075	7	H-4052	32.817	32.543
4	H-7049	40.109	40.067	8	H-4047	32.792	32.536

3.2.3 GEOMETRIC THRUST VECTOR LOCATION.

3.2.3.1 During receiving inspection alignment checks on each engine, the geometric thrust vector location relative to the engine center line was determined. After installation of the engines onto the stage assembly the geometric thrust vector location relative to the stage center line was determined. After static test the engines were again checked to assure that the alignment remained within the specified tolerance. The geometric thrust vector is to be parallel to a fin plane and at an angle (cant angle) of 3 degrees for inboard engines or 6 degrees for outboard engines with the stage centerline (figure 3-1). Each alignment measurement was made in two positions; each being rotated 180 degrees from the other in order to remove the sag or cantilever effect which is the result of the stage being in a horizontal position. These two measurements were then calculated to determine the free-state position of the engines when the stage assumes a firing position. Table 3-2 provides data on the amount of deviation of the geometric thrust vector within a conical tolerance range of 30 minutes of the basic cant angle. A negative sign indicates a reading toward the centerline and a positive sign indicates a reading from the centerline. Prestatic data on engine 7 is not included in table 3-2 because engine 7 was replaced after static test (refer to paragraph 4.3.2.1).

Table 3-2. Geometric Thrust Vector Location

Engine Number	Serial Number	Deviation from Fin Plane	Deviation from Cant Angle	Resultant Deviation from Basic Cant Angle
1	H-7046	0' 28" Twd Fin 1	(6°) - 3' 02"	3' 05" (prestatic)
		1' 36" Twd Fin 4	(6°) - 2' 30"	2' 58" (poststatic)
2	H-7047	5' 35" Twd Fin 3	(6°) - 4' 19"	7' 03" (prestatic)
		6' 48" Twd Fin 2	(6°) - 1' 54"	7' 04" (poststatic)
3	H-7048	1' 44" Twd Fin 5	(6°) - 1' 48"	2' 30" (prestatic)
		2' 00" Twd Fin 4	(6°) - 3' 48"	4' 18" (poststatic)
4	H-7049	2' 57" Twd Fin 7	(6°) - 4' 15"	5' 10" (prestatic)
		5' 43" Twd Fin 6	(6°) - 6' 00"	8' 21" (poststatic)
5	H-4044	4' 07" Twd Fin 8	(3°) - 3' 14"	5' 14" (prestatic)
		0' 36" Twd Fin 7	(3°) - 1' 48"	1' 57" (poststatic)
6	H-4045	1' 56" Twd Fin 2	(3°) - 5' 01"	5' 22" (prestatic)
		3' 12" Twd Fin 5	(3°) - 1' 54"	3' 44" (poststatic)
7	H-4052	Not Applicable	Not Applicable	Not Applicable
		6' 48" Twd Fin 7	(3°) + 8' 18"	10' 47" (poststatic)
8	H-4047	6' 50" Twd Fin 6	(3°) + 3' 53"	5' 28" (prestatic)
		3' 24" Twd Fin 5	(3°) - 4' 12"	5' 24" (poststatic)

3.2.4 THRUST CHAMBER DIMENSIONS.

Engine thrust chamber measurements are taken after each engine test-firing to determine thrust chamber throat and exit areas and the amount of variation in thrust chamber diameter (roundness). The dimensions shown in table 3-3 were taken by CCSD after receipt of the engines (prior to lox dome retrofit penalty firing) and after completion of static test operations. Rocketdyne measurements that were made prior to delivery of the engines and following the lox dome retrofit penalty firing (prior to static test operations) are given in the engine logbook supplied with each engine. The CCSD thrust chamber exit area measurements were made 0.5 inches forward of the extreme exit of the chamber. Thrust chamber throat area measurements were made at the point of smallest thrust chamber diameter which is approximately 55 inches forward from the fuel return manifold.

Table 3-3. Engine Thrust Chamber Throat and Exit Dimensions

Engine		Chamber area (square inches)				Diameter Variation (inches)			
		Prestatic		Poststatic		Prestatic		Poststatic	
Pos.	Serial No.	Throat	Exit	Throat	Exit	Throat	Exit	Throat	Exit
1	H-7046	205.41	1625.54	204.90	1627.11	0.17	0.48	0.16	0.35
2	H-7047	201.41	1625.40	203.88	1626.54	0.06	0.33	0.06	0.35
3	H-7048	204.20	1627.70	204.29	1630.13	0.11	0.15	0.11	0.14
4	H-7049	204.24	1629.42	204.54	1631.18	0.14	0.27	0.14	0.19
5	H-4044	205.16	1630.28	204.52	1629.87	0.15	0.17	0.16	0.14
6	H-4045	204.19	1630.86	205.20	1630.92	0.18	0.17	0.18	0.37
7	H-4052	206.88	1630.98	204.94	1631.16	0.10	0.14	0.10	0.20
8	H-4047	204.55	1628.27	204.74	1628.06	0.12	0.10	0.13	0.22

3.3 ALIGNMENT OF ERECTION TARGETS.

In order to locate the aft targets on the fin lines, brackets were mounted that extend across fin lines 1, 3, 5, and 7 on each outer lox tank. The aft targets were then aligned to their respective fin lines as established by drawing 60C11084. Forward targets were installed and aligned on stage S-IB-1 during preparation for shipment to Kennedy Space Center. To align the forward targets, it was necessary to mount brackets on the spider beam that extend across fin lines 1, 3, 5, and 7. After the completion of alignment of the forward targets to the fin lines, it was found that interference existed between the target assemblies and the antenna panels, and considerable difficulty was encountered during disassembly of the forward targets. Erection target displacement data can be found in table 3-4.

Table 3-4. Erection Target Displacement

Forward Targets		Aft Targets	
Location	Displacement from Fin Line (inches)	Location	Displacement from Fin Line (inches)
Fin line 1	0.003 toward fin 3	On lox 1 Fin line 1	0.007 toward fin line 8
Fin line 3	0.003 toward fin 5	On lox 2 Fin line 3	0.000
Fin line 3	0.004 toward fin 3	On lox 3 Fin line 5	0.003 toward fin line 6
Fin line 7	0.007 toward fin 1	On lox 4 Fin line 7	0.003 toward fin line 8

3.4 STAGE ASSEMBLY ALIGNMENT DATA.

3.4.1 SPIDER BEAM ROLL DISPLACEMENT.

Spider beam roll displacement is defined as the amount of displacement of the spider beam in the stage roll plane relative to the position of the tail unit, and corresponds to the amount of twist of the stage pitch plane (fins 1-5) and yaw plane (fins 3-7). The basic method used to determine the amount of twist in the pitch and yaw planes was as follows:

a. The stage was rotated in a counterclockwise direction (aft looking forward) until fin 1 was down and fin plane 3-7 at the tail unit was level. No clockwise motion was allowed.

b. The displacement of spider beam fin-line targets 3 and 7 above or below fin plane 3-7 was measured and recorded. In table 3-5, a + displacement represents a displacement in a clockwise direction (aft looking forward).

c. Steps a. and b. were repeated placing fins 3, 5, and 7 down.

d. Then, the entire procedure was repeated (steps a., b., and c.) except that the stage was rotated in a clockwise direction.

Table 3-5. Spider Beam Roll Displacement

Fin Down	Counterclockwise		Clockwise	
	Fwd Target	Reading	Fwd Target	Reading
1	3	-0.028	3	-0.030
	7	-0.037	7	-0.047
3	1	-0.010	1	-0.023
	5	-0.020	5	-0.023

Table 3-5. Spider Beam Roll Displacement (continued)

Fin Down	Counterclockwise		Clockwise	
	Fwd Target	Reading	Fwd Target	Reading
5	3	-0.027	3	-0.037
	7	-0.038	7	-0.049
7	1	-0.007	1	-0.025
	5	-0.017	5	-0.065
	Sum	-0.164	Sum	-0.299
	Average	-0.021	Average	-0.037

The maximum allowable roll displacement of the spider beam, relative to the stage pitch and yaw planes established at the tail unit, is ±0.70 inch at 101.250 inches from the stage centerline.

3.4.2 SPIDER BEAM PLANER QUALITIES CHECK.

The spider beam assembly was checked to determine the perpendicularity to the stage centerline, and the planeness of the S-IV attach points. The results of these two alignments were found to be within the specified tolerance.

3.5 ALIGNMENT OF ACCELEROMETER AND RATE GYRO BRACKETS.

The alignment data for all accelerometer brackets and rate gyro brackets that required alignment on stage S-IB-1 is given in table 3-6. Accelerometer brackets and rate gyro brackets requiring alignment are designed so that the accelerometer or rate gyro may be removed or replaced without affecting alignment. During prestatic alignment operations, 1 rate gyro bracket and 14 accelerometer brackets were installed and aligned, and during poststatic alignment operations 2 accelerometer brackets were installed and aligned, these 2 accelerometers (11A75 and 11A76) are control accelerometers and have no measurement numbers.

Table 3-6. Accelerometer and Rate Gyro Bracket Alignment

Measurement Number	Drawing or EO Number	Pitch Alignment		Yaw Alignment		Roll Alignment	
		Tolerance	Actual	Tolerance	Actual	Tolerance	Actual
A7-12	3-60C10234	0° 30'	0' 00"	0° 30'	0' 17"	0° 30'	1' 27"
A53-11	5-60C10004	0° 30'	0' 17"	0° 30'	0' 55"	0° 30'	2' 59"
A54-11	5-60C10C04	0° 30'	0' 35"	0° 30'	0' 42"	0° 30'	0' 35"
E167-10	60C10014	11' 27"	0' 17"	N/A	N/A	N/A	N/A
E168-10	60C10014	N/A	N/A	11' 27"	0' 17"	N/A	N/A
E251-9 E252-9	60C10689	0° 30'	2' 51"	0° 30'	*	1° 00'	20' 00"
E506-8	60C10802	7' 37"	4' 00"	11' 27"	0' 08"	N/A	N/A
E504-11	60C10015	N/A	N/A	0° 15'	2' 33"	0° 15'	1' 08"
E505-11	60C10015	N/A	N/A	0° 15'	1' 25"	N/A	N/A
E226-11	60C10015	0° 15'	0' 15"	0° 15'	0' 34"	N/A	N/A
E227-11	60C10015	0° 15'	0' 51"	N/A	N/A	N/A	N/A
11A75	60C11463	0° 30'	00' 09"	0° 30'	09' 12"	0° 30'	01' 43"
11A76	60C11463	0° 30'	14' 30"	0° 30'	00' 30"	0° 30'	01' 20"

Table 3-6. Accelerometer and Rate Gyro Bracket Alignment (continued)

Measurement Number	Drawing or EO Number	Pitch Alignment		Yaw Alignment		Roll Alignment	
		Tolerance	Actual	Tolerance	Actual	Tolerance	Actual
R500-11 R501-11 R502-11	16-60C10004	0° 30'	0' 35"	0° 30'	4' 20"	0° 30'	0' 17"
**E507-3	60C10442	11' 27"	0' 26"	1' 27"	0' 40"	N/A	N/A
**E508-2	60C10442	11' 27"	1' 09"	11' 27"	0' 34"	N/A	N/A
**E509-9	60C10442	11' 27"	6' 51"	11' 27"	0' 34"	6' 18"	0' 52"
**E510-9	60C10442	11' 27"	1' 16"	6' 18"	4' 10"	11' 27"	0' 34"
**E511-11	5-60C10015	0° 15'	3' 00"	0° 15'	0' 34"	0° 15'	2' 20"
**E512-11	5-60C10015	0° 15'	4' 20"	0° 15'	0' 00"	0° 15'	6' 25"

NOTE:

*This dimension was found to be in tolerance, but the actual measurement was not recorded.

**Pitch alignment for these measurements is the plane passing thru fins 2 and 6. The yaw alignment is the plane passing thru fins 4 and 8.

SECTION IV

INSPECTION

4.1 SCOPE.

This section comprises data related to all inspections performed on stage S-IB-1 during the period beginning with clustering operations and ending with shipment to KSC with the exception of inspections occurring during functional checkout operations (section V) and static test operations (section VI).

4.2 INSPECTIONS PERFORMED.

4.2.1 INPROCESS INSPECTION.

Inprocess inspection is a continuous inspection performed by quality control inspectors on all phases of assembly and modification of S-IB stages to assure that quality levels are maintained and that all components, subassemblies, and assemblies conform to their applicable drawings and specifications. Significant discrepancies found by inprocess inspection during the assembly and modification operations described in section II of this report, are recorded in paragraph 4.2.

4.2.2 SHAKEDOWN INSPECTIONS.

Periodic inspections performed on the overall stage assembly at the completion of a major assembly or test operation are termed shakedown inspections. The process followed in the performance of a shakedown inspection involves a complete and detailed inspection of the stage by CCSD personnel; after which, the stage is presented to NASA quality control for their inspection. The majority of discrepancies found during shakedown inspections are relatively minor and are frequently corrected at the time of discovery. These minor discrepancies primarily are comprised of broken or missing identification tags, loose clamps on cables and tube assemblies, missing dust covers, incorrect type or size of hardware (standard parts), bent tubing, frayed cable coverings, and accumulations of dirt and trash. Significant discrepancies found during shakedown inspections are recorded in paragraph 4.2.

4.2.2.1 Final Assembly Shakedown Inspection. The final assembly shakedown inspection was performed at the end of stage buildup operations and comprised the first major shakedown inspection performed on stage S-IB-1. The final assembly shakedown inspection was performed to insure that all stage components and hardware were installed in conformance to applicable drawings and specifications before beginning prestatic checkout operations. During final assembly shakedown inspection, approximately 990 discrepancies were found and subsequently corrected.

4.2.2.2 Prestatic Shakedown Inspection. Immediately prior to static test operations, the second major shakedown inspection was performed on stage S-IB-1. During the preshipment inspection, approximately 575 discrepancies were recorded and subsequently corrected or otherwise resolved.

4.2.2.3 Poststatic Shakedown Inspection. At the completion of static test operations and before shipment of stage S-IB-1 to CCSD, a shakedown inspection was performed to locate discrepancies that occurred during static test operations. Approximately 310 discrepancies were found and subsequently corrected.

4.2.2.4 Precheckout Shakedown Inspection. After completion of poststatic alterations (para 2.12) and before moving stage S-IB-1 into the checkout test station, a major shakedown inspection was conducted by CCSD and NASA during which approximately 475 discrepancies were found. All of the discrepancies were subsequently corrected or otherwise resolved.

4.2.2.5 Final Shakedown Inspection. Immediately prior to shipment of stage S-IB-1 to KSC, the last major shakedown inspection of the overall stage assembly was performed. During this inspection, approximately 525 discrepancies were found and corrected or otherwise resolved. Refer to paragraph 1.2.7 for discrepancies requiring correction at KSC.

4.3 DISCREPANCIES FOUND DURING INSPECTION.

4.3.1 ELECTRICAL COMPONENTS.

Significant failures and discrepancies recorded on electrical components during inprocess and shakedown inspections, and significant failures and discrepancies recorded but not corrected at static test operations, are covered in the following paragraphs.

4.3.1.1 Engine Actuator Cables, Poststatic.

4.3.1.1.1 Upon return of stage S-IB-1 from static test, the engine actuator cables were x-rayed as a result of the kinked and broken wires found on the engine actuator cables of stages S-I-8 and S-I-10. No immediate action was taken since the x-rays exhibited no extensive bending, which would indicate that the wires had exceeded their yield point and therefore had been permanently deformed. After poststatic checkout, the subject cables again were x-rayed to determine if continuous actuation of the engines was causing wire deformation. The second set of x-rays revealed the following discrepancies:

a. Cable branch 1W6P2 had kinked wires (reference DMN M08872-A).

b. Cable branch 1W7P2 had broken strands of wire (reference item 1, DMN M08871-A).

c. Cable branch 1W7P3 had kinked wires (reference item 2, DMN M08871-A).

d. Cable branch 2W6P3 had kinked wires (reference DMN M13416-A).

e. Cable branch 2W7P2 had kinked wires (reference DMN M13415-A).

f. Cable branch 3W6P2 had kinked wires (reference item 1, DMN M13417-A).

g. Cable branch 3W6P3 had kinked wires (reference item 2, DMN M13417-A).

h. Cable branch 3W7P2 had kinked wires (reference DMN M13418).

i. Cable branch 4W6P3 had kinked wires (reference DMN M13420-A).

j. Cable branch 4W7P2 had internal strands separated (reference item 1, DMN M13419).

k. Cable branch 4W7P3 had kinked wires (reference item 2, DMN M13419).

4.3.1.1.2 All of the foregoing government furnished (GFE) cables were given a use-as-is disposition by NASA with the exception of cable 1W7 which was replaced by Rocketdyne.

4.3.1.2 <u>Cable 5W13, Poststatic</u>. During determination of weight and center of gravity operations, cable connector 5W13P2 was discovered to have the potting compound broken away from the connector shell and that the connector pins were exposed. The defective connector was removed and a new connector installed. Continuity and insulation resistance checks were performed before and after potting, and all values were within the specified limits (reference DMN M13474).

4.3.1.3 <u>Cable 9W17, Prestatic</u>. During phase II of tail area installation, insulation resistance between pins NN and PP on connector 9W17P1 was 85 megohms. The specified minimum is 200 megohms. Investigation into the cause of the discrepant condition disclosed that the volume resistivity of clear shrink-tubing is inadequate to assure 200 megohms between concentric shields. Material Review dispositioned this discrepancy use-as-is and an engineering change proposal (ET40209) was written to require the use of black instead of clear shrink-tubing on all 9W17 cables to be fabricated for use on S-IB-2 and subsequent stages. Black shrink-tubing has higher leakage resistance than clear shrink-tubing (reference DMN M06560).

4.3.1.4 <u>Cable 9W35, Poststatic</u>. During poststatic alterations it was noted that the nylon coating was scuffed near connector 9W35P2, but no damage to the primary insulation was noted. Repair consisted of cleaning the damaged area, applying two coats of vinylite cement then taping the damaged area with three wrappings of electrical tape using a 50 percent overlap (reference DMN M13459).

