NARRATIVE END ITEM REPO
ON SATURN S-IVB - 503
(DAC S/N 1007)

MAY 1967
DOUGLAS REPORT DAC-56505

PREPARED BY J. WOODS
BRANCH CHIEF, QUALITY DATA AND REPORTING
RELIABILITY ASSURANCE DEPARTMENT

PREPARED FOR
NATIONAL AERONAUTICS AND
SPACE ADMINISTRATION
UNDER NASA CONTRACT NAS-

APPROVED BY W. A. FREDERICKSEN
CHIEF ENGINEER, QUALITY ENGINEERING
RELIABILITY ASSURANCE DEPARTMENT

APPROVED BY
DIRECTOR, SATURN PROGRAMS
PRODUCT ASSURANCE

DOUGLAS

DOUGLAS MISSILE & SPACE SYSTEMS DIVISION
SPACE SYSTEMS CENTER – HUNTINGTON BEACH, CALIFORNIA

ABSTRACT

The Narrative End Item Report contained herein is a narrative summary of the Douglas manufacturing and test records relative to the Saturn S-IVB-AS-503 Flight Stage (Douglas P/N LA39300-503, S/N 1007).

Narrations are included on those conditions related to permanent nonconformances which were generated during the manufacturing cycle and existed at the time of acceptance testing. The report sets forth data pertinent to total time or cycle accumulation on time or cycle significant items. Data relative to variations in flight critical components is also included. There is no provision to update or revise the NEIR after initial release.

Descriptors

NEIR
Documentation
Configuration
Significant Items
Stage Checkout
Manufacturing and Test

PREFACE

This Narrative End Item Report is prepared by the Reliability Assurance Operations Department of Douglas Aircraft Company, Inc., for the National Aeronautics and Space Administration under contract NAS7-101. This report is presented in response to requirements of NPC 200-2, paragraph 14.2.4, and is issued in accordance with MSFC-DRL-021, Contract Data Requirements, which details contract data required from Douglas Aircraft Company, Inc. The report summarizes the period from initial stage acceptance testing at the Douglas Space Systems Center, Huntington Beach, California, through final acceptance testing at the Douglas Sacramento Test Center (STC), Sacramento, California, and turnover to NASA/MSFC for delivery to NASA/FTC.

TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

APPENDIX 1

APPENDIX 2

TABLE OF CONTENTS (Continued)

SECTION 1

INTRODUCTION

1.0 INTRODUCTION

1.1 Scope

The NEIR compiles quality evidence and assessments of a particular end item for use in evaluating program objectives and end item usage. This report narrates upon the Saturn S-IVB-503 and discusses the following:

a. Final configuration.

b. Replacements made during test and final checkout (including serial number and change letter of articles removed or substituted).

c. Nature of problems and malfunctions encountered.

d. Corrective action taken or pending.

e. Extent of retests not completed.

f. Total operating hours or cycles for each time or cycle significant system or subsystem.

1.2 Format

This document is organized into sections, with each section fulfilling a specific purpose. The title of each section, and a brief outline of its purpose follow. Section:

1. INTRODUCTION. This section discusses the scope of the NEIR, the Stage Design Concept, Documentation, and Turnover Data.

2. SYSTEM TEST SUMMARIES. A brief summary of principal test areas is presented to give management personnel a concise view of successful test achievement, and remaining areas of concern.

3. STAGE CONFIGURATION. Conformance to engineering design, accepted deviations and waivers, and data on time/cycle significant items.

4. DETAILED NARRATIVE. A presentation in depth of checkout operations, presented with the checkouts at Sacramento Test Center (STC) first, followed by Space Systems Center (SSC) checkouts. Failure and Rejection Reports (FARR's) are referenced as applicable for each paragraph.

APPENDICES:

1. ILLUSTRATIONS. Graphic Art, giving sufficient system detail to clarify areas discussed in the text.

1.2 (Continued)

2. CHARTS. Weld defect charts which show weld discrepancies, included in Table II Failure and Rejection Reports.

3. TABLES.

   a. TABLE I. A compilation of FARR's recorded during systems installation and checkout.

   b. TABLE II. A compilation of FARR's against structural assemblies.

4. GLOSSARY. A list of terms, abbreviations, and phrases used in the NEIR text, with a brief definition.

1.3 Stage Functional Description

A detailed system analysis is beyond the scope of this report. The "S-IVB-503 Stage End Item Test Plan", 1B66170, contains a description of each operational system, and includes a listing of test procedures, with the objective and prerequisite of each test. Stage 503 is primarily a booster stage, consisting of propellant tanks, feed lines, electrical and pneumatic power for operation of stage systems, and such systems as are required for checkout purposes, fuel loading and unloading control, in-flight control and pressurization, and data measurement during these operations.