4.3.1.5 Cable 9W95, Prestatic. During phase II of tail area installation and while installing cable 9W95, the outer insulation on three wires was found to be cut at a point 0.50 inch above cable connector 9W95P6. No damage occurred to the primary (inner) insulation. Repair of cable 9W95 consisted of applying four coats of vinylite cement to the damaged area. Then, all three damaged wires were wrapped together with electrical tape using a 50 percent overlap (reference DMN M06390).

4.3.1.6 Cable 9W96, Poststatic. During preparation for shipment to KSC, inspection revealed a damaged wire 3.5 inches behind the potting boot of connector 9W96P3. The damage consisted of a cut that passed through the insulation and into the conductor severing three strands. Connector 9W96P3 was removed and replaced. Continuity and insulation resistance checks were performed, and all values were within the specified limits (reference DMN M08870).

4.3.1.7 Cable 9W120, Prestatic. During phase I of tail area installation, inspection revealed a scuffed PVC jacket on cable 9W120 and that the outer shield was exposed. No damage to the outer shield was noted. Repair of the damaged area consisted of applying four coats of vinylite cement and three wraps of electrical tape using a 50 percent overlap. Insulation resistance checks were performed and all values were within the specified limits (reference DMN M06382).

4.3.1.8 Cable 9W146, Prestatic. During phase II of tail area installation, cable 9W146 was found to have a short between pins B and K on connector P3. Pin K is the shield termination for the shielded twisted pair of wires between P1-1 and P3-A and between P1-2 and P3-B, as well as for all other shielded wires in cable 9W146. Repair consisted of removing and replacing connectors 9W146P1 and 9W146P3 and the shielded twisted pair of wires. Continuity and insulation resistance checks were performed before and after potting, and all values were within the specified limits (reference DMN M06562).

4.3.1.9 Cable 9W146, Poststatic. During preparation for shipment to KSC, the rubber insert on connector 9W146P2 was found punctured. The cause was due to improper connector mating (para 4.3.1.24). Repair consisted of replacing connector 9W146P2. Continuity and insulation resistance checks were performed and all values were within the specified limits (reference item 2, DMN M13458).

4.3.1.10 Cable 9W200, Poststatic. During static test operations, the outer shell at pin 4 of connector 9W200P2 was broken. After return to CCSD-M this discrepancy was corrected by replacing connector 9W200P2. Continuity and insulation resistance checks were performed and all values were within the specified limits (reference DMN M07555).

4.3.1.11 Cable 11W4, Poststatic. During poststatic alterations, inspection revealed that the shell of cable connector 11W4P1 was bent inward. Cable 11W4 was repaired by replacing the damaged connector. Continuity and insulation resistance checks then were performed and all values were within the specified limits (reference DMN M10586).

4.3.1.12 Cable 11W31, Prestatic.

4.3.1.12.1 During phase II of upper tank area installation and while routing cable branch 11W31P2 the outer insulation was found scuffed on three wires. The copper conductor was exposed on one wire with no damage to the copper conductor. Repair consisted of applying four coats of vinylite cement to the damaged area and three wraps of electrical tape using a 50 percent overlap. Material review requested this discrepancy be resubmitted after prestatic checkout.

4.3.1.12.2 After prestatic checkout cable 11W31 was resubmitted to material review. After reconsideration and re-evaluation of the criticality of this cable a supplement repair instruction was issued. Repair consisted of replacement of cable connectors 11W31J1 and 11W31P2 and the wire from 11W31P2-T to W31J1-17. This repair was accomplished after static test and before poststatic checkout. Continuity and insulation resistance checks were performed before and after potting and all values were within the specified limits (reference DMN M06389-A).

4.3.1.13 Cable 11W36, Prestatic. During phase II of upper tank area installation, it was noted that cable connector 11W36P3 was damaged. Subsequently, cable connector 11W36P3 was replaced; after which, continuity and insulation resistance checks were performed. All values were within the specified limits (reference DMN M06372-A).

4.3.1.14 Cable 11W36, Poststatic. During poststatic alterations while lockwiring cable connector 11W36P11, the strain relief lug and a portion of the connector shell were damaged. Connector 11W36P11 subsequently was replaced with a new connector. Continuity and insulation resistance checks were performed before and after potting, and all values were within the specified limits (reference DMN M13467).

4.3.1.15 Cable 11W72, Poststatic. During preparation for shipment to KSC and while performing inspection of cable 11W72 in the forward end of the center lox tank, it was noted that connector 11W72P2 would not connect to dual receptacle 10A629J1. A closer inspection revealed that connector 11W72P2 was damaged due to improper mating procedures. Defective connector 11W72P2 was replaced. Continuity and insulation resistance checks were performed and all values were within the specified limits (reference DMN M13469).

4.3.1.16 Cable 11W80, Prestatic. During phase I of tail area installation, it was noted that the PVC jacket of cable 11W80 was cut near connector 11W80P1 and that the shield was exposed. No damage to the shield strands was noted. Repair consisted of applying four coats of vinylite cement to the damaged area and three wraps of electrical tape using a 50 percent overlap. Insulation resistance checks were performed and all values were within the specified limits (reference DMN M06775).

4.3.1.17 Cable 11W80, Prestatic. During installation of components into the instrument compartments, inspection revealed that cable 11W80 had damaged insulation on one wire with no damage to shield strands located near connector 11W80P2. Repair consisted of applying four coats of vinylite cement to the damaged area, and three wraps of electrical tape using a 50 percent overlap. Insulation resistance checks were performed and all values were within the specified limits (reference DMN M06371).

4.3.1.18 Cable 11W83, Prestatic. During phase I of tail area installation, the outer insulation and shield were cut on cable 11W83 exposing the inner insulation. Repair consisted of trimming off all loose strands from the damaged portion of the shield and applying four coats of vinylite cement to the damaged area.

Then, three wraps of electrical tape were applied using a 50 percent overlap. Insulation resistance checks were performed and all values were within the specified limits (reference DMN M06378).

4.3.1.19 Cable 11W83, Poststatic. During preparation for shipment to KSC, insulation and shielding damage to cable 11W83 at connector P9 was discovered. Connector 11W83P9 was cut off at the damaged area and a new connector installed. Continuity and insulation resistance checks were performed and all values were within the specified limits (reference DMN M07560).

4.3.1.20 Cable 11W91, Prestatic. During phase I of tail area installation, cable 11W91 was discovered to have insulation damage. No damage to the shield strands was noted. Repair consisted of applying four coats of vinylite cement to the damaged area then three wraps of electrical tape using a 50 percent overlap. Insulation resistance checks were performed and all values were within the specified limits (reference DMN M06377).

4.3.1.21 Cable 12W91, Poststatic. During preparation for shipment to KSC, the PVC jacket on one wire of cable connector 12W91P1 was discovered to be punctured. No damage to the shield or primary insulation was noted. This discrepancy was repaired by cleaning the damaged area and applying four coats of vinylite cement and three wraps of electrical tape using a 50 percent overlap. An insulation resistance check was performed and the values were found to be within the specified limits (reference item 1 of DMN M08868).

4.3.1.22 Cable 12W96, Poststatic. During phase I of tail area installation, the PVC jacket on one wire to cable connector 12W96P2 was cut. No damage to the shield or primary insulation was noted. The cause of damage was attributed to personnel working in the stage. Repair consisted of cleaning the damaged area and applying four coats of vinylite cement and three wraps of electrical tape, using a 50 percent overlap. An insulation resistance check was performed and all values were found to be within the specified limits (reference item 2 of DMN M08868).

4.3.1.23 Cable 13W31, Poststatic. During preparation for shipment to KSC, cable 13W31 was accidently touched with a hot soldering iron resulting in damage to the PVC jacket near connector 13W31P1. No damage to the primary insulation was noted. Repair consisted of cleaning and applying four coats of vinylite cement to the damaged area. Then the damaged wires were wrapped together with a minimum of three wraps of electrical tape, using a 50 percent overlap. The cable was rechecked for insulation resistance, and all values were found to be within the specified limits (reference DMN M13411).

4.3.1.24 J-Box Receptacle, Poststatic. It was noted during preparation for shipment to KSC, improper mating of connector 9W146P2 (para 4.3.1.9) to receptacle 9A11J1 on J-box 60C40289 caused pin 13 to be bent. Repair consisted of replacing receptacle 9A11J1 (reference item 1, DMN M13458).

4.3.1.25 Gearcase Heater Cable, Poststatic. During preparation for shipment to KSC, the engine-7 gearcase heater cable assembly 501924 serial number 1363143 was found to have a cut completely around the insulation exposing the conductor. Repair was performed by Rocketdyne Division and consisted of replacing cable serial number 1363143 with cable serial number 6331162. The cause of damage was attributed to personnel working in the stage (reference DMN M13466).

4.3.1.26 Connector, Hypergol Unit, Poststatic. During preparation for shipment to KSC, the electrical connector was dislodged from the 201966 hypergol unit. Repair was performed by Rocketdyne Division and consisted of replacing the connector. The cause was attributed to personnel working in the stage (reference DMN M13475).

4.3.2 MECHANICAL COMPONENTS.

Significant failures and discrepancies recorded on mechanical components during inprocess and shakedown inspections, and significant failures and discrepancies recorded but not corrected at static test operations, are covered in the following paragraphs.

4.3.2.1 Rocket Engine, Position 7, Poststatic. At static test operations, a hole 0.375-inch long and 0.063 inch wide was found in the thrust chamber of engine serial number H-4046 (see paragraph 6.6.2.18). Upon return of stage S-IB-1 to CCSD-M, engine serial number H-4046 was removed from the stage and replaced by engine serial number H-4052 at engine position 7 (reference DMN H00286). The damaged engine was returned to Rocketdyne for rework and replacement of the thrust chamber. Following repair, engine serial number H-4046 was returned to CCSD-M and was designated the spare inboard engine for stages S-IB-1 and S-IB-2. Refer to the engine logbook for detailed information on the rework of engine H-4046.

4.3.2.2 Turbine Exhaust Duct, Engine 7, Poststatic. The bellows nearest the heat exchanger on turbine exhaust duct 20C00013, serial number 24B5678, was found to be severely distorted after replacement of engine 7. A subsequent examination by Material Review found that turbine exhaust duct serial number 24B5678 was unfit for flight and recommended replacement. The defective turbine exhaust duct was removed and replaced by turbine exhaust duct serial number 24B5679 (reference DMN M10620).

4.3.2.3 Turbine Exhaust Duct, Engine 8, Poststatic.

4.3.2.3.1 Prior to lox dome retrofit modification (para 2.6.2.1) turbine exhaust duct 20C00013, serial number 24B5677, was prefitted to engine serial number H-4047 at position 8 and tolerances were within specified limits. After the lox dome retrofit modification when engine serial number H-4047 was installed, the tolerances relative to the installation of turbine exhaust duct serial number 24B5677 could not be met. This problem was submitted to Material Review and a use-as-is disposition was made (reference DMN M10239-A).

4.3.2.3.2 At static test operations, excessive distortion of the downstream bellows was noted (para 6.6.2.16). Examination of the distorted bellows by CCSD quality control engineering after stage S-IB-1 was returned to CCSD-M, revealed that the original out-of-tolerance condition of the turbine exhaust was aggravated by static firing and resulted in distortion of the bellows.

Attempts to bring the tolerances up to specifications by realignment were without success and the turbine exhaust duct then was removed and replaced by turbine exhaust duct serial number 83B5509 (reference DMN M07552).

NOTE

Lower turbine exhaust duct 20C00014, serial number 83B5510 also was replaced at this time to obtain adequate flexibility in the lower assembly in order to allow the upper assembly to conform to the drawing. Lower turbine exhaust duct serial number 83B5513 was installed (reference sheet 4 of DMN M07552).

4.3.2.4 Lox Manifold Drain Flex Hose, Engine 5, Poststatic. Inspection during poststatic shakedown inspection disclosed that flex hose assembly 60C20873-1 (10413270), serial number 82B5820 at engine 5, was flattened in two places and had a bulge in a third place. The braided shielding of the flex hose assembly also appeared to have been stretched. After the stage was returned to CCSD-M, the discrepancy was submitted to Material Review and a use-as-is disposition was made (reference item 1, DMN M07551).

4.3.2.5 Lox Manifold Drain Flex Hose, Engine 8, Poststatic. Inspection during poststatic shakedown inspection disclosed that flex hose assembly 60C20873-1 (10413270), serial number 32B6439 at the engine-8 lox manifold drain line, was bulged and flattened. After the stage was returned to CCSD-M, the discrepancy was submitted for Material Review action and a use-as-is disposition was made (reference item 3, DMN M07551).

4.3.2.6 Flex Hose Drain Line, Engine 5, Poststatic. During the poststatic shakedown inspection at MSFC-Huntsville, flex hose 60C20875-1 (10438157), serial number 44B5842 at engine 5, was found to have a bulge at one end. The defective flex hose was scrapped and replaced (reference item 2, DMN M07551).

4.3.2.7 Gox Line, Engine 4, Prestatic. During the engine rotational deflection tests (para 3.2.1), gox line 20C00059, serial number 113B5008 at engine 4, was found to have a deflection of 18 degrees when the engine was gimballed to 8 degrees. The maximum allowable deflection is 15 degrees. The deviation was caused by fitting and aligning the gox line without the engines being installed. The improper sized gox line was removed and replaced by gox line serial number F1051 (reference DMN M10236).

4.3.2.8 Lox Suction Line, Engine 7, Poststatic. During poststatic alterations, lox suction line 20C00044, serial number 13B5795, was found to have a dent, 0.011-inch deep, in the convolute bellows. The damaged line was removed and replaced by line serial number 21 (reference DMN M10577-A).

4.3.2.9 Fuel Wraparound Line, Engine 8, Poststatic. During inspection for damage to flexible ducting bellows as poststatic alterations neared completion, a nick was found in the bellows of fuel wraparound line 20C00077, serial number 83B5486. Examination of the defect by Material Review resulted in the replacement of fuel wraparound line serial number 83B5486 with fuel wraparound line serial number 12. The damaged line then was returned to the vendor for repair (reference DMN M10399).

4.3.2.10 Hydraulic Actuators, Engine 2, Prestatic. Prior to installation of engine 2 onto stage S-IB-1, hydraulic package 20C85053, serial number 122, was found to be contaminated due to O-ring deterioration (reference FFADS 0410). Due to the possibility of contamination resulting from use with the contaminated hydraulic package, the 60C60001 hydraulic servo actuators, serial numbers 302 and 305, were removed from engine 2 on stage S-IB-1 and returned to the vendor for cleaning. Actuator serial number 302 (fuel side) was replaced by actuator serial number 306. Actuator serial number 305 (lox side) was replaced by actuator serial number 309 (reference DMN M07505).

4.3.2.11 Hydraulic Package, Engine 4, Poststatic. During poststatic alterations, package 20C85053, serial number 117 was found to have internal contamination due to a mutilated O-ring. The cause was attributed to incorrect installation of a plug and

O-ring at static test operations when the transducer for static test measurement HP-100 was removed and the plug and O-ring installed. Hydraulic package serial number 117 was removed and returned to the vendor for rework, and hydraulic package serial number 121 was installed (reference DMN M08557 and DMN M08627).

4.3.2.12 Main Hydraulic Pump, Engine 4, Poststatic. Due to contamination of the engine-4 hydraulic system (para 4.3.2.12), main hydraulic pump 20C85035, serial number 93024, was removed and returned to the vendor for cleaning and rework. Main hydraulic pump serial number 93044 was installed (reference DMN M08557 and DMN M08630).

4.3.2.13 Hydraulic Actuators, Engine 4, Poststatic. Due to contamination of the engine-4 hydraulic system (para 4.3.2.12), the 60C60001 hydraulic servo actuators, serial numbers 303 and 304, were removed and returned to the vendor for cleaning and rework. Actuator serial number 303 (lox side) was replaced by actuator serial number 342. Actuator serial number 304 (fuel side) was replaced by actuator serial number 343 (reference DMN M08557, DMN M08628, and DMN M08629).

4.3.3 INSTRUMENTATION AND TELEMETRY COMPONENTS.

Significant failures and discrepancies recorded on instrumentation and telemetry components during inprocess and shakedown inspections, and significant failures and discrepancies recorded but not corrected at static test operations, are covered in the following paragraphs.

4.3.3.1 AC Amplifier, Poststatic (B501-4). At static test operations, the specified range for measurement B501-4 was exceeded. After return of stage S-IB-1 to CCSD-M, amplifier 50C10382, serial number C190 was removed for test and replaced by amplifier serial number C305. Subsequent testing of amplifier serial number C190 failed to disclose any discrepancy and the amplifier was returned to supply (reference FFADS 0653).

4.3.3.2 Microphone Cable, Poststatic (B501-4). When performing tests on the components of measurement B501-4 (para 4.3.3.1) cable 50C12265 was found to be open (no continuity). The defective cable was scrapped and a new cable installed (reference FFADS 0653).

4.3.3.3 Cable, Poststatic (C61-2). During static test operations, cable 50C10225, serial number C0006, was found to have insulation damage and bare wire exposed. After return of stage S-IB-1 to CCSD-M, the cable was repaired (reference DMN H00296).

4.3.3.4 DC Amplifier, Poststatic (D1-8). At static test operations, a no-output indication was received from measurement D1-8 (para 6.6.3.7). After stage S-IB-1 was returned to CCSD-M, amplifier 50C10388, serial number 14244 was removed, tested, and found to have no output. The limiting diode in the amplifier output was checked and found to be good. Amplifier serial number 14244 then was returned to the vendor for rework and was replaced by amplifier serial number 0335 (reference FFADS 0666).

4.3.3.5 Accelerometer, Prestatic (E11-8). During preparation for shipment to static test, it was discovered that accelerometer 50C10395, serial number 547, was calibrated to conform to the E11-8 measurement curve for stage S-IB-2. Accelerometer serial number 547 was removed and replaced by accelerometer serial number 597 which had been calibrated for stage S-IB-1 (reference DMN M10785).

4.3.3.6 Accelerometer, Poststatic (E33-1). Just prior to moving stage S-IB-1 into poststatic checkout, accelerometer 50C10105, serial number 233 was found to be damaged and was scrapped. All components of measurement E33-1 were removed from the stage, recalibrated with replacement accelerometer serial number 186, and reinstalled (reference DMN M07921).

4.3.3.7 Accelerometer, Prestatic (E33-3). During preparation for shipment to static test, accelerometer 50C10105, serial number 255, was damaged by personnel working in the stage and was scrapped. Accelerometer serial number 252 was the initial replacement but failed to meet the calibration specifications (reference FFADS 0453). Accelerometer serial number 264 was selected, calibrated, and installed on the stage as the replacement for accelerometer serial number 255 (reference DMN M10456 and para 5.3.3.14).

4.3.3.8 Accelerometer, Poststatic (E33-3). After completion of poststatic checkout during preparation for shipment to KSC, accelerometer 50C10105, serial number 1081, was damaged by personnel working in the stage and was scrapped. Accelerometer serial number 227 was calibrated into measurement E-33-3 and installed on the stage (reference DMN M13468).

4.3.3.9 Accelerometer, Prestatic (E503-9). During stage assembly operations prior to prestatic checkout, accelerometer 50C10406, serial number 1150 was damaged during installation and was replaced. Accelerometer serial number 351 was installed (reference DMN M06241 and para 5.3.3.20).

4.3.3.10 Accelerometer, Poststatic (E509-9). At static test operations, bias noise was observed on accelerometer 60C50067, serial number 11662F. After stage S-IB-1 was returned to CCSD-M, the accelerometer was removed for test; however, the noise problem could not be verified. The accelerometer then was recalibrated and reinstalled (reference FFADS 0670 and para 5.3.3.26).

4.3.3.11 Liquid Level Rack, Poststatic (L19-O2). During static test operations, a no-output indication was received from the channel-4 amplifier of liquid level rack 50C12295, serial number 401007. After return of stage S-IB-1 to CCSD-M, the malfunction was verified. Subsequent trouble analysis revealed that the channel-4 amplifier printed-wiring card was defective. The defective card was scrapped and a new card was installed. The liquid level rack then was retested, found acceptable, and reinstalled on the stage (reference FFADS 0667).

4.3.3.12 Liquid Level Probe, Poststatic (L20-F4). At static test operations, no output was received from liquid level probe 50C10295, serial number 1089. Upon return of stage S-IB-1 to CCSD-M, the malfunction was verified by functional and continuity tests. The defective probe was removed and returned to the vendor for failure analysis, and probe serial number 941 was installed (reference FFADS 0671).

4.3.3.13 Strain Gage, Prestatic (S535-11). During phase II of upper tank area installation, the insulation of wire number 10 of the cable to strain gage 50C50054-1 (measurement number S535-11) was found to be cut through to the conductor. Repair of the damage consisted of applying four coats of vinylite cement and three wraps of electrical tape using a 50 percent overlap (reference DMN M06559).

4.3.4 STRUCTURAL COMPONENTS.

Significant failures and discrepancies recorded on structural components during inprocess and shakedown inspections, and significant failures and discrepancies recorded but not corrected at static test operations, are covered in the following paragraphs.

4.3.4.1 Ripples, Fuel Tank 3, Poststatic. Upon return of stage S-IB-1 from static test, repair and investigation into the cause of the ripples that were found in fuel tank 3 (para 6.6.4.2) was accomplished. The cause of the ripples is still unknown as investigation is still being conducted. Repair consisted of removing all surface protective finish from the outside surface at the defective areas. Then by spooning and bumping using contour block reinforcement on the opposite side, the defective areas were brought back to their original shape. Dye penetrant inspection was performed on both sides of the repaired areas, and x-rays were taken, both showing no cracks. The tank was then pressure tested in accordance with procedure CR P-817. The defective areas were surface finished with zinc chromate primer and painted in accordance with drawing 10M10396 (reference DMN H00297).

4.3.4.2 Lox Tank 2, Poststatic. During static test and while removing a flex line from the stage, personnel were unaware that the 750 psi GN_2 system was under pressure. When one end of the flex line was disconnected the line swung freely from side to side making contact with the skin of lox tank 2 causing two gouges and a number of scratches. Upon return to CCSD-M the gouges and scratches were smoothed out and a dye penetrant inspection was performed which showed no cracks (reference DMN H00261).

4.3.4.3 Lox Tank 3, Poststatic. During static test and while adjusting the vertical load cells, stage movement at the upper end of lox tank 3 was sufficient to make contact with a test stand platform causing damage in the form of scratches on the outer skin. Four scratches were inboard of the prima-cord cover and one scratch was outboard of the prima-cord cover. Upon return to CCSD-M the scratches were blended out and the defective area was restored to its original finish (reference DMN H00258).

4.3.4.4 Flame Curtain, Engine 1, Poststatic. During poststatic alterations and while fitting the 30C03566 flame curtain on engine 1, the flame curtain was accidently torn, approximately 5 inches in length. Repair consisted of covering the torn area with a patch made from fiberglass tape in conjunction with Dow Corning A9094 primer and 90-092 sealant (reference item 1, DMN M13412).

4.3.4.5 Flame Curtain, Engine 4, Poststatic. During poststatic alterations and while fitting the 30C3566 flame curtain on engine 4, the flame curtain was accidently torn, approximately 2 inches in length. Repair consisted of covering the torn area with a patch made from fiberglass tape in conjunction with Dow Corning A9094 primer and 90-092 sealant (reference item 2, DMN M13412).

SECTION V

FUNCTIONAL CHECKOUT

5.1 SCOPE.

5.1.1 This section covers prestatic and poststatic functional checkout of the subsystems of stage S-IB-1. During checkout operations, actual conditions that will occur during static firing or launch, are duplicated where possible and simulated when environmental conditions prevent duplication. In addition to functionally testing mechanical and electrical components by operating stage subsystems, leak checks and hardware inspections are performed to assure that recorded test results provide an accurate measure of the performance of subsystems and of the overall stage.

5.1.2 Specific information on tests that were conducted, tests that required rerun, and tests that were not completed is provided in paragraph 5.2. Failures that occurred and discrepancies that were found within the electrical, mechanical, instrumentation and telemetry, and structural systems and components of the S-IB stage are documented in paragraph 5.3 along with an indication of whether the defect happened during prestatic or poststatic functional checkout. Repetitive failures that occurred on the same part or on similar parts are grouped in successive paragraphs.

5.2 CHECKOUT TEST RECORD.

5.2.1 TESTS COMPLETED.

Table 5-1 lists all prestatic checkout procedures that were run and successfully completed, and table 5-2 lists all poststatic checkout procedures that were run and successfully completed.

Table 5-1. Prestatic Checkout Test Record

Test Procedure	Date Started	Date Completed	Remarks
Power Distribution. 1-CM-IB-201B-A2.0 Revision J	30 Nov 64	4 Dec 64	
General Networks and Malfunction Cutoff Test. 1-CM-IB-201B-A5.0 Revision T	15 Jan 65	17 Jan 65	
Components Test. 1-CM-IB-201B-A6.0 Revision M	20 Jan 65	21 Jan 65	
Acceleration Measurements. 2-CM-IB-201B-3.1 Revision B	12 Dec 64	21 Jan 65	
Acoustics Measurements 2-CM-IB-201B-3.2 Revision B	9 Dec 64	21 Jan 65	
Temperature Measurements. 2-CM-IB-201B-3.3 Revision E	5 Dec 64	19 Jan 65	See paragraph 5.3.3.41

Table 5-1. Prestatic Checkout Test Record (continued)

Test Procedure	Date Started	Date Completed	Remarks
Pressure Measurements. 2-CM-IB-201B-3.4 Revision E	29 Dec 64	14 Jan 65	See paragraphs 5.3.3.11 & 5.3.3.12
Vibration Measurements. 2-CM-IB-201B-3.5 Revision B	9 Dec 64	21 Jan 65	See paragraph 5.3.3.24
Signals. 2-CM-IB-201B-3.10 Revision B	9 Dec 64	12 Jan 65	See paragraph 5.3.3.28
Liquid Level Measurements. 2-CM-IB-201B-3.11 Revision C	9 Dec 64	12 Jan 65	See paragraphs 5.3.3.29 & 5.3.3.33
Voltage & Current. 2-CM-IB-201B-3.12 Revision E	2 Dec 64	23 Dec 64	
Strain Measurements. 2-CM-IB-201B-3.15 Revision C	7 Dec 64	21 Jan 65	See paragraph 5.3.3.39

Table 5-1. Prestatic Checkout Test Record (continued)

Test Procedure	Date Started	Date Completed	Remarks
DDAS Calibration Verification. 2-CM-IB-201B-A3.18 Revision C	21 Dec 64	21 Dec 64	
Instrumentation Compatibility (TM vs Hardwire). 3-CM-IB-201B-10.0 Revision A	16 Jan 65	28 Jan 65	See paragraphs 5.3.3.6, 5.3.3.38, & 5.3.3.44
Telemeter Calibrator Test. 3-CM-IB-201B-10.1 Revision C	5 Jan 65	5 Jan 65	
Discriminator & Subcarrier Oscillator Adjustment. 3-CM-IB-201B-10.2 Revision B	6 Jan 65	6 Jan 65	
TM Ground Station & Airborne Pre-emphasis. 3-CM-IB-201B-10.3 Revision B	6 Jan 65	6 Jan 65	

Table 5-1. Prestatic Checkout Test Record (continued)

Test Procedure	Date Started	Date Completed	Remarks
SS/FM Ground Station Setup. 3-CM-IB-201B-10.4 Revision B	21 Dec 64	21 Dec 64	
PCM Ground Station Setup. 3-CM-IB-201B-10.5 Revision B	4 Jan 65	4 Jan 65	
RF Compatibility. 3-CM-IB-201B-10.6 Revision E	23 Jan 65	23 Jan 65	
DDAS Functional Check. 3-CM-IB-201B-10.7 Revision B	7 Jan 65	7 Jan 65	
Range Safety Command Antenna & Lines. 4-CM-IB-201B-1.1 Revision B	11 Dec 64	15 Dec 64	
TM Antenna & Lines. 4-CM-IB-201B-1.2 Revision A	16 Dec 64	18 Dec 64	

Table 5-1. Prestatic Checkout Test Record (continued)

Test Procedure	Date Started	Date Completed	Remarks
Range Safety Command System. 4-CM-IB-201B-7.1 Revision A	14 Dec 64	15 Dec 64	
Telemetry Systems. 4-CM-IB-201B-7.2 Revision C	16 Dec 64	18 Dec 64	
Rerun after EO incorp	5 Jan 65	5 Jan 65	
SS/FM Accuracy, Cross-Talk, Linearity, and Programing. 4-CM-IB-201B-7.3 Revision B	16 Dec 64	14 Jan 65	
Radiated Compatibility Interference Test. 4-CM-IB-201B-8.1 Revision B	7 Jan 65	7 Jan 65	
Control Accelerometer. 5-CM-IB-201B-9.6	25 Jan 65	25 Jan 65	

Table 5-1. Prestatic Checkout Test Record (continued)

Test Procedure	Date Started	Date Completed	Remarks
Pressure Switches. 6-CM-IB-201B-4.1 Revision B	30 Nov 64	3 Dec 64	
GN_2 Control Pressure System. 6-CM-IB-201B-4.2 Revision B	1 Dec 64	3 Dec 64	See paragraph 5.3.2.2
CR P-747 Special Test	13 Jan 65	18 Jan 65	See paragraph 5.3.2.18
Fuel System. 6-CM-IB-201B-4.4 Revision B	4 Dec 64	29 Jan 65	See paragraphs 5.3.2.3 through 5.3.2.13
Lox Tanks Pressurizing System. 6-CM-IB-201B-4.6 Revision B	2 Dec 64	7 Dec 64	
Lox System. 6-CM-IB-201B-4.7 Revision B	5 Dec 64	10 Dec 64	
Vehicle Heaters System. 6-CM-IB-201B-A4.8 Revision C	11 Dec 64	12 Dec 64	

Table 5-1. Prestatic Checkout Test Record (continued)

Test Procedure	Date Started	Date Completed	Remarks
EDS Test. 7-CM-IB-201B-12.0 Revision B	18 Jan 65	18 Jan 65	
Simulated Plug Drop. 7-CM-IB-201B-A11.0 Revision P	24 Jan 65	28 Jan 65	

Table 5-2. Poststatic Checkout Test Record

Test Procedure	Date Started	Date Completed	Remarks
Power Distribution 1-CM-IB-201D-A2.0 Revision B	12 Jun 65	12 Jun 65	
Power Up 1-CM-IB-201D-A2.1	12 Jun 65	12 Jun 65	
Power Down 1-CM-IB-201D-A2.2	12 Jun 65	12 Jun 65	
General Networks Malfunction Cutoff Test No. 1 1-CM-IB-201D-A5.0 Revision A	29 Jun 65	1 Jul 65	See paragraph 5.3.3.51
General Networks Malfunction Cutoff Test No. 2 1-CM-IB-201D-A21.0 Revision B	1 Jul 65	2 Jul 65	See paragraph 5.3.2.21

Table 5-2. Poststatic Checkout Test Record (continued)

Test Procedure	Date Started	Date Completed	Remarks
Components Test 1-CM-IB-201D-A6.0 Revision C	29 Jun 65	30 Jun 65	
UMA Scan & Calibrate 2-CM-IB-201D-A3.0 Revision A	13 Jun 65	2 Jul 65	See paragraphs 5.3.3.3, 5.3.3.5, & 5.3.3.7
Acceleration 2-CM-IB-201D-3.1	19 Jun 65	6 Jul 65	
Acoustics 2-CM-IB-201D-3.2	19 Jun 65	6 Jul 65	See paragraph 5.3.3.1
Temperature 2-CM-IB-201D-3.3 Revision A	19 Jun 65	17 Jul 65	
Pressure 2-CM-IB-201D-3.4 Revision C	20 Jun 65	17 Jul 65	See paragraph 5.3.3.9

Table 5-2. Poststatic Checkout Test Record (continued)

Test Procedure	Date Started	Date Completed	Remarks
Vibration 2-CM-IB-201D-3.5 Revision A	14 Jun 65	17 Jul 65	See paragraphs 5.3.3.13, 5.3.3.15, 5.3.3.18, 5.3.3.23, 5.3.3.25, through 5.3.3.27
RF & TM 2-CM-IB-201D-3.9 Revision A	12 Jun 65	12 Jul 65	
Signals 2-CM-IB-201D-3.10 Revision A	17 Jun 65	12 Jul 65	
Liquid Level 2-CM-IB-201D-3.11	14 Jun 65	12 Jul 65	See paragraphs 5.3.3.32, 5.3.3.34, & 5.3.3.35
Voltage and Current 2-CM-IB-201D-3.12 Revision C	12 Jun 65	17 Jul 65	See paragraph 5.3.3.36
Miscellaneous 2-CM-IB-201D-3.13	11 Jun 65	6 Jul 65	
Angular Velocity 2-CM-IB-201D-3.14	11 Jun 65	12 Jul 65	See paragraph 5.3.3.37

Table 5-2. Poststatic Checkout Test Record (continued)

Test Procedure	Date Started	Date Completed	Remarks
Strain 2-CM-IB-201D-3.15	14 Jun 65	18 Jul 65	
R.P.M. 2-CM-IB-201D-3.16 Revision B	14 Jun 65	16 Jul 65	
Sensor Identification 2-CM-IB-201D-A3.17 Revision A	19 Jun 65	2 Jul 65	
DDAS Calibration Verification 2-CM-IB-201D-A3.18 Revision B	3 Jul 65	7 Jul 65	See paragraphs 5.3.3.46 & 5.3.3.47
Dynamic Pressure 2-CM-IB-201D-3.19	19 Jun 65	16 Jul 65	See paragraph 5.3.3.8
Instrumentation Compatibility Test, Telemeter vs Hardwire & Telemeter vs Predicted, 3-CM-IB-201D-A10.0 Revision A	7 Jul 65	10 Jul 65	See paragraphs 5.3.3.10, 5.3.3.45, & 5.3.3.48

Table 5-2. Poststatic Checkout Test Record (continued)

Test Procedure	Date Started	Date Completed	Remarks
Telemeter Calibrator Test 3-CM-IB-201D-10.1	14 Jun 65	14 Jun 65	
Discriminator & Sub-Carrier Oscillator Adjustment 3-CM-IB-201D-10.2	15 Jun 65	15 Jun 65	
TM Ground Station & Airborne Pre Emphasis Procedure 3-CM-IB-201D-10.3 Revision A	15 Jun 65	15 Jun 65	
SS/FM Ground Station Set Up 3-CM-IB-201D-10.4	15 Jun 65	16 Jun 65	
PCM Ground Station Set Up 3-CM-IB-201D-10.5 Revision A	15 Jun 65	15 Jun 65	
RF Compatibility 3-CM-IB-201D-10.6 Revision A	25 Jun 65	25 Jun 65	

Table 5-2. Poststatic Checkout Test Record (continued)

Test Procedure	Date Started	Date Completed	Remarks
DDAS Functional Check 3-CM-IB-201D-10.7 Revision A	16 Jun 65 3 Jul 65	 3 Jul 65	See paragraph 5.2.2.2
Range Safety Command Antenna & Lines 4-CM-IB-201D-1.1 Revision A	12 Jun 65	12 Jun 65	See paragraph 5.2.2.1
TM Antenna, Lines, and Power Dividers 4-CM-IB-201D-1.2 Revision A	11 Jun 65	11 Jun 65	
ODOP Antennas and Transmission Lines 4-CM-IB-201D-1.3 Revision A	14 Jun 65	14 Jun 65	
Antenna Transmission Line Phasing 4-CM-IB-201D-1.4	11 Jun 65	11 Jun 65	
Range Safety Command 4-CM-IB-201D-7.1	17 Jun 65	17 Jun 65	

Table 5-2. Poststatic Checkout Test Record (continued)

Test Procedure	Date Started	Date Completed	Remarks
Telemetry Systems 4-CM-IB-201D-7.2	13 Jun 65	15 Jun 65	
SS/FM Accuracy, Cross Talk Linearity & Programming 4-CM-IB-201D-7.3	17 Jun 65	18 Jun 65	
ODOP System 4-CM-IB-201D-7.4 Revision A	19 Jun 65	20 Jun 65	
Radiated Compatibility Interference Test 4-CM-IB-201D-8.1 Revision A	22 Jun 65	22 Jun 65	
Control System 5-CM-IB-201D-9.0 Revision B	11 Jun 65	17 Jul 65	
Actuator Linearity Test 5-CM-IB-201D-A9.4 Revision A	29 Jun 65	2 Jul 65	

Table 5-2. Poststatic Checkout Test Record (continued)

Test Procedure	Date Started	Date Completed	Remarks
Pressure Switches 6-CM-IB-201D-4.1 Revision A	15 Jun 65	17 Jun 65	See paragraph 5.3.2.1
GN_2 Control Pressure System 6-CM-IB-201D-4.2 Revision A	15 Jun 65	16 Jul 65	See paragraphs 5.3.2.22 & 5.3.2.29
H-1 Engine Systems 6-CM-IB-201D-4.3 Revision A	17 Jun 65	20 Jun 65	See paragraphs 5.3.2.26 through 5.3.2.28
Fuel System 6-CM-IB-201D-4.4 Revision A	20 Jun 65	22 Jun 65	
Instrument Compartment 6-CM-IB-201D-4.5	15 Jun 65	16 Jun 65	See paragraph 5.3.2.30
Lox Pressurizing System 6-CM-IB-201D-4.6 Revision A	22 Jun 65	23 Jun 65	

Table 5-2. Poststatic Checkout Test Record (continued)

Test Procedure	Date Started	Date Completed	Remarks
Lox System 6-CM-IB-201D-4.7 Revision A	22 Jun 65	19 Jul 65	See paragraphs 5.3.2.18, 5.3.2.23, 5.3.2.24
Vehicle Heaters System 6-CM-IB-201D-A4.8 Revision B	21 Jun 65	21 Jun 65	
Lox Seal Cavity 6-CM-IB-201D-4.9	19 Jul 65	19 Jul 65	
Camera Eject 6-CM-IB-201D-4.10 Revision A	18 Jun 65	22 Jun 65	
Simulated Plug Drop 7-CM-IB-201D-A11.0 Revision A	10 Jul 65	12 Jul 65	See paragraph 5.3.1.1
Simulated Flight Test 7-CM-IB-201D-A20.9 Revision C	12 Jul 65	14 Jul 65	See paragraph 5.3.3.45.3

5.2.2 TESTS RERUN.

5.2.2.1 Prestatic Checkout. During prestatic checkout, telemetry systems procedure 4-CM-IB-201B-7.2 (table 5-1) required rerun after modification of the RF container assemblies of telemeters F1, F2, and S1.