1.4 Documentation

1.4.1 Data

Manufacturing and test records for this stage include Fabrication Orders (F.O.'s), Assembly Outlines (A.O.'s), Failure and Rejection Reports (FARR's), Serial Engineering Orders (SEO's), Radiographic Inspection Records, Hydrostatic test data, Vehicle Checkout Laboratory (VCL) test data, STC test data, and vendor data. F.O.'s and A.O.'s record in sequence all manufacturing processes, procedures, and Quality Control inspection activities. Any discrepancy from a drawing requirement is recorded on a FARR by Inspection and

1.4.1 (Continued)

Test personnel. The FARR is also used to record the Material Review Board (MRB) disposition applicable to the discrepancy. SEO's may be written: to define the rework required by a FARR; to change the effectivity; or to change other drawing requirements. Radiographic Inspection Records and X-ray photographs of all weld seams are maintained on file by the contractor. All original data is retained in the contractor's Reliability Assurance Department Central Data files. Vendor technical data is received on functional purchased parts and also retained in Central Data files. The majority of documentation referenced within this report is included in the log book which accompanies each stage.

1.4.2 Turnover

1.4.2.1 Douglas Space Systems Center

Turnover of the Saturn DSV-4B-1-1 (S-IVB-503) stage, for transport to Douglas STC, was made at Douglas SSC, Huntington Beach. Conditional acceptance was made by the Air Force Plant Representative, Quality Assurance Division Representative. A letter, A3-131-12.30.8-L-2554, dated 7 October 1966, from the Douglas Contracts Manager to the NASA/MSFC Resident Management Office, I-CO-SD/DAC, covered the submittal of documentation for purposes of technical turnover of the stage to STC. A copy of that letter and accompanying documentation is included in the stage log book (reference Volume 1, Part 1, Section 1).

1.4.3 Age Requirements

Certain components of the Stage 503 systems have age requirement factors. Data defining the requirements, and records relative to age items, replacement schedules, and storage procedures, are on file at SSC.

[redacted] SECTION 2 [redacted]

SYSTEM TEST SUMMARY

2.0 System Test Summary

The following paragraphs present a narrative summary of manufacturing and stage checkout of the S-IVB-503 Stage. Stage checkouts conducted at the Sacramento Test Center (STC) and at the Space Systems Center (SSC) are summarized in paragraphs 2.1 and 2.2, respectively. Detailed narrations of the stage checkouts at STC and SSC are presented in Section 4.

2.1 Stage Checkout - Sacramento Test Center (STC)

The S-IVB/SV SA503 stage acceptance test program was conducted at the Sacramento Test Center between October 1966 and January 1967. Prefiring checkouts were completed by 10 January 1967. Countdown for static firing of the stage began on 19 January 1967 and continued until 20 January 1967 at 1622 hours, at which time the stage was destroyed by explosion (see Douglas Report DAC-56526 for a detailed summary of this incident).

2.1.1 Prefiring Activity

The stage arrived at STC on 11 October 1966, and was installed in Beta Complex test stand III. Of the twenty-five handling and checkout procedures (H&CO) conducted for purposes of prefiring checkout, seven were impounded. The remaining eighteen procedures, available for narrative presentation, were grouped as follows:

a. Propulsion system tests.

b. Forward and aft skirt purge.

c. Electrical/electronic systems tests.

d. Structural inspection.

e. Hydraulic system test.

f. Integrated systems test.

g. Countdown procedures.

2.1.1 (Continued)

The propulsion system tests involved an automatic checkout and a final leak check. There were fifteen failure and rejection reports written as a result of these tests; of these, fourteen were satisfactorily resolved. The fifteenth had not been cleared at the time of this printing.

The forward and aft skirt purge was performed acceptably, with no failures noted.

The electrical/electronic systems tests consisted of the following:

a. Power distribution tests.

b. Umbilical interface compatibility check.

c. Propellant utilization system tests.

d. Level sensor and control unit calibration.

e. Cryogenic temperature sensor verification.

f. Single sideband system tests.

g. Telemetry system test.

h. Digital data acquisition system test.

The tests were performed satisfactorily, with seventeen failure and rejection reports written to resolve problems encountered.

The structural inspection was run to determine the prefiring structural soundness of the stage. The one failure and rejection report was suitably resolved.