5.2.2.2 Poststatic Checkout. During poststatic checkout, DDAS functional check procedure 3-CM-IB-201D-10.7 (table 5-2) required rerun after replacement of the PCM/DDAS assembly (para 5.3.3.47).

5.2.3 TESTS NOT COMPLETED OR NOT RUN.

5.2.3.1 Prestatic Checkout. All procedures required for prestatic checkout were run and successfully completed. Procedures that were not run were not required due to an alternate or optional procedure or due to waiver of the initial requirement. These procedures are recorded in the following list:

a. Pressure Calibration and Functional Test, 2-CM-IB-201B-A3.4B (Option to manual procedure 2-CM-IB-201B-3.4E.)

b. Flow Measurements, 2-CM-IB-201B-3.6 (Not issued and not required for prestatic checkout. Engines not installed.)

c. Engine Position Measurements, 2-CM-IB-201B-3.7 (Not issued and not required for prestatic checkout. Engines not installed.)

d. Guidance and Control Measurements, 2-CM-IB-201B-3.8A (Not required. Engines not installed.)

e. RF and TM Measurements, 2-CM-IB-201B-3.13 (Not issued for prestatic checkout.)

f. Miscellaneous Measurements, 2-CM-IB-201B-3.13
(Not issued for prestatic checkout.)

g. Angular Velocity Measurements, 2-CM-IB-201B-3.14B
(Not run due to parts shortage.)

h. RPM Measurements, 2-CM-IB-201B-3.16
(Not required. Engines not installed.)

i. Sensor Identification, 2-CM-IB-201B-A3.17
(Operations performed manually.)

j. ODOP Antenna and Lines, 4-CM-IB-201B-1.3A
(Parts not installed.)

k. Control System, 5-CM-IB-201B-9.0B
(9.6 portion completed. Remainder not run; engines not installed.)

l. Actuator Linearity, 5-CM-IB-201B-A9.4
(Not issued and not required. Engines not installed.)

m. H-1 Engine System, 6-CM-IB-201B-4.3
(Not issued and not required. Engines not installed.)

n. Instrument Compartments, 6-CM-IB-201B-4.5B
(Not completed. See paragraph 5.3.2.30.)

o. Lox Seal Cavity, 6-CM-IB-201B-4.9
(Not issued and not required. Engines not installed.)

p. Instrumentation Compatibility Test, TM vs Hardwire and TM vs Predicted, 3-CM-IB-201B-10.0 (Option to automated procedure 2-CM-IB-201B-A10.0.)

5.2.3.2 Poststatic Checkout. All procedures required for poststatic checkout were run and successfully completed. Procedures that were not run were not required due to an alternate or optional procedure, or due to waiver of the initial requirement. These procedures are recorded in the following list:

a. Pressure Calibration and Functional Test, 2-CM-IB-201D-A3.4 (Option to manual procedure 2-CM-IB-201D-3.4C.)

b. Instrumentation Compatibility Test, TM vs Hardwire and TM vs Predicted, 3-CM-IB-201D-10.0 (Option to automated procedure 2-CM-IB-201-A10.0.)

5.3 FAILURES AND DISCREPANCIES.

The failures and discrepancies recorded during functional checkout operations are divided into four primary categories comprising electrical components, mechanical components, instrumentation and telemetry components, and structural components. These categories correspond to the primary divisions of the engineering departments of CCSD and MSFC. Where possible, the specific procedure that was being run when a failure occurred is referenced in the paragraph covering the failure. Since the final digits of each procedure number are nonrepetitive, the complete procedure number is not referenced. For example, procedure 6-CM-IB-201B-4.4 is referenced as procedure 4.4 in paragraph 5.3.2.6.

5.3.1 ELECTRICAL COMPONENTS.

Electrical components may be identified by part numbers beginning with 40M, 40C, or 60C4. A few electrical components, such as the distributors, have part numbers beginning with 50M, 50C, or 60C5. Failures and discrepancies recorded on electrical components during prestatic and poststatic checkout are detailed in the following paragraphs.

5.3.1.1 Camera Timer, Poststatic. When running simulated plug-drop procedure A11.0, camera timer 40C20614-3, serial number SA0322, failed to trigger the camera system as specified. Camera timer serial number SA0322 was removed, scrapped, and replaced by camera timer serial number SA0358 (reference FFADS 2774).

5.3.1.2 Cable 5W13, Prestatic. When preparing stage S-IB-1 for movement from the checkout station, the potting and wiring at connector 5W13PS were pulled loose from the connector. The cable was repaired by replacing the connector and performing continuity and insulation resistance checks before and after potting (reference DMN M10324).

5.3.1.3 Cable 9W176, Prestatic. During installation of the lox tank 4 recess-receptacle (previously a shortage), pin 4 in connector 9W176P1 was found to be broken off. The cable was repaired by replacing the connector and performing continuity and insulation resistance checks before and after potting (reference DMN M06714).

5.3.1.4 Cable 12W47, Poststatic. Two wires of cable 12W47 were found to be damaged at a point approximately six inches from connector 12W47P2. The damage consisted of frayed insulation on both wires with the insulation completely removed on one wire. Repair consisted of wrapping the area of damage with electrical tape (reference DMN M08898).

5.3.2 MECHANICAL COMPONENTS.

Mechanical components may be identified by part numbers beginning with 20M, 20C, or 60C2. Small diameter tube assemblies that are referenced on the stage assembly drawings also are considered to be in the mechanical component category but may have part numbers beginning with 10M, 10C, or 60C1. Failures and discrepancies recorded on mechanical components during prestatic and poststatic checkout are detailed in the following paragraphs.

5.3.2.1 GN2 High Pressure Switch, Poststatic. GN_2 high pressure switch 60C20452, serial number 25251, was found to operate (actuate/deactuate) below the specified limits of 2965 (±30) psia on actuation and 2835 psia minimum on deactuation. The actual values recorded during procedure 4.1 were 2931 psia on actuation and 2831.7 psia on deactuation. Switch serial number 25251 was removed from the stage and returned to the vendor for failure analysis. Switch serial number 25270 was installed (reference FFADS 0517 and FFADS 0745).

5.3.2.2 Prevalve Timing, Prestatic. Investigation of timing discrepancies on the eight fuel and eight lox prevalves on stage S-IB-1 disclosed that the orifices that control the timing were the same as those used on the normally-open prevalves on stage S-I-10. Since the 60C20340 fuel prevalves and the 60C20339 lox prevalves on stage S-IB-1 are normally-closed types, the timing characteristics were reversed. To correct this condition, engineering orders were released under ECP ET-60206 to remove the old orifices and install type 60C04037 orifices (0.0210-inch diameter nominal) into the control-pressure inlet of the fuel prevalves. In addition, type 60C04036 orifices (0.042-inch diameter nominal) were installed at the vehicle control-pressure inlet on each of the eight solenoid-operated 20C30128 prevalve control valves in place of MC237D4W adapters. The orifices in the control-pressure inlet of the lox prevalves were determined to be Parker type F61C1543-4 (0.086-inch diameter nominal). Refer to table 1-3 for actual orifice sizes.

5.3.2.3 Fuel Prevalve, Engine 1, Prestatic.

5.3.2.3.1 Inspection during prestatic checkout revealed that fuel prevalve 60C20340, serial number 110, had bronze particles on the pinion gear and bearings. The cause was attributed to chafing between the rack portion of the rack and pinion and the bronze bushing. Prevalve serial number 110 was removed from the stage and the actuator portion was sent to the vendor for rework and analysis. (See paragraph 5.3.2.7.2.) Prevalve serial number 117 was installed (reference DMN M06760 and DMN A37633-A).

5.3.2.3.2 When running fuel system procedure 4.4, fuel prevalve 60C20340, serial number 117, displayed GN_2 lipseal leakage of 32 standard cubic inches per minute (scim). The maximum allowable GN_2 lipseal leakage was 5 scim. The discrepant prevalve was removed from the stage, repaired by replacing the Parker F61C1529 ball seal, then reinstalled (reference DMN M06797).

5.3.2.4 Fuel Prevalve, Engine 2, Prestatic.

5.3.2.4.1 When running fuel system procedure 4.4, fuel prevalve 60C20340, serial number 102, displayed GN_2 lipseal leakage of 45 scim. The maximum allowable GN_2 lipseal leakage was 5 scim. The discrepant prevalve was removed from the stage to be repaired and reinstalled; however, when the prevalve was disassembled, brass particles were found in the control piston gearcase. Prevalve serial number 102 was returned to the vendor for rework and prevalve serial number 118 was installed on the stage (reference DMN M06723 and DMN M05833).

5.3.2.4.2 When running fuel system procedure 4.4 at engine 2, fuel prevalve 60C20340, serial number 118, was found to have a lipseal leakage of 18 scim, the maximum allowable lipseal leakage is 15 scim. Valve serial number 118 was removed and replaced by valve serial number 133 (reference FFADS 0534).

5.3.2.5 Fuel Prevalve, Engine 3, Prestatic.

5.3.2.5.1 Investigation during prestatic checkout revealed that the pinion gear was rubbing on the actuator housing in fuel prevalve 60C20340, serial number 111, and that metal chips were present in and around the pinion gear and bearing. Prevalve serial number 111 was removed from the stage and replaced by prevalve serial number 112 (reference DMN M06756).

5.3.2.5.2 When running fuel system procedure 4.4, fuel prevalve 60C20340, serial number 112 was found to have a lipseal leakage of 8.2 scim. The maximum allowable lipseal leakage was 5 scim. The leakage problem was eventually resolved by the release of EO 13-10C01694 which extended the maximum allowable GN_2 lipseal leakage from 5 scim at 10 psig to 15 scim at 10 psig (reference DMN M10304).

5.3.2.6 Fuel Prevalves, Engines 4 and 5, Prestatic. When running fuel system procedure 4.4, engine-4 fuel prevalve 60C20340, serial number 106, and engine-5 fuel prevalve 60C20340, serial number 109, were found to have lipseal leakages of 8.5 scim and 10 scim, respectively. The leakage problem was eventually resolved by the release of EO 13-10C01694 which extended the maximum allowable GN_2 lipseal leakage at 10 psig from 5 scim to 15 scim (reference DMN M10305 and DMN M10306, respectively).

5.3.2.7 Fuel Prevalve, Engine 6, Prestatic.

5.3.2.7.1 Inspection during prestatic checkout revealed that fuel prevalve 60C20340, serial number 103, had brass chips in and around the pinion gear and bearings. Prevalve serial number 103 was removed from the stage and replaced by prevalve serial number 116 (reference DMN M06757).

5.3.2.7.2 When running fuel system procedure 4.4, fuel prevalve 60C20340, serial number 116, was found to have a lipseal leakage of 36 scim. The maximum allowable lipseal leakage was 5 scim. Prevalve serial number 116 was removed from the stage; then, the actuator assembly was removed from the prevalve and installed on prevalve serial number 110 (see para 5.3.2.3). Prevalve serial number 110 then was installed on the stage (reference DMN M06796, DMN A37633-A, and FFADS 0353).

5.3.2.8 Fuel Prevalve, Engine 7, Prestatic. When running fuel system procedure 4.4, fuel prevalve 60C20340, serial number 105, was found to have a lipseal leakage of 10.75 scim. The maximum allowable lipseal leakage was 5 scim. Prevalve serial number 105 was removed from the stage and returned to the vendor for rework. Prevalve serial number 114 was installed (reference DMN M06724).

5.3.2.9 Fuel Prevalve, Engine 8, Prestatic. When running fuel system procedure 4.4, fuel prevalve 60C20240, serial number 108 was found to have a lipseal leakage of 120 scim. The maximum allowable lipseal leakage was 5 scim. Prevalve serial number 108 was removed from the stage and returned to the vendor for rework. Prevalve serial number 113 was installed (reference DMN M06725).

5.3.2.10 Fuel Fill and Drain Valve, Prestatic. Investigation during prestatic checkout revealed that fuel fill and drain valve 20C30043, serial number 257, had metal chips in the actuator on the inner and outer bearings, and that the actuator pinion gear was damaged. Valve serial number 257 was removed and returned to the vendor for rework. Valve serial number 102 was installed (reference DMN M06759).

5.3.2.11 Fuel Dump Valve, Prestatic.

5.3.2.11.1 Investigation during prestatic checkout revealed that fuel dump valve 20C30043, serial number 207 had metal chips in the actuator on the inner and outer bearings. Valve serial number 207 was removed and replaced by valve serial number 103 (reference DMN M06758).

5.3.2.11.2 When running fuel system procedure 4.4, a lipseal leakage of 33 scim was found on fuel dump valve 20C30043, serial number 103. The maximum allowable lipseal leakage was 5 scim. Valve serial number 103 was removed from the stage and returned to the vendor for rework. Valve serial number 261 was installed (reference DMN M10309).

5.3.2.12 Position Switch, Fuel Dump Valve, Prestatic. During inspection of ball-rotor valves for metal particles within the actuator assembly, the mounting bracket of the position-indicating switch on fuel dump valve 20C30043, serial number 293, was found to be cracked. The cause of the damage was attributed to the over-peening of a dowel pin that passes through the switch mounting bracket. The damaged switch was removed from the valve and a new switch installed (reference DMN M06767).

5.3.2.13 Fuel Interconnect Line O-Ring, Prestatic. When performing leak checks on the 20C00009 fuel interconnect line to fuel tank 3, external leakage was detected between the flange of the fuel interconnect line and the 30C00091 fuel transfer assembly. A more detailed inspection revealed that the leak was the result of a sheared O-ring which was found to have a missing section approximately 1-inch long. After an unsuccesful search of the fuel transfer assembly, the missing O-ring section was found in the sump of fuel tank 4. No crumbled pieces of O-ring or other contamination of the area was found.

5.3.2.14 Lox Prevalve, Engine 3, Prestatic. Inspection during prestatic checkout revealed that lox prevalve 60C20339, serial number 117, had metal chips on the actuator bearings and that corrosion was present between the body of the position-indicating switch and the outer bearing. The valve was removed from the stage and replaced by valve serial number 110 (reference DMN M06761).

5.3.2.15 Lox Prevalve, Engine 4, Prestatic. Inspection during prestatic checkout revealed that lox prevalve 60C20339, serial number 108, had metal shavings on the rear bearing in the actuator. Valve serial number 108 was removed and replaced by valve serial number 114 (reference DMN M06764).

5.3.2.16 Lox Prevalve, Engine 5, Prestatic. Inspection during prestatic checkout revealed that lox prevalve 60C20339, serial number 107 had metal particles on the pinion gear and rear bearing. Valve serial number 107 was removed and replaced by valve serial number 115 (reference DMN M06763).

5.3.2.17 Lox Prevalve, Engine 7, Prestatic.

5.3.2.17.1 Inspection during prestatic checkout revealed that lox prevalve 60C20339, serial number 106, had metal chips in and around the pinion gear and bearings. Valve serial number 106 was removed and replaced by valve serial number 102 (reference DMN M06762).

5.3.2.17.2 When running lox system procedure 4.7, lox prevalve 60C20339, serial number 102 was found to have a lipseal leakage of 21.6 scim. The maximum allowable lipseal leakage was 5 scim. Valve serial number 102 was removed from the stage and replaced by valve serial number 116 (reference DMN M10302).

NOTE

The actuator from lox prevalve serial number 102 was removed and installed on lox prevalve serial number 118. (The original actuator from lox prevalve serial number 118 had been returned to the vendor for rework after removal from stage S-IB-2) Refer to paragraph 6.6.2.5.

5.3.2.17.3 When running lox system procedure 4.7, lox prevalve 60C20339, serial number 116, was found to have a lipseal leakage of 7.25 scim. The maximum allowable lipseal leakage was 5 scim. The problem was submitted to material review and was dispositioned to use the discrepant prevalve for static test. Retest and evaluation was to be performed after static test (reference DMN M10310 and DMN A38069).

5.3.2.18 Lox Prevalve, Engine 7, Poststatic. During poststatic checkout operations, lox system procedure 4.7 was run to retest lox prevalve 60C20339, serial number 116, as required by DMN A38069 (para 5.3.2.17.3). The lipseal leakage was found to have increased from 7.25 scim (prestatic) to 12 scim. Since the maximum allowable leakage was 5 scim, prevalve serial number 116 was removed and replaced by prevalve serial number 142 (reference DMN M10310 and DMN A38069).

NOTE

Due to replacements resulting from failure investigations on fuel and lox prevalves, a special procedure (CR P-747) was released to assure that the prevalves installed at the completion of prestatic checkout were acceptable for use at static test.

5.3.2.19 Lox Dump Valve, Prestatic. Inspection during prestatic checkout disclosed metal particles on the pinion gear and rear actuator bearing of lox dump valve 20C30042, serial number 216. The valve was removed and replaced by valve serial number 201 (reference DMN M06795).

5.3.2.20 Lox Vent Valve, 7-Inch, Prestatic. When running lox system procedure 4.7, 7-inch lox vent valve 20C30122-1 serial number CH872, was found to be leaking past the lipseal at a rate of 36 scim. The maximum allowable leakage was 25 scim. Vent valve serial number CH872 was removed and replaced by vent valve serial number CH874 (reference DMN M06728-A).

5.3.2.21 Lox Vent Valve, 7-Inch, Poststatic.

5.3.2.21.1 When running procedure A21.0, the position indicating switch on 7-inch lox vent valve 20C30122-1, serial number CH374, became stuck in the valve-open position. Vent valve serial number CH374 was removed and replaced by vent valve serial number 107 (reference FFADS 2754).

5.3.2.21.2 After installation of vent valve serial number 107, leakage past the control piston was found to be 1.4 scim. The maximum allowable leakage was 1.0 scim. The problem was submitted to Material Review and was dispositioned "use as is" (reference FFADS 2776).

5.3.2.22 Lox Vent Control Valve, Poststatic. Solenoid-operated control valve 20C30128, serial number 701, was found to have leakage in excess of 400 scim out of the vent port. The discrepant valve was removed and replaced by valve serial number 885 which was removed from stage S-IB-4 for use on stage S-IB-1 (reference FFADS 0531).

5.3.2.23 Lox Turbopump, Engine 1, Poststatic. On engine serial number H-7046 at position 1, lox turbopump 458450-11, serial number 6326239 was found to have a seal leakage of 230 scim at 20 psig lox tank pressure. The maximum allowable leakage is 30 scim at a lox tank pressure of 30 scim. Efforts to stop or greatly reduce the leakage by repositioning the stage were unsuccessful (reference DMN M08886).

5.3.2.23.1 In order to stop the leakage, the lox wraparound line was disconnected from the turbopump adapter by CCSD personnel; then, Rocketdyne personnel removed the turbopump adapter from the turbopump inlet to gain access to the turbopump interior. Turbopump seal NA5-26595, serial number S-141, was removed to Rocketdyne and replaced with turbopump seal NA5-26595, serial number S-103. In addition to the turbopump seal, all related shims, mountings, gaskets, and bolts, including the long and short adapter bolts, were replaced. All rework was performed at Michoud under the surveillance of a quality control inspector from Rocketdyne at Canoga Park, California. All parts removed were sent to the Rocketdyne failure analysis laboratory at Canoga Park, California.

5.3.2.23.2 The turbopump adapter and the lox wraparound line were reconnected and the engine was retested in accordance with procedure CR P-1130. The resultant turbopump seal leakage at 30 psig lox tank pressure was measured at 2.8 scim. Test firing of the engine was not required due to extra precautions taken to observe dimensions and tolerances during the rework. The lox turbopump seal requires close observation during lox tanking operations at KSC as final assurance that seal leakage will remain within specified tolerances.

5.3.2.24 Lox Turbopump, Engine 2, Poststatic. On engine serial number H-7047 at position 2, lox turbopump 458450-11, serial number 6352432 was found to have a seal leakage of 270 scim at 20 psig lox tank pressure. The maximum allowable leakage is 30 scim at a lox tank pressure of 30 scim. Efforts to stop or greatly reduce the leakage by repositioning the stage were unsuccessful (reference DMN M08887).

5.3.2.24.1 In order to stop the leakage, the lox wraparound line was disconnected from the turbopump adapter by CCSD personnel; then, Rocketdyne personnel removed the turbopump adapter from the turbopump inlet to gain access to the turbopump interior. Turbopump seal NA5-26595, serial number S-188, was removed by Rocketdyne and replaced with turbopump seal NA5-26595, serial number S-104. In addition to the turbopump seal, all related shims, mountings, gaskets, and bolts, including the long and short adapter bolts, were replaced. All rework was performed at Michoud under the surveillance of a quality control inspector from Rocketdyne at Canoga Park, California. All parts removed were sent to the Rocketdyne failure analysis laboratory at Canoga Park, California.

5.3.2.24.2 The turbopump adapter and the lox wraparound line were reconnected and the engine was retested in accordance with procedure CR P-1130. The resultant turbopump seal leakage at 30 psig lox tank pressure was measured at 3.0 scim with the pump shaft rotating horizontally. Test firing of the engine was not required due to extra precautions taken to observe dimensions and tolerances during the rework. The lox turbopump seal requires close observation during lox tanking operations at KSC as final assurance that seal leakage will remain within specified tolerances.

5.3.2.25 Check Valve, Poststatic. Check valve 20C30132, serial number 999, was removed from the stage during a malfunction verification on another component. The removal process caused the check valve to become contaminated. The contaminated check valve was recleaned and returned to stock, and check valve serial number 1160 was installed (reference DMN M08884).

5.3.2.26 Check Valve, Engine 1, Poststatic. During the poststatic shakedown inspection at MSFC-Huntsville, the lock-wire holes in check valve NA5-28051, serial number 6324733 on engine H-7046 (position 4) were found to be damaged. During poststatic checkout operations, check valve serial number 6324733 was removed and replaced by check valve serial number 2461753 (reference DMN M07541).

5.3.2.27 Check Valve, Engine 4, Poststatic. Check valve NA5-28049-1B, serial number 2120356 on engine H-7049 (position 4) was found to have reverse seat leakage. The defective check valve was removed and replaced by check valve serial number 3010546 (reference DMN M07539).

5.3.2.28 Lox Dome Purge Check Valve, Poststatic. Check valve NA5-26032, serial number 147 at engine 4 was found to be leaking around the body. The discrepant check valve was removed and replaced by check valve serial number 99 (reference DMN M08888).

5.3.2.29 750 PSI Regulator, Poststatic. Upon completion of poststatic checkout, EO3-20C30134 was accomplished which required cleaning and lubrication of the 750 psi regulator 20C30134. Regulator serial number CH002 was removed and regulator serial number CH023 was then installed and tested in accordance with procedure 4.2 and CR P-1176. During this testing it was noted that the A port output flow for bleed plug 9512-959106-5 was only 9 scims. Specifications state an output flow of 75 (±25) scim. This discrepant condition was corrected by replacing bleed plug 9512-959106-5. Retesting produced an output flow of 63 scims (reference FFADS 2794).

5.3.2.30 Instrument Compartment Ducts, Prestatic. Excessive leakage from the precooling ducts in the instrument compartments occurred during prestatic checkout. Close examination revealed that several ducts were torn and/or severely abraded. Although the ducts could not meet the leak check requirements, they were still functional since static test requirements are for air flow only. Therefore, it was decided to delay replacement or repair of the ducts until poststatic checkout, at which time the repairs were completed (reference DMN M07537, DMN M10312, DMN M10314, DMN M10325, DMN M10326, and DMN M10329).

5.3.3 INSTRUMENTATION AND TELEMETRY COMPONENTS.

Instrumentation and telemetry components may be identified by part numbers beginning with 50M, 50C, or 60C5. Failures and discrepancies recorded on instrumentation and telemetry components during prestatic and poststatic checkout are detailed in the following paragraphs. Failures and discrepancies affecting measurements are in order according to measurement number. All replaced components requiring calibration into a measurement system were calibrated prior to installation on the stage.

5.3.3.1 AC Amplifier, Poststatic (B500-11). When running procedure 3.2 on measurement B500-11, AC amplifier 50C10382-5, serial number 0175 was found to be out of tolerance. Investigation revealed that the amplifier printed-wiring range card had an incorrect resistor installed. A new range card was obtained and installed in the amplifier which was recalibrated and returned to the stage (reference FFADS 0546).

5.3.3.2 Zone Box, Poststatic (C1-7). Zone box 50C10404, serial number 1784 was found to have a 22K-ohm leakage path between pins A and B. The defective zone box was removed from the stage and replaced by zone box serial number 176 (reference FFADS 0529).

5.3.3.3 DC Amplifier, Poststatic (C59-1). When running procedure A3.0, the output of DC amplifier 50C10394, serial number 1513 was noted to be drifting in HI-cal mode. The cause of the drift was established during a subsequent bench test and was found to be high contact resistance on relays K1 and K2. Amplifier serial number 1513 was returned to the vendor for rework and amplifier serial number 2047 was installed (reference FFADS 0521).

5.3.3.4 Cable, Prestatic (C61-1). Cable 50C10225, serial number C0005, was found to be damaged and was repaired. The repair was made by applying electrical tape, glass cloth, and a thermosetting adhesive over the area of damage. The damage was caused by personnel traffic in the tail area of the stage (reference DMN M10318).

5.3.3.5 DC Amplifier, Poststatic (C89-2). DC amplifier 50C10394, serial number 1597, had no output in any calibrate or run mode during procedure A3.0. The amplifier was removed and returned to the vendor for failure analysis and amplifier serial number 2050 was installed (reference FFADS 0522).

5.3.3.6 DC Amplifier, Prestatic (C264-1).

5.3.3.6.1 DC amplifier 50C10394, serial number 1587, gave indications of oscillating when the high-level calibrate voltage (HI-cal) was applied. When the amplifier was removed from the stage for bench test, the defect could not be confirmed and the amplifier was recalibrated and reinstalled (reference DMN M06788).

5.3.3.6.2 DC amplifier 50C10394, serial number 1587, was found to have an output 0.160 vdc above the 0.680 vdc specified for operation in RUN mode. Subsequent bench tests revealed that the amplifier gain-adjust potentiometer was not at the correct setting. The potentiometer was readjusted and the amplifier was reinstalled on stage S-IB-1 (reference DMN M06778 and FFADS 0342).

5.3.3.6.3 When running TM vs hardwire procedure A10.0, DC amplifier 50C10394, serial number 1587, failed to conform to specifications. Using manual procedure 3.3, an attempt was made to adjust the amplifier to the values shown on the calibration curve. This attempt revealed that the amplifier gain could not be adjusted to the specified LO-cal output without causing the HI-cal output to be out of tolerance. It also was noted that the amplifier oscillated when in HI-cal mode. The amplifier then was removed from the stage for bench test. Two subsequent bench tests, one in the tlectrical fabrication area and one in the receiving inspection area, failed to verify the discrepancy and amplifier serial number 1587 was returned to stock. Amplifier serial number 1674 was selected as the replacement and was installed on stage S-IB-1 (reference DMN M06798, DMN M10866, and FFADS 0351).

5.3.3.7 DC Amplifier, Poststatic (C528-12). DC amplifier 50C10394, serial number 1360 would not switch to HI-cal or LO-cal modes during procedure A3.0. The amplifier was removed and subjected to a bench test which failed to verify the malfunction. To eliminate any possibility of high contact resistance, the contacts of connectors P1 and P2 were cleaned and the amplifier recalibrated prior to reinstallation (reference FFADS 0525).

5.3.3.8 Pressure Transducer, Poststatic (D14-2). When running procedure 3.19, pressure transducer 50C10397, serial number 3-7864 for measuremtne D14-2, displayed a tendency to drop out of operation and was intermittent. The discrepant transducer was removed and replaced by transducer serial number 6-6286 (reference FFADS 0532).

5.3.3.9 Transducer, Poststatic (D41-9). When running pressure measurements procedure 3.4, transducer 50C12180, serial number 4-7805, was 18.6 percent out of tolerance at 14.5 psia. The transducer was removed and replaced by transducer serial number 7-5032 (reference FFADS 0524).

5.3.3.10 Pressure Transducer, Poststatic (D124-10. During performance of procedure A10.0, pressure transducer 50C10306, serial number 3-8381 at measurement D-124-10, failed to conform to values specified by the calibration curve. The discrepant transducer was removed and replaced by transducer serial number 3-9323 (reference FFADS 2773).

5.3.3.11 Pressure Transducer, Prestatic (D500-11). During procedure 3.4, the output voltage of measurement D500-11 was low at all pressures applied to transducer 50C10259, serial number M2096. The transducer was removed from the stage on DMN M06755 and given a bench test. No malfunction could be found and the transducer was returned to stock. Transducer 50C10259, serial number M2410 was installed (reference DMN M06755, DMN M10852, and FFADS 0339).

5.3.3.12 Pressure Transducer, Prestatic (D502-11). When performing steps 21 and 22 of procedure 3.4 on measurement D502-11, all values of output voltage from transducer 50C10306, serial number 3-9346, deviated from the calibration curve by approximately 4 percent. All readings were low, indicating that the transducer had been overpressurized on the low side. The damaged transducer was scrapped and replaced by transducer serial number 3-9308 (reference DMN M06781, DMN M10851, scrap tag 17035, and FFADS 0279).

5.3.3.13 Accelerometer, Poststatic (E12-8). During performance of procedure 3.5 for measurement E12-8, accelerometer 50C10395, serial number 536, was found to have a damaged connector pin and was scrapped. Accelerometer serial number 1022 was installed (reference FFADS 2752).

5.3.3.14 Accelerometer, Poststatic (E33-3). During poststatic checkout operations, accelerometer 50C10105, serial number 264, was damaged by personnel working in the stage and was scrapped. Accelerometer serial number 1081 was installed (reference DMN M08885 and para 4.3.3.8).

5.3.3.15 Accelerometer, Prestatic (E251-9).

5.3.3.15.1 No output was received from measurement E251-9 during procedure 3.5. Trouble analysis revealed that accelerometer was removed from the stage and returned to the vendor for failure analysis. Accelerometer serial number 8738F was installed (reference DMN M06732, DMN M10853, and FFADS 0229).

5.3.3.19 Emitter Follower, Prestatic (E501-4). During checkout of measurement E501-4, it was found that the gain of AC amplifier 50C10382, serial number C162, could not be adjusted. All components of measurement E501-4 were removed from the stage for detailed trouble analysis and bench test. Close examination of emitter follower 50C10401, serial number 0013, revealed that electrical connector J2 was loose due to a break in the inner threads beneath the locknut, and that one wire was broken from the connector. The defective emitter follower was returned to the vendor for further failure analysis and rework, and was replaced by emitter follower serial number 0016. The measuring system was recalibrated with the new components before reinstallation on stage S-IB-1 (reference DMN M06709, DMN M10641, DMN A10859-A, FFADS 0271, and FFADS 0274).

5.3.3.20 Accelerometer, Prestatic (E503-9).

5.3.3.20.1 Accelerometer 50C10406, serial number 351 was damaged by personnel working in the stage, and was replaced by accelerometer serial number 438 (reference DMN M06789).

5.3.3.20.2 Accelerometer 50C10406, serial number 438, was damaged by personnel working in the stage, and was replaced by accelerometer serial number 435 (reference DMN M06793).

5.3.3.21 Accelerometer Cable, Poststatic (E503-9). During poststatic checkout operations, accelerometer cable 50C12265 was damaged by personnel working in the stage and was scrapped (reference DMN M08896).

5.3.3.22 Accelerometer and Cable, Prestatic (E505-11). No output in Hi-cal mode was received from measurement E505-11; however, the bias voltage was normal. Trouble analysis by substitution methods revealed that accelerometer 50C10395, serial number 540, was defective (DMN M06734). As a result, the measuring system was removed from the stage for recalibration with a new accelerometer. A more detailed examination in the calibration area disclosed that cable 50C03753-1 was open from pin 4 to pin D and that no defect existed in accelerometer serial number 540. The defective cable was replaced with a new cable and the system, including accelerometer serial number 540, was recalibrated and reinstalled (reference DMN M06734, DMN M10642, and FFADS 0209).

5.3.3.23 Accelerometer, Poststatic (E597-3). When running vibration measurements procedure 3.5, the output from measurement E507-3 was noted to be 0.015 vdc above the 2.32 vdc specified. During subsequent trouble analysis, the O-ring was found to be missing from the electrical connector on accelerometer 60C50066, serial number 11650F. The missing O-ring was installed and the accelerometer reinstalled on the stage (reference DMN M08889).

5.3.3.24 Accelerometer, Prestatic (E508-2). Accelerometer 60C50066, serial number 11651F, was found to have no measurable output at any acceleration (g) level during procedure 3.5. The accelerometer was removed from the stage and the failure verified by bench test. Accelerometer serial number 11651F was returned to the vendor for failure analysis and accelerometer serial number 11657F was installed on the stage (reference DMN M06787A and FFADS 0269).

5.3.3.25 Accelerometer, Poststatic, E508-2). When running procedure 3.5, an erratic output was observed from accelerometer 60C50066, serial number 11657F at measurement E508-2. The discrepant accelerometer was removed and replaced by accelerometer serial number 12525F (reference FFADS 2767).

5.3.3.26 Accelerometer, Poststatic (E509-9). During procedure 3.5, erratic output readings were obtained from accelerometer 60C50067, serial number 11662F at measurement E509-9. The discrepant accelerometer was removed and replaced by accelerometer serial number 12098F (reference FFADS 2762).