The hydraulic system test was performed with no functional failures noted.

2.2 Stage Checkout, SSC

The stage was placed in SSC VCL checkout tower 6 on 15 July 1966, and prepared for systems tests. Checkout operations lasted 44 days, terminating on 14 September 1966. Detailed narration on all tests will be found in paragraph 4.2, with the following six major areas of testing being covered:

a. Umbilical mechanical mating.

b. Environmental control system.

c. Electrical/electronic systems.

d. Propulsion system.

e. Hydraulic system.

f. All systems test.

As certain portions of the testing program were performed simultaneously, the grouping is arbitrary in order to form a coherent sequence.

The umbilical mating tests, consisting of two procedures, verified the umbilical fit and function. One failure covered by a failure and rejection report was suitably resolved.

The environmental control system tests of the forward skirt thermo-conditioning system, consisting of three procedures, were satisfactorily completed. The check of the aft skirt and interstage purge system was also accomplished without significant problems.

The electrical/electronic systems tests comprised twenty-three procedures, divided into the following thirteen areas:

a. Power distribution tests.

b. Continuity compatibility checks.

c. Propellant utilization tests.

2.2 (Continued)

d. Level sensor and control unit calibration.

e. Exploding bridgewire test.

f. Range safety tests.

g. Cryogenic temperature sensor verification.

h. Signal conditioning setup.

i. Single sideband tests.

j. Telemetry tests.

k. Digital data acquisition tests.

l. Telemetry and range safety antenna test.

m. APS simulator test.

Revisions were made to the procedures as required to implement corrections and changes, and to allow testing with existing equipment shortages. Difficulties and problems were suitably resolved, including twenty-eight items that were covered by rejection reports.

The propulsion system tests consisted of the following categories:

a. Propulsion system control console/stage compatibility test.

b. LH_2 tank pressurization system leak check.

c. Pneumatic control system leak check.

d. Cold helium system leak check.

e. Propellant tanks leak check.

f. Repressurization system leak check.

g. J-2 engine system leak check.

h. Propulsion system automatic test.

i. Engine alignment.

2.2 (Continued)

All of the propulsion system tests were completed satisfactorily, with revisions as required. Leakage and other problems were suitably resolved, including fifteen rejection report items.

The hydraulic system tests, consisting of two procedures, were satisfactorily completed after some procedure and program changes. No failure and rejection reports were prepared.

The all systems automatic test, performed with umbilicals in and with umbilicals out, was completed satisfactorily, with 103 procedure revisions and two rejection reports solving problems encountered.

SECTION 3

STAGE CONFIGURATION

3.0 Stage Configuration

The paragraphs of this section define the configuration of the Saturn S-IVB-503 Stage, and note the variations applicable thereto. The narrative includes an explanation of why each part was a variation, and describes the significant differences between the variant parts and those to be used on subsequent stages. Those modifications which were incorporated prior to static acceptance firing are also noted.

Scope changes affecting the stage are briefly described, along with the intent of the changes, their implementation, and the extent and status of their incorporation.

Existing contractural configuration control papers are referenced wherever possible.

3.1 Design Intent Verification

The configuration of this stage is defined in the Engineering Configuration List (ECL) compiled for Stage 503, manufacturing serial number 1007. Dated 19 September, 1966, revision A, this ECL document includes a listing of all parts, non-hardware drawings, and manufacturing and process specifications required for manufacture and test of the stage, as defined by Engineering production drawings and EO releases. The ECL has been transmitted to NASA under separate cover.

Verification of Design Engineering intent is accomplished by a comparison of the ECL, the Planning Configuration List (PCL), and the Reliability Assurance Department As-Built Configuration List (ABCL). Any noted discrepancies were resolved by the contractor, and a listing of the resultant action is filed at the contractor's facility.

3.2 Stage Variations

Components and assemblies which are variations to the stage design, identified by SEO dash numbers after the part number, are detailed in this paragraph. Only Flight Critical Items installed in the stage with SEO's are reviewed. A description of these variations by part name, part number, and serial number, is presented, along with the applicable SEO's. The following components and assemblies either have minor variations, or are affected by changes in production testing requirements. All are of production configuration.