5.3.3.27 Accelerometer, Poststatic (E510-9). During procedure 3.5, the output from accelerometer 60C50067, serial number 11663F for measurement E510-9, was found to remain constant at 0.075 volts. Accelerometer serial number 11663F was removed and replaced by accelerometer serial number 12091F (reference FFADS 2761).

5.3.3.28 Pulse Detector, Prestatic (K2-12, K3-12 and K67-12. When running procedure 3.10, no output was received from pulse detector 60C50094, serial number 0024, for measurements K2-12, K2-13, and K67-12. Investigation of the detector revealed that the input capacitors were missing at input pins 21 through 24 and that no polarity jumper was installed (ECP ET50294-1). The pulse detector was removed from the stage for incorporation of the missing items and was not reinstalled until after completion of prestatic checkout operations. As a result, the portions of procedure 3.10 covering measurements K2-12, K2-13, and K67-12 were not completed (reference DMN M06731 and Obsolete Material Tag 105236).

5.3.3.29 Liquid Level Rack, Prestatic (L19-O1). Examination of checkout station recorder output during performance of procedure 3.11 revealed that pulse 12 of measurement L19-O1 was missing from the output of liquid level rack 50C12295, serial number 401006. In order to complete the procedure, liquid level rack serial number 401006 was removed and replaced by liquid level rack serial number 310004. Subsequent failure analysis of the defective liquid level rack revealed a defective GV-105-B1 amplifier card which was replaced (reference DMN M06730, DMN M10643, and FFADS 0326).

5.3.3.30 Liquid Level Adapter, Prestatic (L42-F2). Continuous liquid level adapter 50C10699, serial number 20, would not perform in accordance with specifications when placed in HI-cal mode. The defective adapter (serial number 20) was removed from the stage and returned to the vendor for failure analysis. Adapter serial number 39 was installed as the replacement (reference DMN M06784 and FFADS 0345).

5.3.3.31 Liquid Level Adapter, Poststatic (L42-F2). The output of continuous liquid level adapter 50C10699, serial number 35 for measurement L42-F2, was found to be erratic in LO-cal mode. Adapter serial number 35 was removed and replaced by adapter serial number 51 (reference FFADS 0551).

5.3.3.32 Liquid Level Adapter, Poststatic (L43-F3. During procedure 3.11, an erratic output in LO-cal mode was observed from liquid level adapter 50C10699, serial number 18 for measurement L43-F3. The discrepancy was verified and the adapter replaced by adapter serial number 40 (reference FFADS 2766).

5.3.3.12.2 When rerunning procedure 3.5, no output was received from measurement E251-9. The trouble was isolated to accelerometer 50C10131, serial number 8738F. The accelerometer was moved to another measurement channel that was known to be good and the no-output indication remained the same. The accelerometer then was removed for bench test and it was found that the accelerometer output remained at approximately 1 volt through a range of zero g to maximum g. Accelerometer serial number 8738F was returned to the vendor for failure analysis and rework, and accelerometer serial number 11990F was installed. Procedure 3.5 was not rerun again and the measurement system was accepted on the basis of tests performed during test operations at MSFC-Huntsville (reference DMN M06795, DMN M10158, DMN M10327, and FFADS 0352).

5.3.3.16 <u>Accelerometer, Prestatic (E339-11)</u>. When checking measurement E339-11 with procedure 3.5, no indication of accelerometer exitation was received. Visual examination of accelerometer 50C10406, serial number 422, disclosed that the electrical connector stud was misaligned and that the connector was bent. Accelerometer serial number 422 was scrapped and replaced by accelerometer serial number 433. AC amplifier 50C10382-3, serial number C155; emitter follower 50C10401, serial number 0011; and the original 50C12265 cable were calibrated as a system with the new accelerometer prior to installation on stage S-IB-1 (reference DMN M06738 and FFADS 0253).

5.3.3.17 <u>Emitter Follower and Cable, Prestatic (E339-11)</u>. Emitter follower 50C10401, serial number 0011, and cable 50C12265 were damaged by personnel working in the tank skirt. Emitter follower serial number 0011 and the damaged cable were replaced by emitter follower serial number 14A and a new cable. Measuring system E339-11 then was recalibrated with the new components (reference DMN M10320).

5.3.3.18 <u>Accelerometer Cable, Poststatic (E339-11)</u>. When running procedure 3.5 on measurement E339-11, the 50C12295 accelerometer cable was found to be open. The defective cable was scrapped and a new cable was recalibrated with the system and installed (reference FFADS 2751).

5.3.3.33 Liquid Level Probe, Prestatic (L46-O1). Continuous liquid level probe 50C10362, serial number 39599, could not be calibrated in accordance with specifications due to increased capacitance between pins 4 and 6 (550 uuf) and between pins 4 and 5 (130 uuf). An investigation established the cause of the discrepancy as a defective electrical connector. Since the probe could not be calibrated, the L46-O1 portion of procedure 2-CM-IB-201B-3.11 was not completed. Subsequently, the discrepant connector was replaced and the probe successfully calibrated during static test operations at MSFC-Huntsville (reference DMN M06783).

5.3.3.34 Liquid Level Adapter, Poststatic (L46-O1).

5.3.3.34.1 No output for measurement L46-O1 was received from continuous liquid level adapter 50C10699, serial number 30. The discrepant adapter was removed and returned to the vendor for failure analysis. Adapter serial number 24 was installed (reference FFADS 0550).

5.3.3.34.2 After installation, it was found that liquid level adapter 50C10699, serial number 24 for measurement L46-O1, could not be correctly calibrated. Adapter serial number 24 was removed and returned to the vendor for rework and failure analysis, and adapter serial number 50 was installed (reference FFADS 0553).

5.3.3.35 Continuous Liquid Level Adapter, Prestatic L49-O4). Continuous liquid level adapter 50C10699, serial number 16, would not switch to HI-cal or LO-cal modes as specified. Closer inspection revealed that the calibrate relays in the adapter were operative but the adapter would not lock in either calibrate mode. As a result, adapter serial number 16 was removed from stage S-IB-1 and returned to the vendor for failure analysis and rework. Adapter serial number 42 was installed as the replacement for the defective adapter. Procedure 3.11 was not rerun after adapter replacement and the new adapter was accepted on the basis of procedures performed during static test operations at MSFC-Huntsville (reference DMN M10311, DMN M10327, FFADS 0377, and item 79 of prestatic checkout Squawk Sheet K04450).

5.3.3.36 DC Amplifier, Poststatic (M19-12). When performing procedure 3.12, DC amplifier 50C10394, serial number 1174 for measurement M19-12, could not be adjusted to within the tolerance of the calibration curve. The amplifier was removed and returned to the vendor for rework and failure analysis. Amplifier serial number 1774 was installed (reference FFADS 0549).

5.3.3.37 Rate Gyro, Poststatic (R502-11). When running procedure 3.14 for measurement R502-11, rate gyro 50C10676, serial number 264 was found to have no output. The discrepant rate gyro was removed and replaced by rate gyro serial number 280 (reference FFADS 2757).

5.3.3.38 DC Amplifier, Prestatic (S523-11). When running step 2 of TM vs hardwire procedure A10.0, DC amplifier 50C10388, serial number 0110 for measurement S523-11, was found to have no output in HI-cal or LO-cal mode. The failure was verified and amplifier serial number 0110 was returned to the vendor for failure analysis. Amplifier serial number 0259 was installed (reference DMN M06800, DMN M10157, and FFADS 0365).

5.3.3.39 DC Amplifier, Prestatic (S553-20). During performance of strain measurements procedure 3.15, DC amplifier 50C10388, serial number 14290 for measurement S553-20, gave indications that the output voltages for HI-cal and LO-cal modes were reversed. A close examination during a subsequent bench test disclosed that the calibrate relays functioned correctly when activated by switches S1 and S2 on the amplifier, but that the connections to P1-13 and P1-14 and to P2-13 and P2-14 were cross-wired. Amplifier serial number 14290 was returned to the vendor for corrective action and amplifier serial number 0319 was installed (reference DMN M06749, DMN M10646, and FFADS 0258).

5.3.3.40 DC Amplifier, Poststatic (S561-22). The output of DC amplifier 50C10388, serial number 14296 for measurement S561-22, could not be adjusted to within the specified tolerance. DC amplifier serial number 0458 was selected as the replacement for DC amplifier serial number 14296; however, during calibration, DC amplifier serial number 0458 failed to meet the DC offset specifications. DC amplifier serial number 0123 then was selected, calibrated, and installed (reference FFADS 0540 and FFADS 1513, respectively).

5.3.3.41 Measurement Calibrator, Prestatic. When running procedure 3.3, measurement calibrator 50C10285, serial number 181, failed to switch to HI-cal mode on channel 15. The failure was verified and the measurement calibrator was returned to the vendor for detailed failure analysis. Measurement calibrator serial number 216 was installed on stage S-IB-1 (reference DMN M06744, DMN M06745, and FFADS 0272).

5.3.3.42 Measurement Calibrator, Poststatic. During final checkout operations, it was found that measurement calibrator 50C10285, serial number 184, would not switch into RUN mode on channel 11. Measurement calibrator serial number 184 was removed and replaced by measurement calibrator serial number 125 (reference FFADS 0548).

5.3.3.43 Measuring Rack Selector, Prestatic. Connector J3 on measuring rack selector 50C12313, serial number 17, was found to have 28 vdc on pins F, G, and H at all times. This condition prohibits control over all channels except channels 15 and 19. The defective measuring rack selector was removed from the stage and returned to the vendor for rework, and was replaced by measuring rack selector serial number 18. Both measuring rack selectors were labeled "nonflight". Following completion of checkout operations, measuring rack selector serial number 18 was removed and replaced by flight-configuration measuring rack selector serial number 1004 (reference DMN M06713 and item 55 of prestatic checkout Squawk Sheet K04450).

5.3.3.44 Tape Recorder, Prestatic.

5.3.3.44.1 The record and playback function of tape recorder 50C10338, serial number 62, failed to operate during procedure A10.0. Preliminary inspection disclosed that the metallic strip at the end of the tape, which is used as a switch in the recorder start-stop circuit, was peeling from the tape. Then, the operating time records were checked and it was found that the tape life had been exceeded. The discrepant tape recorder was removed from the stage and returned to the vendor for failure analysis and rework, and was replaced by tape recorder serial number 074 (reference DMN M06790 and FFADS 0333).

5.3.3.44.2 During an attempt to rerun procedure A10.0 after installation of tape recorder 50C10338, serial number 074, considerable noise was encountered in the recorder output during playback. The highest noise-levels were found to occur in the vicinity of 730 cycles per second (cps), 1700 cps, and 2300 cps on both recorder channels. The tape recorder then was removed from the stage and retested in the CCSD engineering laboratories; however, the noise discrepancy could not be verified. Tape recorder serial number 074 was returned to stock and tape recorder serial number 070 was installed (reference DMN M06791 and FFADS 0270).

5.3.3.44.3 During the third attempt to complete procedure A10.0, the track-1 output of tape recorder 50C10338, serial number 070, contained noise and was at a low signal level. A detailed bench check at the vendor's facility revealed that no track-1 output was present due to a broken lead between the reproduce amplifier in the recorder and the head for track 1. Tape recorder serial number 070 was replaced by tape recorder serial number 074 (see para 5.3.3.44.2) on stage S-IB-1 (reference DMN M06794 and FFADS 0347).

5.3.3.44.4 During the fourth attempt to complete procedure A10.0, tape recorder 50C10338, serial number 074, was found to have excessive noise in the output (see para 5.3.3.44.2). Recorder serial number 074 was removed from the stage and returned to the vendor for failure analysis. After completion of prestatic checkout, vendor repair operations on tape recorder serial number 070 (para 5.3.3.44.3) were completed and the recorder was shipped to CCSD-Michoud for installation on stage S-IB-1 (reference DMN M06799 and FFADS 0356).

5.3.3.45 Tape Recorder, Poststatic.

5.3.3.45.1 After stage S-IB-1 moved into the checkout test station for poststatic checkout, it was found that tape recorder 50C10338, serial number 070, would not be able to complete checkout operations without exceeding the maximum allowable operating cycles. Tape recorder 070 was removed and replaced by tape recorder 074 (reference DMN M08893).

5.3.3.45.2 Tape recorder 50C10338, serial number 074, was found to have noise in the output signal at 1300 and 1700 cycles per second (cps). Tape recorder serial number 074 was removed and replaced by serial number 1029 (reference FFADS 2758).

5.3.3.45.3 When running procedure A10.0, noise was present on tracks 1 and 2 of tape recorder 50C10338, serial number 1029. The discrepant recorder was removed and returned to the vendor for rework and failure analysis. Recorder serial number 070 was installed (reference FFADS 2764).

5.3.3.45.4 Excessive noise was noted in the output of tape recorder 50C10338, serial number 070 when running simulated flight test procedure A20.0. The discrepant tape recorder was removed and returned to the vendor for failure analysis and rework. Subsequently, tape recorder serial number 1029 was reinstalled after completion of final checkout (reference FFADS 2779).

5.3.3.46 Multiplexer, Telemeter F1, Poststatic. During procedure A3.18, no output was received from channel 1, frame 5 of multiplexer 60C50081-5, serial number 001. The discrepancy was corrected by removing printed wiring board M2807A, serial number 037, and installing printed wiring board M2807A, serial number AH44 (reference FFADS 0528).

5.3.3.47 PCM/DDAS Assembly, Poststatic. During PCM/DDAS calibration procedure 3.18 an output of 0.636 vdc was obtained from PCM/DDAS assembly 60C50079-1, serial number 003, with no input applied. The discrepant PCM/DDAS assembly was removed and replaced by PCM/DDAS assembly 005 (reference FFADS 2759).

5.3.3.48 Dual Output Amplifier, Telemeter F2, Poststatic. When running procedure A10.0, dual output amplifier 50C60036-3, serial number 113 on telemeter F2, was found to have an excessively noisy output. Amplifier serial number 113 was removed and replaced by amplifier serial number 00137 which was removed from stage S-IB-3 (reference FFADS 2769).

5.3.3.49 RF Container Assembly, Prestatic. RF container assembly 50C12196-5, serial number 001 was found to be generating a signal that mixed with the output frequency from channel 1 causing an erroneous output. During a subsequent bench test, it was found that the ac filament output of the invester in the RF container assembly was being inductively coupled to the transmitter input circuits. This condition caused a 3400 cps modulation of the transmitter output. On recommendation from CCSD design engineering, three leads (J2-E to J101-E, L1 to TB1-E4, and E1 to GND lug) were physically separated from the cable bundle containing lead TB1-E8 to J102-C, and rerouted to pass between the transmitter and filter and under transmitter connector J105. Photographs were taken of the new routing and lead dress for use in preparation of engineering orders that will effect a similar change on the RF container assemblies used on subsequent S-IB stages. Also, similar changes were made to RF container assemblies 50C12196-7, serial number 001, and 50C12196-9, serial number 001. All three assemblies were reinstalled on stage S-IB-1.

5.3.3.50 Power Divider, Poststatic. When performing insulation resistance tests during procedure 1.1, power divider 50C12173, serial number C0002, was found to have low insulation resistance at connectors J1, J2, and J3. The specified minimum insulation resistance was 200 megohms. The value measured was 160 megohms. Power divider serial number C0002 was removed and replaced by power divider serial number SA0166 (reference FFADS 0516).

5.3.3.51 TM Calibrator Power Supply, Poststatic. When running procedure A5.0, a failure occurred affecting the +28-vdc output from TM calibrator power supply 60C40056, serial number 02. The defective power supply was removed and returned to the vendor for failure analysis. Since no replacement was available, power supply serial number 04 was removed from stage S-IB-3 and installed (reference FFADS 0552).

5.3.3.52 Zone Boxes, Poststatic. In order to assure that zone box cable insulation was in good condition when stage S-IB-1 was shipped to KSC, inspections and tests were conducted on all installed zone boxes at the termination of poststatic checkout operations.

5.3.3.52.1 A visual inspection was performed on each zone box to assure the following:

a. Fiberglass insulation not visible through stainless steel overbraid.

b. No breaks or irregularities in the overbraid.

c. No evidence of discoloration or burned material that would indicate insulation breakdown.

5.3.3.52.2 Insulation resistance tests were performed on each zone box to assure that the insulation resistance was a minimum of 50 megohms at 50 vdc between pins A and B and between all pins and the zone box case. Continuity resistance tests were performed on each zone box to assure that the internal resistances were as specified.

5.3.3.52.3 Of the 66 zone boxes inspected and tested, 25 were rejected and were replaced. Refer to the 16 July 1965 entries of part numbers 50C10402, 50C10403, and 50C10404 in table 1-7 for determination of zone boxes replaced.

5.3.4 STRUCTURAL COMPONENTS.

Structural components may be identified by part numbers beginning with 30M, 30C, or 60C3. Occasionally failures or discrepancies of structural components will be documented by stage assembly part numbers beginning with 10M, 10C, or 60C1. No failures or discrepancies were recorded on structural components during prestatic and poststatic checkout.

SECTION VI

STATIC TEST OPERATIONS

6.1 SCOPE.

6.1.1 This section contains a general summary of inspection and static test data relative to static test operations at MSFC, Huntsville, Alabama on stage S-IB-1. For more detailed information, refer to the static test publications listed at the rear of this report.

6.1.2 On March 6, 1965, stage S-IB-1 was shipped by barge from the CCSD manufacturing facility at MSFC-Michoud. The stage arrived at the MSFC-Huntsville dock on March 14, 1965, and was installed in the static test tower east (STTE) on March 15, 1965.

6.2 STATIC TEST CONFIGURATION.

The static test configuration of stage S-IB-1 is defined by drawing 60C10016.

6.2.1 COMPONENTS NOT INSTALLED.

Flight components not installed for static test and deletions from the flight configuration as specified by drawing 60C10016 include the stabilizer fins, outboard engine shrouds, instrumentation cannister doors, and lox replenish valve.

6.2.2 COMPONENTS ADDED.

Hardware additions include static test holddown brackets, upper stage deluge firex ring, inboard engine turbine exhaust duct extensions, auxiliary lox dome purge manifold, and three lox and three fuel dump valves.