Paragraph	Part Name	Part Number	S/N
3.2.1	Fuel Tank Vent and Relief Valve	1A48257-507-002	0038
3.2.2	Oxidizer Tank Vent and Relief Valve	1A48312-503-005	0025
3.2.3	Helium Fill Module	1A57350-505-001	0223
3.2.4	Chill System Installation	1A59098-3-013	N/R
3.2.5	LH_2 Propulsive Vent Regulator and Shutoff Valve	1B51753-501-006	008
3.2.6	Pressurization Control Module Assembly	1B56653-501-002	00018
3.2.7	Time Delay Circuit Module	1B59020-1-001	016

3.2.1 Fuel Tank Vent and Relief Valve (1A48257-507-002, S/N 0038)

SEO 1A48257-507-002 waived B/P requirements for external leakage checks of this valve, contingent upon eventual satisfactory completion of second product acceptance checks per B/P. The waiver was granted because the vendor did not employ acceptable testing methods. These methods will be modified in the future.

3.2.2 Oxidizer Tank Vent and Relief Valve (1A48312-503-005, S/N 0025)

SEO 1A48312-503-005 waived B/P requirements for external leakage checks of this valve, contingent upon eventual satisfactory completion of second product acceptance tests per B/P. The waiver was granted because the vendor did not employ acceptable testing methods. These methods will be modified in the future.

3.2.3 Helium Fill Module (1A57350-505-001, S/N 0223)

SEO 1A57350-505-001 authorized the use of this module, as modified by the vendor per Engineering variation V-720.

3.2.4 Chill System Installation (1A59098-3-013 A)

SEO 1A59098-3-013A authorized that check valve, P/N 1A59098-013-3, and strainer, P/N 1A59098-013-5, be fabricated and installed in the chill system per B/P. This was rework intended to eliminate possible interference between the check valve flapper and strainer.

3.2.5 LH_2 Propulsive Vent Regulator and Shutoff Valve (1B51753-501-006, S/N 008)

SEO 1B51753-501-006 authorized production acceptance testing and use for checkout purposes of this valve instead of P/N 1B51753-503.

3.2.6 Pressurization Control Module Assembly (1B56653-501-002, S/N 00018)

SEO 1B56653-501-002, a salvage SEO initiated by FARR A180211, authorized the rework required to eliminate leaks caused by slight misalignments due to coupling short lengths of large diameter tubing.

3.2.7 Time Delay Circuits Module (1B59020-1-001, S/N 016)

SEO 1B59020-1-001 authorized relocating the tab on card Q6 to correct its location.

3.3 Scope Change (SC) and Engineering Change Proposal (ECP) Verification

Verification of SC/ECP's which affect this stage have been listed on the DD829-1 form included in the Stage Log Book. SC's and ECP's which could not be verified prior to stage delivery, as a result of equipment shortages, have been verified to the extent of completion by Douglas/AFQA personnel, and recorded in the Stage Log Book on a separate form. SC's scheduled for accomplishment after turnover are listed in the Turnover Documentation section of the Stage Log Book. Verifications are detailed in the following three paragraphs as SC/ECP's incorporated in the initial design; SC/ECP's incorporated and verified at DAC; and SC/ECP's pending incorporation and/or verification.

3.3.1 Scope Changes/Engineering Change Proposals Incorporated in Initial Design

The following SC's and ECP's were part of the original engineering release, and were therefore incorporated in the initial design:

a. SC 1016B, authorized by CCO's 21 and 29, deleted provisions for stage retro-rockets.

b. SC 1027B, authorized by CCO 40, provided for the incorporation of a recirculation type chilldown system.

c. SC 1075B, authorized by CCO's 35, 42 and 55, increased propellant tank wall thickness to accomodate increased J-2 engine head pressure.

d. SC 1096, authorized by CCO 25, removed the fiberglass heat barriers which had insulated the forward and aft skirts from the cryogenic propellant tanks.

e. SC 1104A, authorized by CCO's 49, 54, 76, 77, 160, 207, and 238, provided for the redesign of the umbilical propellant fill and drain couplings.

f. SC 1115, authorized by CCO's 51, 117, 250, and 251, provided for the implementation of MSFC specifications for preliminary vibration, acoustic, and shock tests.