6.2.3 COMPONENTS SUBSTITUTED.

Block II (SA-5 through SA-10) type static test heat shield panels and engine flame curtains similar to flight hardware were used in place of the actual flight hardware. A peripheral tail skirt radiation shield is also included as a part of the static test configuration.

6.3 INSPECTION AND LEAK CHECKS.

6.3.1 INSPECTION AND LEAK CHECKS PERFORMED.

Inspection and leak checks that were performed on stage S-IB-1 are as follows:

a. Pretest inspection and leak checks, SA-25

b. Posttest inspection and leak checks, SA-25

c. Pretest inspection and leak checks, SA-26

d. Posttest inspection and leak checks, SA-26

6.3.2 OBJECTIVES.

The primary objective of the inspection and leak checks is to checkout all systems for hardware discrepancies and leaks prior to and after each static test firing. The pretest inspection and leak checks are performed to verify that the stage configuration for static firing conforms to the latest drawings and specifications. The posttest inspection and leak checks are performed to locate discrepancies that may have occurred during actual firing.

6.4 STATIC TESTS.

The acceptance test firings of stage S-IB-1 were performed by the CCSD Systems Static Test Branch at the Static Test Tower East (STTE), Marshall Space Flight Center (MSFC), Huntsville, Alabama.

6.4.1 TESTS PERFORMED.

6.4.1.1 Short Duration Firing, SA-25. The short duration firing (SA-25) was performed by the CCSD static test branch at the static test tower east (STTE), Marshall Space Flight Center, Huntsville, Alabama. Static test SA-25 was conducted on April 1, 1965. Termination was initiated by the firing panel operator after a test duration of 35.174 seconds from ignition command to inboard cutoff signal.

6.4.1.2 Long Duration Firing, SA-26. The long duration firing (test SA-26) was performed by the CCSD systems static test branch on April 13, 1965. The duration of test SA-26 was 138.210 seconds. Inboard engine cutoff was initiated by the switch selector 2 seconds after the lox low-level depletion sensor in lox tank 2 was uncovered. This sensor is located 28.2 inches below theoretical tank bottom. Outboard engine cutoff signal, triggered by dropout of the thrust-ok pressure switch on engine 1, occurred 6.80 seconds later. Thrust decay resulting from lox depletion began 117 milliseconds before dropout of the thrust-ok pressure switch. Thrust decay was also indicated on engine 3, 67 milliseconds prior to dropout of its thrust-ok pressure switch.

6.4.2 TEST OBJECTIVES.

The primary purpose for static test of stage S-IB-1 was to demonstrate the correct functional operation and performance of flight systems. This precept was satisfied by conducting a short duration firing and a long duration firing with flight conditions simulated as closely as possible.

6.4.2.1 Test Objectives, Short Duration Firing. The short duration firing constitutes a confidence test to verify airborne/ground control system compatibility, to checkout instrumentation, and to verify engine performance. Based on data obtained from this test, corrections will be made prior to the long duration static firing as required. The following specific objectives were established for the short duration firing:

a. Performance check of the gimbal system.

b. Performance check of the telemetry system.

c. Performance check of the engines.

d. Evaluation of the modified fuel pressurizing system.

e. Determination of lox boiloff rate.

f. Evaluation of tank pressurization system transients with flight ullages.

6.4.2.2 Test Objectives, Long Duration Firing. The long duration firing constitutes an acceptance test and confirms the correct operation of all flight systems. The following objectives were established for the long duration firing:

a. Determine propellant tank draining rates and terminal lox draining characteristics.

b. Verify engine performance.

c. Verify performance of the gimbal control system.

d. Verify reliability and performance of telemetry equipment.

e. Obtain lox boiloff evaluation data and verify bulk lox density obtained during initial tanking.

6.5 STATIC TEST OPERATIONS DATA.

The following paragraphs present data relative to static test operations for stage S-IB-1. Included in these paragraphs is selected data considered pertinent to launch and future static firings.

6.5.1 ENGINE SYSTEMS DATA.

6.5.1.1 Thrust-OK Pressure Switches, Pretest SA-26. Due to the flight design for stage S-IB-1, it was necessary to replace the thrust-ok pressure switches that were rated at 840 psia with new thrust-ok pressure switches rated at 800 psia.

6.5.1.2 MLV Position Indicator Installation. The main lox valves (MLV) position indicators were installed by Rocketdyne personnel after the stage arrived at static test. The position indicators were then functionally checked by cycling the main lox valves and recording potentiometer resistance. All readings were satisfactory.

6.5.1.3 Lox Dome Vibrations, Engines 4 and 8. At cutoff of test SA-25 abnormal lox dome vibrations were recorded on engines 4 and 8. The rough combustion cutoff (RCC) measurements for these two engines commenced counting approximately one second after cutoff, and each measurement accumulated a total of 25 counts. This represented a vibration level in excess of 100 g rms for less than 1 millisecond. All engines experienced a definite vibration buildup at cutoff, but only engines 4 and 8 exceeded 100 g rms.

6.5.2 GN_2 CONTROL SYSTEM DATA.

The GN_2 control system functioned satisfactorily during test SA-26 except for obtaining 3000 psig preignition control sphere pressure. With the gearcase purge on, the maximum control sphere pressure obtained was 2965 psig using a supply pressure of 3100 psig. A functional check performed after test SA-26 showed that a change of the supply orifice from a 0.050-inch to a 0.555-inch diameter would provide the specified 3000 psig preignition control-sphere pressure when using both the gearcase and calorimeter purges.

6.5.3 FUEL SYSTEM DATA.

6.5.3.1 The fuel system functioned satisfactorily during test SA-25 and SA-26 with the exception of the uneven fuel levels experienced during test SA-26. The fuel level for both tests was 634.5 inches which provided the required 2 percent ullage. A comparison of fuel levels during test SA-26 shows that from X + 17 seconds, the fuel level in fuel tank 3 was 9 inches above the fuel level in fuel tank 1 and remained relatively constant until X + 62 seconds. At this time, the fuel levels began changing until the fuel in fuel tank 1 reached a level 35 inches higher than the fuel in fuel tank 3 at X + 95 seconds. This 35-inch difference stayed constant through the remainder of the test.

6.5.3.2 The uneven fuel levels were apparently the result of unequal ullage pressures which were caused by an unbalanced pressure distribution in the fuel pressurizing manifold. Two conditions apparently contribute to this uneven pressure distribution. One being the pressurizing manifold has only one port to let the pressurizing gas enter. The second condition, which occurs when fuel tanks 2 and 3 receive the highest ullage pressures, is caused by activation of the facility fuel pressurizing system in conjunction with stage pressurization. This causes an unequal pressure distribution in the fuel pressurizing manifold. This condition is peculiar to static test because of the need for supplemental pressurization.

6.5.4 LOX SYSTEM DATA.

6.5.4.1 <u>Lox Container Ullage</u>. For test SA-25, the lox height was 650.5 inches in the center lox container at ignition. This is equivalent to a 2.2 percent ullage. The desired 1.7 percent ullage was not attained due to lox boiloff during a preignition hold of the countdown. Lox container ullage at ignition on test SA-26 was 6 percent with a lox height of 624 inches.

6.5.4.2 <u>Lox Tank Pressurization</u>.

6.5.4.2.1 Lox tank preignition pressurization was accomplished in 82.7 seconds for test SA-25. Following the ignition transients, lox tank pressure increased from 53.5 psia at 5 seconds after ignition (X + 5) to 57.5 psia at cutoff. The excessive lox tank pressure was attributed to incorrect heat exchanger orificing and gox flow control valve minimum-flow gate position.

The excessive lox tank pressure was rectified by reducing the gox flow past the gate of the gox flow control valve from 21 pounds-per-second to 19 pounds-per-second (see paragraph 6.5.4.3).

6.5.4.2.2 Test SA-26 preignition pressurization was accomplished in 71.5 seconds, utilizing a 0.149-inch diameter orifice in the lox pressurizing ground supply. Lox tank pressure during the test was maintained between 50 and 55 psia.

6.5.4.3 Gox Flow Reduction. The 0.108-inch diameter orifices in the heat exchanger lox inlet were replaced with 0.104-inch diameter orifices. This orifice change was made in conjunction with a change in the minimum-flow setting of the gox flow control valve from 0.290-inch to 0.255-inch (EO 2-60C26023) to reduce the excessive lox tank pressure experienced during test SA-25. After test SA-26, a second change was made in the minimum-flow setting of the gox flow control valve (EO 3-60C26023) to further reduce gox flow.

6.5.4.4 Lox Container Boiloff Rates. During standby for test SA-25, the outboard lox tank boiloff rate was calculated at 6.32 pounds per second, the boiloff rate for the center lox tank was calculated at 3.08 pounds per second, and the total boiloff rate was 9.40 pounds per second. The total boiloff rate during standby of test SA-26 was 11.986 pounds-per-second.

6.5.4.5 Lox Depletion Characteristics, Test SA-26. A comparison of lox depletion characteristics between the discrete probe data from the center lox tank and the continuous probe data from the outer lox tanks show a variation in levels of approximately 4 to 9 inches between the center lox tank and the outer tanks during test SA-26. The discrete probe data was used due to the loss of the continuous level probe in the center lox tank. The differential height between tanks during the cutoff sequence also was verified by comparing actuations of lox discrete probes 14 and 15 in all lox tanks.

6.5.5 HYDRAULIC AND CONTROL SYSTEMS DATA.

6.5.5.1 Actuator Movement, Posttest SA-25. The position trace on the oscillograph records for test SA-25 indicated actuator movement less than the amount specified by the gimbal program. The input signal trace was correspondingly low, which indicated the systems response was normal. The problem was isolated to an incorrect resistance-loading of the calibration input signal. This resistance-load was corrected for static test SA-26.

6.5.5.2 Actuator Movement, Pretest SA-26. Pretest functional checks were performed on all engine hydraulic systems upon completion of the cleaning and purging operations prior to test SA-26. All systems performed satisfactorily with two exceptions. The yaw actuator differential-pressure trace for engine 4 was highly erratic; and, slight blips were observed simultaneously in the engine-2 yaw actuator control-valve trace, position trace, differential-pressure trace, and supply-pressure trace. The condition at engine 4 was found to be an instrumentation problem and was corrected prior to test SA-26. Investigation at engine 2 revealed no discrepancies, and the operation was satisfactory during test SA-26.

6.5.6 INSTRUMENTATION AND TELEMETRY SYSTEMS DATA.

6.5.6.1 Installation of Test Instrumentation. Beginning with stage S-IB-1, all static test instrumentation will be installed and checked at MSFC-Huntsville. Previously this has been done at MSFC-Michoud.

6.5.6.2 Telemetry Systems Data.

6.5.6.2.1 The primary purpose of operating the telemetry (TM) system during static test was to verify the proper operation of the flight TM components in a simulated flight environment. During static firing signals from various flight transducers and simulated signals are transmitted by a radio-frequency link from the static test tower antennas to the quality and reliability assurance laboratory ground station.

6.5.6.2.2 Results received from both static firings of stage S-IB-1 indicated that the overall functions of the telemetry systems were satisfactory. A total of 529 measurements were used on each static firing. Test SA-25 had 18 discrepant measurements for a 3.4 percent failure, and test SA-26 had only 14 discrepant measurements for a 2.6 percent failure.

6.5.6.3 Flight Measurements. Upon initial application of power to stage S-IB-1 following erection in the static test tower, an automated scan of flight measurements was performed through the digital data acquisition system (DDAS) to determine the initial status of flight instrumentation. Since all measurements do not appear on the DDAS link, a measurement scan also was performed on single sideband (SS/FM) telemetered measurements and on FM/FM telemetered measurements. Approximately 88 percent of all measurements required work at static test. The majority of measurements that were rejected were strain gage measurements that were calibrated when the stage was in the horizontal position. These measurements required recalibration when the stage was erected in the static test tower.

6.5.6.4 TM Submultiplexer, Posttest SA-25. The oscillograms for engines 2, 3, and 4 on test SA-25 indicated that the conax valve fired at the same time the main lox valve started to close. This discrepancy in data is possibly due to the fact that the TM submultiplexer is designed to sample each signal only once every 83.3 milliseconds. A change in signal status between samplings would be received at an incorrect (delayed) time. The maximum delay in signals being received through the TM submultiplexer to the DDAS ground station and to the ground support equipment would be 83.3 milliseconds. On subsequent stages, all critical events will bypass the submultiplexer.

6.6 FAILURES AND DISCREPANCIES.

6.6.1 ELECTRICAL COMPONENTS.

Electrical system verification on stage S-IB-1 was performed prior to and during static firing. Failures that occurred and discrepancies that were found during static test operations are documented in the following paragraphs.

6.6.1.1 Cable 9W29, Posttest SA-26. While disconnecting the stage cables prior to removal of the stage from the static test tower it was noted that the bottom portion of pins A and B of connector 9W29J1 were excessively pitted due to moisture that leaked into the connector. The connector was removed and replaced by a new connector (reference UCR 01168).

6.6.1.2 Thrust-OK Pressure Switch Connector, Pretest SA-25. A visual inspection of the thrust-ok pressure switches revealed damage to outboard thrust-ok pressure switch NA5-27359-1A, serial number 25358, on engine 2. The electrical connector was bent approximately 10 to 15 degrees, and the switch housing was dented in several places. Due to the amount of damage incurred, the discrepant thrust-ok pressure switch was replaced by thrust-ok pressure switch serial number 25403 (reference UCR 01131 and DMN H00230). This switch was subsequently replaced by a modification which installed a higher-rated NA5-27446 switch (para 6.5.1.1)

6.6.2 MECHANICAL COMPONENTS.

Failures that occurred and discrepancies that were found on mechanical components prior to and during static test operations are documented in the following paragraphs.

6.6.2.1 Thermal Switch, Hydraulic, Pretest SA-25. During preliminary checkout of stage S-IB-1 for test SA-25, it was noted that the temperature-ok indication from the engine-2 auxiliary hydraulic pump motor was not being received. A detailed inspection of the thermal protector switch in motor 20C85065, serial number 1335456, disclosed that one wire had separated from the connector mounted in the thermal switch cover. The probable cause was determined to be corrosion of the solder connection due to a coating of cera-bend compound. The connection was cleaned and resoldered and a normal temperature-ok indication was received (reference UCR 01138).

6.6.2.2 Flexible Hose Assemblies, Engine 3. While performing an engine purge checkout on engine 3, serial number H-7048, it was discovered that the 20C00520 flexible hose assemblies between the thrust outrigger and the engine purge panel were improperly connected. The hose assemblies were crossed such that the fuel injector purge was connected to the gas-generator lox-injector purge, the gas-generator lox-injector purge to the lox dome purge, and the lox dome purge to the fuel injector purge. The hose assemblies were changed to the proper configuration and a gas sample was taken of the fuel injector purge at the engine purge panel to check the non-volatile residue count; the result of which proved negative (no contamination). This indicated that the gas-generator lox-injector manifold had not been contaminated (reference UCR 01114).

6.6.2.3 Heat Exchanger Lox Inlet, Pretest SA-25. While performing a heat exchanger leak check at engine 6, serial number H-4046, excessive leakage was noted at the lox inlet flange on the heat exchanger. An inspection revealed that a neoprene O-ring had been installed and was coated with an excessive amount of lubricant (specific type unknown). An analysis was made of the lubricant to determine lox compatability and the results indicated 3.9 milligrams non-volatile residue (NVR). The lox-compatibility specification states 1 milligram NVR, but since no lubricant was found inside the heat exchanger lox-inlet tube, the flanges were cleaned and the correct 20C00441 flexitallic gasket was installed (reference UCR 01113).

6.6.2.4 Gas Generator and Turbine Exhaust Leakage, Posttest SA-25. During performance of the gas generator and turbine exhaust leak checks, leakage was detected at each engine position. Table 6-1 shows the engine position and serial number, the location of the leakage, and the corrective action taken to stop the leakage.

Table 6-1. Gas Generator and Turbine Exhaust Leak Checks.

Engine		Location of Leakage	Corrective Action
Pos	Serial No.		
1	H-7046	Instrumentation boss on turbine inlet	Replaced copper crush seal
2	H-7047	Turbine to turbine exhaust duct flange	Replaced gasket
3	H-7048	Instrumentation boss on turbine inlet	Replaced copper crush seal
4	H-7049	Turbine inlet flange	Replaced gasket
5	H-4044	Turbine inlet flange	Specified torque reapplied
6	H-4045	Turbine inlet flange	Replaced gasket
7	H-4046	Turbine inlet flange	Specified torque reapplied
8	H-4047	Instrumentation boss on turbine inlet	Replaced copper crush seal

6.6.2.5 Lox Prevalve, Engine 4, Pretest SA-25. During the propellant loading test prior to test SA-25 lox prevalve, 60C20339, serial number 114 on engine 4, failed to give a closed indication. This lox prevalve was removed and replaced with serial number 118 (reference UCR 01116 and DMN H00215).

6.6.2.6 Lox Prevalve, Engine 2, Pretest SA-25.

6.6.2.6.1 During the propellant loading test prior to test SA-25 lox prevalve 60C20339, serial number 105 on engine 2, failed to give a closed indication whenever it was cycled. Subsequently the lox prevalve was replaced with serial number 119 (reference UCR 01122 and DMN H00216).

6.6.2.6.2 Immediately after test SA-25 the lox prevalve at engine 2 again failed to give a closed indication when it was closed, but once the valve achieved ambient conditions the closed indication was received. Due to this discrepant condition lox prevalve, serial number 119 was replaced with lox prevalve serial number 109 (reference UCR 01122, DMN H00216, and DMN H00248).

6.6.2.7 Pressure Transducer, Engine 2, Posttest SA-25. During the quick-look data session following test SA-25 it was noted that the output of the 20C85079 pressure transducer, serial number 1029, was erratic (measurement number D29-2). One-half second after turning the auxilliary pumps on, the trace dropped from approximately 3220 psig to 1280 psig. The fluctuations continued throughout the remainder of the test, but were not as pronounced. The static pressure transducer (Wiancko) sensing the same pressure revealed no unusual vibrations during the time these fluctuations occurred. This indicated that the 20C85079 flight pressure transducer was defective which prompted its replacement by serial number 1027 (reference UCR 01146 and DMN H00225).