3.3.1 (Continued)

g. SC 1151, authorized by CCO's 113, 154, 235, and 356, provided for hydraulic system design changes to increase system pressure.

h. SC 1152, authorized by CCO 98, provided for the installation of a check valve in the GH_2 bleed line.

i. SC 1167, authorized by CCO's 237, and 330, provided for monitoring and checkout of the J-2 engine switches and valves.

j. SC 1176, authorized by CCO 79, provided that MC fittings be incorporated into all stage systems.

k. SC 1185, authorized by CCO's 125 and 187, and NASA letter 89, provided for interface plug supervision circuits.

l. SC 1195A, authorized by CCO's 140, 230, 339, 391, 397, 407, and MSFC letter L336, provided for a basic static firing measurement program.

m. SC 1204, authorized by CCO's 360, 361, 171, and 220, provided for modification of the complete telemetry system.

n. SC 1211A, authorized by CCO's 185 and 233, provided for longitudinal vibration loads.

o. SC 1232A, authorized by CCO's 242, and 330, revised stage electrical system compatibility requirements.

p. SC 1266, authorized by CCO's 281 and 455, provided for an auxiliary LOX pressure system.

q. SC 1276, authorized by CCO 273, provided for electrical interface connectors and cables.

r. SC 1277, authorized by CCO 265, provided for S-IVB/V Flight vehicles emergency detection system.

s. SC 1278A, authorized by CCO 271, provided for the redesign of the circuitry for the stage coarse loading potentiometers.

t. SC 1282, authorized by MSFC letter TD-48, provided a mounting bracket for the stage to instrument unit connectors.

u. SC 1295, authorized by CCO 282, provided certain hardwire measurement capability through the umbilical. Several measurements were changed from DDAS to hardwire, and certain hardwire measurements were changed to DDAS.

v. SC 1297A, authorized by CCO's 284 and 330, provided that the forward skirt venting system be modified.

3.3.1 (Continued)

w. SC 1304, authorized by CCO 288, provided for the reduction of LH_2 tank pressure, with associated design changes.

x. SC 1306, authorized by CCO 296, provided the necessary paperwork to reflect the change of status of the EBW firing units to government furnished parts.

y. SC 1354, authorized by NASA letter I-CO-L-1205, incorporated the new range safety controller, P/N 40M32016, supplied by MSFC.

z. SC 1363, authorized by CCO 329, provided an on - off control system for the telemetry transmitter.

aa. SC 1390, authorized by CCO's 201 and 341, provided for the removal of telemetry circuits monitoring the APS.

ab. SC 1400, authorized by CCO's 354, 429, and 508, provided for revised channel assignments.

ac. ECP X005, authorized by CCO's 365 and 406, provided for the allocation of discrete launch signals to the separate bilevels on the PCM/DDAS.

ad. ECP X043, authorized by CCO's 409 and 468, provided individual internal/external control of the range safety receivers and EBW firing units.

3.3.2 Incorporated and Verified Scope Changes/Engineering Change Proposals

The following SC/ECP's have been incorporated and verified by Douglas/AFQA personnel, with concurrence recorded on the DD829-1 form in the Stage Log Book:

a. SC 1045B, authorized by CCO 118, documented the design criteria for the Douglas evaporative heat transfer system used to condition the NASA instrument unit, and the stage forward skirt electronic components.

b. SC 1124, authorized by CCO 259, provided closed loop checkout capability for the stage range safety command RF system.

c. SC 1153A, authorized by CCO's 163 and 280, provided for the redesign of the propellant utilization system, to enable rapid installation of system components under prelaunch conditions at KSC.

3.3.2 (Continued)

d. SC 1187, authorized by CCO's 136, 172, and 330, installed the MSFC furnished control accelerometers and rate gyro.

e. SC 1189, authorized by CCO's 111 and 126, provided for the design, release, and manufacture of the necessary parts and documents for the two-hour and four-and-one-half hour translunar coasts.

f. SC 1193, authorized by CCO 156, provided for the redesign of the LOX tank vent line and supporting hardware.

g. SC 1203, authorized by CCO 168, provided for RPM measurement of the LOX and LH_2 turbopumps.

h. SC 1205, authorized by CCO 173, provided for the installation of three additional interface connectors.

i. SC 1207, authorized by CCO's 197, 213, 330, 343, and 414, provided for the modification of the propellant utilization system.

j. SC 1218, authorized by CCO's 202 and 330, provided for a recirculation type chilldown system.

k. SC 1219, authorized by CCO 201, provided for the removal of the telemetering circuit monitoring the APS.

l. SC 1326, authorized by CCO 279, 496, and 595, provided for recirculating chilldown pump pressure measurements.

m. SC 1344, authorized by CCO 712, provided for the S-IVB/V "LEM" oxidizer tank assembly.

n. SC 1274, authorized by CCO's 264 and 330, provided short circuit protection for the power supplies.

o. SC 1241, authorized by CCO 222, provided an additional sensing element for the engine cutoff circuit.

p. SC 1364, authorized by CCO's 368, 459, and 602, incorporated modifications called out in the J-2 engine interface document.

q. SC 1376A, authorized by CCO's 395 and 467, provided for the reduction of trapped propellants at burnout.

r. SC 1397, authorized by CCO 351, provided for the necessary safety measures in the charge ullage ignition and charge ullage jettison command circuits to prevent inadvertent firing or jettisoning of the ullage rockets.

s. ECP X021, authorized by CCO 363, provided for static test monitoring of the engine turbopump RPM.

3.3.2 (Continued)

t. ECP X056, authorized by CCO's 413 and 572, provided that consecutive reference designation numbers be assigned to stage relays.

u. ECP X071, authorized by MSFC letter I-V-S-IVB-E065-28, provided for the transmittal of T/M documentation and modification of the T/M calibrator.

v. ECP X082, authorized by CCO's 434 and 539, provided new engine transducer design requirements.

w. ECP X083, authorized by CCO's 438 and 568, provided for additional T/M measurements.

x. ECP X085, authorized by CCO 444, provided for the redesign of the engine cutoff circuitry.

y. ECP X092, authorized by CCO's 451 and 539, provided for additional MSFC flight control wiring.

z. ECP X099, authorized by CCO 461, provided for additional hardwire measurements through the umbilical.

aa. ECP X113, authorized by CCO's 472 and 539, provided a method for implementing the secure range safety command system.

ab. ECP X114, authorized by CCO 482, provided for independent excitation of power supplies.

ac. ECP X124, authorized by CCO's 506, 539, and 562, provided for changes in the stage for Rocketdyne ECP compatibility.

ad. ECP X134, authorized by CCO's 526, 573, and 636, provided for the redesign of the J-2 engine electrical interface.

ae. ECP X136, authorized by CCO's 329, 538, and 631, provided for the release of a coolant system common to both the S-1B and S-V stages.

af. ECP X137, authorized by MSFC letter I-V-S-TD-65-53, defined the programmed mixture ratio.

ag. ECP X165, authorized by CCO 567, provided for reprogramming of launch control measurements.

ah. ECP X176, authorized by CCO 587, modified the thrust structure.

ai. ECP X178, authorized by CCO 597, provided for the release of a stage positive pressure system.

3.3.2 (Continued)

aj. ECP X198, authorized by CCO's 658 and 692, revised the engine thrust OK circuits.

ak. ECP X199, authorized by CCO 634, provided for the redesign of APS modules.

al. ECP X209, authorized by CCO 847 and NASA letter L96, revised forward skirt paint requirements.

am. ECP X221, authorized by CCO 693, provided for the redesign of APS Gemini engine nozzle supports.

an. ECP X217, authorized by CCO 698, provided black teflon hoses for the hydraulic system.

ao. ECP X239, authorized by CCO 729, provided for implementation of the safing engine start circuits.

ap. ECP X535, authorized by MK/WK, modified the propellant tank electrical feedthru.

3.3.3 Scope Changes/Engineering Change Proposals Pending Incorporation and/or Verification

The following SC/ECP's had not been fully incorporated and verified at the time of stage turnover to FTC. Of these, some were partially verified, to be completed at FTC, and some were to be incorporated and verified after turnover.

a. SC 1247, authorized by CCO 227, provided for mounting brackets for four EBW firing units and pulse sensors.

b. SC 1312, authorized by NASA letter TD-64-101, reduced tolerances on dome segments.

c. SC 1383A, authorized by MSFC I-CO-SD-4-1616, provided for the incorporation of dual diaphragm switches.

d. ECP X109, authorized by CCO's 476, 524, and 599, provided for measurement changes on the S-IVB/V flight stages.

e. ECP X114, authorized by CCO 482, provided for independent excitation of power supplies.

f. ECP X117, authorized by CCO's 374 and 547, provided for the installation of an instrumentation probe and quality meter.