6.6.2.8 Pressure Transducer, Engine 3, Posttest SA-25. Static test data accumulated on the 20C85079 flight pressure transducer, serial number 1034, on engine 3 (measurement number D29-3), indicated fluctuations occurring throughout test SA-25. These fluctuations were most pronounced after engine cutoff when they reached an amplitude of approximately 800 psig. The flight pressure transducer appeared to be erratic since the Wiancko transducer sensing the same pressure didn't show the fluctuations. The defective flight transducer was replaced with serial number 1056 (reference UCR 01147 and DMN H00250).

6.6.2.9 Pressure Transducer, Engine 1, Posttest SA-25. The review of data for test SA-25 disclosed that the 20C85079 flight pressure transducer, serial number 1032 (measurement number D29-1), indicated fluctuations. These fluctuations occurred after ignition with a maximum amplitude of 270 psig. The flight pressure transducer was defective and was replaced by serial number 12292 (reference UCR 01148 and DMN H00228.

6.6.2.10 Auxiliary Hydraulic Pump, Engine 1, Pretest SA-26. While performing cleaning operations following replacement of the supply pressure transducer at engine 1, (paragraph 6.6.2.9), the discharge pressure from auxiliary hydraulic pump 20C85064, serial number MX99281, was discovered to be only 87 psig. The specified pressure is 3000 (±50) psig. Auxiliary hydraulic pump 20C85064, serial number MX99281, and corresponding motor 20C85065, serial number 1335440, were removed and auxiliary hydraulic pump serial number MX100735A with pump motor serial number 1335447 were installed prior to static test SA-26. When removing the defective auxiliary hydraulic pump, the snap-ring that holds the spline shaft in place between the pump and motor was found to be broken. Since the splines of the spline shaft cannot become disengaged from the pump or motor, this defect could not have caused the low auxiliary pump discharge pressure. The broken snap-ring was removed and replaced (reference UCR 01156 and DMN H00251).

6.6.2.11 Charging Valve Leak. During precharging of the engine-1 accumulator 20C85062, serial number 124, to 1600 psig, a GN_2 leak was noted at the 18659 high-pressure charging valve. Investigation revealed that the charging valve poppet was scored, subsequently the discrepant charging valve was removed and replaced by serial number 130 prior to static test SA-26 (reference UCR 01157 and DMN H00252).

6.6.2.12 Auxiliary Pump and Motor, Engine 2. When cleaning the engine-2 hydraulic system following the installation of low-pressure flex hoses (refer to modification bulletin FH-651-B1-A), an unusual noise was heard in the 20C85064 auxiliary pump, serial number MX100724A. As the temperature of the hydraulic oil approached the normal operating range, this noise increased noticeably. The auxiliary pump and 20C85065 motor, serial number 1335456 were removed and replaced with a new 20C85064 auxiliary pump, serial number MX100728A, and 20C85065 motor, serial number 1335457 prior to test SA-25. The defective auxiliary pump and motor were sent to CCSD-Michoud for further investigation. The spare hydraulic package assembly, from which the new auxiliary pump and motor were removed, was also returned to CCSD-Michoud (reference UCR 01137, DMN H00242, and DMN H00243).

6.6.2.13 Hydraulic Bleed Valve, Pretest SA-25. A hydraulic leak also was observed during cleaning and filling operations on the engine-2 main hydraulic pump at low-pressure bleed valve 20C85009, serial number 0009. Investigation revealed that the O-ring on this bleed valve was damaged. Since a new O-ring was not available, bleed valve 20C85009, serial number 135-1, and its corresponding O-ring were removed from the defective auxiliary pump (paragraph 6.6.2.11) and installed on the main hydraulic pump at engine 2. The defective O-ring and bleed valve serial number 0009 were installed on the defective auxiliary pump prior to shipment of the pump to CCSD-Michoud.

6.6.2.14 Conax Valve Installation, Pretest SA-25. When installing the 1804001 conax valve assembly insufficient clearance was encountered between the lower conax squib and the housing of the 307454 gas generator control valve. This did not allow enough clearance to connect the 10-281302-4S engine harness connector. If the conax valve were inverted so that the squib nearest the manifold was on top, severe interference resulted between the squib and the 12-601585 main lox valve closing control line on engines 1, 2, 4, and 7 which could result in a high-pressure fuel leak at the conax manifold seal. Therefore, a jumper cable with a smaller connector (MS3106E-10SL-4S) was employed and the conax valves at engines 1, 2, 4, and 7 were installed with the low side squib down next to the gas generator control valve housing (reference UCR 01140 and DMN H00274).

6.6.2.15 Hydraulic Actuator, Engine 2, Pretest SA-26. During pretest functional checks, slight blips were indicated simultaneously by the supply pressure trace, the yaw actuator control valve trace, the yaw actuator position trace, and the yaw actuator differential pressure trace (measurements HP702-2, GM 104, HD101-2, and HP700-2 respectively) for engine 2. A thorough investigation revealed no discrepancies and during test SA-26, the system performed normally (reference UCR 01173).

6.6.2.16 Turbine Exhaust Duct, Engine 8, Posttest SA-26. A visual inspection of engine 8 that was performed after test SA-26 revealed distortion of a bellows section in the turbine exhaust duct adjacent to the heat exchanger inlet. The extent of damage and final disposition was determined when the stage was returned to CCSD-Michoud (Refer to paragraph 4.3.2.3).

6.6.2.17 Thrust Chamber Leak Checks. The normal procedure for performing the internal thrust chamber leak checks is to prefill the fuel jacket to the 72-inch level with fuel. Because of the accelerated schedule at static test, the chambers were flushed with trichlorethylene and the posttest leak check made. This was the first time the chambers were checked for leaks above the fuel prefill level. The leaks noted in table 6-2 were more pronounced with trichlorethylene, prompting a leak check with fuel during which the leakage was measured as shown in table 6-2. The leaks listed in table 6-2 are located in inches aft from the face of the injector and in degrees counterclockwise from the fuel inlet manifold (aft looking forward).

Table 6-2. Thrust Chamber Leakage

Engine		Leakage Rate	Leakage Location	
Pos	Serial No		Below Injector	Counter clockwise
3	H-7048	4 drops per minute	6 inches	120°
4	H-7049	Slight seep	6 inches	5°
5	H-4044	Slight seep	6 inches	240°
7	H-4046	3.5 to 4 milliliters per minute	9 inches	85°
7	H-4046	130 milliliters per minute	13 inches	80°

6.6.2.18 Engine-7 Thrust-Chamber Tube Leak, Posttest SA-26. An immediate posttest inspection of engine 7, serial number H-4046, revealed an internal thrust-chamber tube leak 13 inches below the injector. A closer inspection indicated a longitudinal crack 0.375-inch long by 0.063-inch wide. When the stage was returned to CCSD-Michoud, the engine was removed and replaced by engine serial number H-4052. Refer to paragraph 4.3.2.1.

6.6.2.19 Engine-2 P_c Pop, Posttest SA-26. Oscillograph data from test SA-26 indicated that engine 2 experienced a chamber pressure (P_c) pop after the hypergol diaphragm had burst. The cause for P_c pop is attributed to residual fuel in the igniter which precedes the hypergol into the thrust chamber during the engine start sequence. Prior to test SA-26, an attempt was made to reduce the occurrence of P_c pops by purging the igniter fuel-systems and visually inspecting the hypergol orifices. No restrictions or abnormal flow conditions were noted. The igniter fuel-system purge was expected to reduce conditions conducive to P_c pops but did not completely eliminate them, as indicated by engine 2 performance during test SA-26.

6.6.2.20 Main Lox Valve, Engine 5, Test SA-26. Oscillograph data indicated that the main lox valve position indication from engine 5 was erratic during test SA-26; however, the opening and closing traces were normal. A further investigation revealed that two of the position indicator housing screws were loose, thus allowing the position indicator potentiometer to vibrate during test SA-26.

6.6.2.21 Crush-Washer Installation. During static testing crush-washers were installed due to leakage at small-diameter tube assembly fitting that could not be stopped by refitting and retightening, or replacement of parts. These crush-washers were installed at the following locations:

a. Between bulkhead union MC164D6 and tube assembly 10C11322-1. Upon return to CCSD-Michoud, tube assembly 10C11322-1 was removed and replaced. At this time the crush-washer was removed and not reinstalled. (Refer to UCR 01104 and squawk V00188-8).

b. Between bulkhead union MC164D6 and tube assembly 10C11361. Upon return to CCSD-Michoud, tube assembly 10C11361 was removed and replaced. At this time the crush-washer was removed and not reinstalled. (Refer to squawk V00188-9).

c. Between fitting AN832-16C at lox tank 1 and tube assembly 60C10392-1. Tube assembly 60C10392-1 is for static test use only and was removed. At this time the crush-washer was removed and not reinstalled. (Refer to squawk V00195-8).

d. Between fitting AN832-16C at lox tank 1 and tube assembly 60C10393-1. Tube assembly 60C10393-1 is for static test use only and was removed. At this time the crush-washer was removed and not reinstalled. (Refer to squawk V00195-9).

These crush-washers were the only crush-washers installed, because of discrepant conditions. Upon departure from CCSD-Michoud to Kennedy Space Center, stage S-IB-1 had no unplanned crush-washers installed.

6.6.3 INSTRUMENTATION AND TELEMETRY COMPONENTS.

The following paragraphs cover failures and discrepancies of instrumentation and telemetry components. All static test peculiar instrumentation was installed and checked at MSFC-Huntsville. Previously only part of this was accomplished at MSFC-Huntsville.

6.6.3.1 Pressure Transducer, Test SA-25. During test SA-25, it was noted that the 50C12012 transducer on engine 5 (measurement D1-5) showed evidence of leakage. Investigation revealed that the AN901-4C sealing gasket did not seal properly and was pinched. A new AN901-4C gasket was properly installed eliminating the leakage (reference UCR 01144).

6.6.3.2 Conisphere Temperature Thermocouple, Test SA-25. The 50C10340 conisphere temperature thermocouple on engine 8 malfunctioned at ignition. Posttest inspection indicated that the fast-response lead was bent against the heavy wire lead; however, the junction was covered with carbon and the exact cause of the malfunction could not be proven. All thermocouples were replaced prior to test SA-26.

6.6.3.3 Liquid Level Rack Assemblies, Pretest SA-25. Prior to test SA-25, four 50C12295-1 liquid level rack assemblies, serial numbers 402011, 402013, 403018, and 306049 malfunctioned. On each liquid level rack assembly one liquid level discrete measurement failed (measurement numbers L19-O3, L20-F1, L20-F4, and L19-OC, respectively). A wet condition was simulated by paralleling the output of the proper discrete probe with a 100-thousand-ohm resistance. When the 100-thousand-ohm resistance was removed, the measurement should have responded with a one-pulse output. There was no response. These four inoperative liquid level rack assemblies were replaced with serial numbers 302030, 405023, 401006, and 401005 respectively (reference UCR 01119, UCR 01123, UCR 01124, UCR 01125, DMN H00221, DMN H00222, DMN H00223, and DMN H00224).

6.6.3.4 PCM/RF Assembly, Pretest SA-25.

6.6.3.4.1 While performing an RF-power-radiated test on the 50C12187-1 pulse chain modulated radio frequency (PCM/RF) assembly, serial number 002, no indication of radio frequency power was received on the RF wattmeter. Investigation revealed that 28 vdc power was applied to the package in the proper manner, but subsequent bench tests were conducted and the package was still found to be faulty. This discrepant PCM/RF assembly was replaced by PCM/RF assembly serial number 001 (reference UCR 01112 and DMN H00214).

6.6.3.4.2 After installation of PCM/RF assembly 50C12187-1, serial number 001, and while transmitting a PCM wavetrain, it was found that the modulation of the RF carrier had failed completely. During subsequent bench tests, the carrier was observed to have modulation at first application of power, but the modulation gradually diminished completely. This assembly was replaced with 50C12187-1 PCM/RF assembly serial number 005 (reference UCR 01115 and DMN H00234).

6.6.3.5 P1 Multiplexer, Pretest SA-25. Four channels to the P1 multiplexer had no assigned measurements and were wired to open-circuit terminals in a measurement distributor. The 100-thousand-ohm resistors on the P1 multiplexer cards were removed as measurements on these cards are parallel to FM/FM channels. This open-circuit input to the P1 multiplexer generates approximately 2 volts of noise. It was recommended that a 100-thousand-ohm resistor be installed in the measuring distributors for the unused channels. This will eliminate the open-circuit condition and its inherent excessive noise.

6.6.3.6 Frequency Divider, Measurement T12-7. Evaluation of telemetry records after test SA-25 showed all measurements appeared realistic with the exception of a 50C10695 frequency divider serial number 23564, measurement T12-7. 30 seconds after ignition, measurement T12-7 indicated 26370 RPM, but the reading over the hardwire loop for the same measurement indicated 33030 RPM. This frequency divider was replaced with a 50C10695 frequency divider, serial number 23565 (reference UCR 01153 and DMN H00226).

6.6.3.7 DC Amplifier, Test SA-25. Evaluation of oscillograph records of test SA-25 revealed that combustion chamber pressure measurement D1-8 did not respond to pressure changes. Investigation revealed that the associated 50C10388 signal conditioning amplifier, serial number 14244, failed to produce an output. Measurement D1-8 was not active during test SA-26 because no replacement was available (reference UCR 01174 and DMN H00290).

6.6.3.8 S1 Telemeter Assembly. Evaluation of the 15 single sideband telemetry channels following test SA-25 and SA-26 revealed an excessive amount of noise on each of the channels. Extensive bench tests on the single sideband S1 telemeter assembly and the S1 RF assembly revealed that the S1 package was extremely sensitive to noise present on the 28 vdc power source applied +28 volts power. Because the noise from the power source can be passed through the intelligence channels of a single sideband package, and because of the difficulty in determining the difference between this noise and actual data, it was recommended that all single sideband packages be arranged with an internal filter that will efficiently filter the 28 vdc power to the S1 package (reference UCR 01162 and DMN H00298).

6.6.4 STRUCTURAL COMPONENTS.

The following paragraphs cover failures and discrepancies of structural components that were found prior to and during static test operations.

6.6.4.1 Fuel Tank Sliding Pins, Posttest SA-26. Following test SA-26 it was found that three 30C00427 tank sliding pins were slightly galled. The location of these pins are as follows:

a. Fuel tank 1 next to lox tank 2.

b. Fuel tank 3 next to lox tank 4.

c. Fuel tank 4 next to lox tank 1.

Investigation revealed that the lubricating grease that covers the sliding pins was contaminated and was the apparent cause of the galled condition. This discrepant condition is covered by UCR 01169 and DMN H00260.

6.6.4.2 Ripples, Fuel Tank 3, Posttest SA-26. While removing the stage from the static test tower, five ripples were discovered in fuel tank 3. These ripples were approximately 12-inches long, 1.50-inches wide, and 0.25-inch deep. The cause of this condition is under investigation (reference UCR 01186 and DMN H00297).

6.6.4.3 Heat Shield Panels, Posttest SA-25 and SA-26. Posttest inspection of the heat shield panels and the center access chute cover following test SA-25 revealed that only slight damage occurred during the test. No separation of M-31 insulating material from the stage panels occurred. The panels were discolored and large amounts of M-31C, vapor barrier coating, were burned away. The surface of the 10C11457 instrumented panel installed between fins 1 and 8 next to engine 4 had several cracks. The aft surface of the access chute was charred and completely covered with small cracks to a depth of approximately 0.016-inch which is considered normal. There was no evidence of any fire or hot gas leaks in the engine compartment. Posttest inspection of the heat shield panels following test SA-26 revealed that the usual damage was incurred during this test. Approximately 1500 square inches of M-31 insulation material separated from the panels. Part of the remaining M-31 insulation was cracked and loose.

6.6.4.4 Heat Shield Curtains, Posttest SA-26. The reflective heat shield curtains were tattered on the inboard quadrants of engines 1, 3, and 4, during test SA-26. The curtain on engine 4 was torn completely through and the flexible gimbal boot was charred over an area of approximately 30 square inches. The peripheral static-test radiation shield was torn at the fin 1 and fin 8 positions. The aspirator covers on all outboard engines were tattered on the inboard quadrants; however, only the reflective covers was damaged.

REFERENCE DOCUMENTS

1. S-IB-1 Documentation for KSC comprised of the following:

   (a) Serialized Components List (1.1 - 1.3)
   (b) Component Removal and Installation Record (2.1)
   (c) NASA Authorized Waivers (3.1 - 3.2)
   (d) Approved Deviations (4.1 - 4.2)
   (e) Instrumentation and Telemetry Documentation (6.1-6.9)
   (f) Incomplete/Unincorporated Engineering Orders (7.1-7.3)
   (g) Uncorrected Discrepancies List (8.1 - 8.2)
   (h) Drawings (10.1 - 10.7)
   (i) Engineering Parts List Defining S-IB-1 Prelaunch Configuration (11.1)
   (j) Shipping Document; MSFC Form 71 (13.1)
   (k) H-1D Engine Logbooks (12.1)
   (l) Weight and Balance History Log, S-IB-1 (5.2)
   (m) Pneumatic Test Record, Poststatic Checkout (5.3)

2. Post Static Test Status Report, S-IB-1

3. S-IB Stage Propulsion Report, S-IB-1

4. Saturn S-IB Stage Final Static Test Report, S-IB-1

5. Static Test Quality Control Final Report, S-IB-1

6. Preliminary Static Test Report Test, SA-25, S-IB-1

7. Preliminary Static Test Report Test, SA-26, S-IB-1

SUPPORTING DOCUMENTS

1. Checkout Test Record, Prestatic, S-IB-1
2. Checkout Test Record, Poststatic, S-IB-1
3. Pneumatic Test Record, Prestatic Checkout, S-IB-1
4. CCSD Inspection Squawk Sheets, S-IB-1
5. CCSD Defective Material Notices, S-IB-1
6. CCSD Functional Failure Analysis Data Sheets, S-IB-1
7. Unsatisfactory Condition Reports, S-IB-1

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