3.3.3 (Continued)

g. ECP X119, authorized by CCO's 502 and 586, provided for venting of the S-IVB stage liquid hydrogen tank.

h. ECP X126, authorized by CCO's 511, 551, 578, and 607, specified manufacture and installation of cryogenic repressurization systems.

i. ECP X132, authorized by CCO's 383, 422, 435, 508, and 516, provided for a Model DSV-4B-229 analog measuring system kit.

j. ECP X134, authorized by CCO 537, provided for redesign of the J-2 engine S-IVB stage electrical interface.

k. ECP X147, authorized by TD 151, provided for the additon of relays to the 28V aft power distribution panel.

l. ECP X162, authorized by NASA letter TD-65-78, provided purge requirements for the J-2020 and subsequent configuration engines.

m. ECP X171, authorized by CCO's 79 and 582, provided flared tubing for all S-IB and S-V stages.

n. ECP X180, authorized by NASA letters TD-65-48, L740, and L972, specified certain changes to mission control measurements.

o. ECP X181, authorized by CCO 659, provided for implementation of the cryogenic repressurization system.

p. ECP X188, authorized by CCO's 611 and 647, provided for the measurements of the secure command system.

q. ECP X190, authorized by NASA letter I-CO-S-IVB-5-762, provided an active environmental control system for the forward skirt.

r. ECP X196, authorized by CCO 705, provided for rework and redesign of the rate gyro intercostal support.

s. ECP X204, authorized by CCO's 650, 661, 670, and 708, deleted pad safety and minimum liftoff pressure switches.

t. ECP X222, authorized by NASA letter TD66, modified the LH_2 and LOX tank probes.

u. ECP X224, authorized by CCO 739, provided for RPM measurements for the recirculation chilldown pump.

v. ECP X227, authorized by CCO 704, implemented these measurement changes.

w. ECP X251, authorized by CCO 763, provided for stage compatibility with the J-2 engine.

3.3.3 (Continued)

x. ECP X252, authorized by MSFC letter I-CO-S-IVB-6-63, provided shot peening requirements for APS oxidizer tanks.

y. ECP X255, authorized by NASA letter I-CO-SIVB-6-130, provided for environmental conditioning of the Model II switch selector.

z. ECP X262, authorized by CCO's 813 and 853, and MSFC letter I-CO-SIVB-6-198, modified the EDS cutoff circuits.

aa. ECP X264, authorized by CCO 781, deleted accelerometer and rate gyro provisions.

ab. ECP X267, authorized by MSFC letter I-CO-SD-L-131-66, provided for utilization of the DSV-4B-773 test plug.

ac. ECP 0271, authorized by CCO 798, provided additional measurements for the range safety system.

ad. ECP 0273, authorized by CCO 837, provided for deletion of LH_2 tank translunar vent termination pressure switch.

ae. ECP 0277, authorized by CCO 801, provided for deletion of the pyrotechnic connection dispersion system.

af. ECP 0278, authorized by CCO 809, rechanneled telemetry measurements to change sample rates.

ag. ECP 0281, authorized by MSFC letter I-CO-SD-L-192-66, provided for the design of a stage coolant system.

ah. ECP 0288, authorized by CCO 791, provided for incorporation of J-2 engine ECP NA-J2-451.

ai. ECP 0295, authorized by TD-66-14, provided for maximum heat trajectory insulation.

aj. ECP 0302, authorized by MSFC letter I-CO-SIVB-6-485, provided for an LH_2 slosh filter and guidance system computer N/F filter design.

ak. ECP 0304, authorized by CCO 886, deleted the vent termination pressure switch.

al. ECP 0313, authorized by CCO 860, provided for the installation of modules in signal conditioning racks.

am. ECP 0314, authorized by MSFC letter I-60-SD-L-329-66, provided for the rework and installation of the Model II switch selector.

an. ECP 0318, authorized by MSFC letter I-CO-SIVB-6-519 and CCO 956, modified the range safety controller safing plug.

3.3.3 (Continued)

ao. ECP 0420, authorized by MSFC letter 348, provided for the multiplexer temperature conditioning shroud.

ap. ECP 0432, authorized by MSFC letter 772, provided for the installation of flight measurement C013-401.

aq. ECP 0341, authorized by letter L307, provided for a Calmec low pressure cold gas check valve.

ar. ECP 0443, authorized by CCO 879, provided for the installation of the hazardous gas detection system.

as. ECP 0449, authorized by MSFC letter 319, provided for the modification of the forward skirt thermo-conditioning panel.

at. ECP 0354, authorized by letter L307, provided a thermal barrier for the ambient helium fill system.

au. ECP 0355, authorized by letter L307, provided for the redesign of the LH_2 pressurization diffuser.

av. ECP 0364, authorized by letter L307, added a check valve to the APS helium supply line.

aw. ECP 0421, authorized by letter L772, added telemetry measurement K151.

ax. ECP 0441, authorized by MSFC letter I-CO-SIVB-6-779A, provided for rework of the remote analog submultiplexer.

ay. ECP 0444, authorized by letter L323, provided for installation of wires in wire harness branch 403W4.

az. ECP 0450, authorized by letter L323, changed the auxiliary tunnel cover.

ba. ECP 0456, authorized by MSFC letter 319, provided for a wire change to branched wire harness 411W295.

bb. ECP 0466, authorized by letter L805, modified the propellant utilization static inverter/converter telemetry voltage supply.

bc. ECP 0471, authorized by MK/WK, provided for the installation of common bulkhead pressure transducers.

bd. ECP 0479, authorized by letter L459, provided wiring changes for PAM inputs to the DDA unit.

be. ECP 0481, authorized by MK/WK, provided for hi-lok changes in the aft skirt.

3.3.3 (Continued)

bf. ECP 0486, authorized by MSFC letter 964, provided for the replacement of diodes in the inverter/converter.

bg. ECP 0488, authorized by letter L348, provided for the installation of ullage pressure transducers on the forward dome.

bh. ECP 0490, authorized by MSFC letter 685, provided for the redesign of checkout valve 1B53817.

bi. ECP 0493, authorized by letter L416, redesigned the LOX and LH_2 chilldown systems shutoff valves.

bj. ECP 0504, authorized by MK/WK, provided for reconfiguration of the helium pressure regulator module.

bk. ECP 0505, authorized by letter L398, modified the breakpoint module amplifier.

bl. ECP 0510, authorized by letter L459, installed coaxial cable assembly 411W12.

bm. ECP 0511, authorized by letter L459, redesigned the LH_2 chilldown shutoff valve purge line.

bn. ECP 0519, authorized by letter L374, provided for redesign of the impingement curtain.

bo. ECP 0533, authorized by MSFC letter 418, provided for temperature and pressure transducer installation.

bp. ECP 0534, authorized by letter L459, provided for redesign of tank relief valves, P/N's 1A49590 and 1A49591.

bq. ECP 0542, authorized by letter L874, revised the PCM RF assembly Model II.

br. ECP 0547, authorized by MSFC letter 988 and CCO 966, provided for the bi-level summing network module.

bs. ECP 0565, authorized by MSFC letter 465, provided for redesign of the fill and drain valve, P/N 1A48240-505.

bt. ECP 0567, authorized by CCO 968, provided for J-2 engine temperature measurements.

bu. ECP 0575, authorized by MSFC letter 465, provided for the rework of auxiliary hydraulic pump assembly.

bv. ECP 0592, authorized by MSFC letter 573, provided for the deletion of APS helium fill module.

3.3.3 (Continued)

bw. ECP 0600, authorized by MSFC letter 489, provided for the rework of the engine driven pump check valve.

bx. ECP 0601, authorized by CCO 993, provided for LOX tank bolt and nut change.

by. ECP 0605, authorized by MSFC letter 487, provided for emergency detection system transducer vibration isolation.

bz. ECP 0613, authorized by MSFC letter 1176, provided for replacement of hydrogen hose support bracket bolts.

ca. ECP 0622, authorized by MSFC letter 617, provided for insulation resistance test for 10 amp relay.

cb. ECP 0630, authorized by MSFC letter 500, provided for reconfiguration of the LOX inlet duct.

cc. ECP 0633, authorized by MSFC letter 617, provided for the rework of LH_2 propellant duct resilient mounts.

cd. ECP 0639, authorized by MSFC letter 617, provided for the relocation of the pressure transducer.

ce. ECP 0651, authorized by MSFC letter 685, provided for the chilldown inverter core reset resistor.

cf. ECP 0801, authorized by letter L319, provided for rework of the LH_2 pressurization module strap.

cg. ECP 0808, authorized by MSFC letter 685, provided for transducer mountings for measurement D-055.

ch. ECP 0809, authorized by MK/WK, modified a wire harness for the power input for measurement D055.

3.4 Reliability Time/Cycle Significant Items

Accurate up-to-date time/cycle data for the twenty-five time or cycle significant items as detailed in drawings 1B55425H and 1B55423 are found in the tabulation that follows.

503 TABULATION OF TIME/CYCLE SIGNIFICANT ITEMS

PART NAME & PART NUMBER	SERIAL NUMBER	ENGINEERING LIMITS	ACCUMULATED MEASUREMENT	REMARKS
G.F.P. (1B55423E)	207	1,000 CYCLES	46 CYCLES	
40M39515-113 EBW FIRING UNIT	206	1,000 CYCLES	38 CYCLES	
	205	1,000 CYCLES	33 CYCLES	
	204	1,000 CYCLES	64 CYCLES	
40M39515-119 EBW FIRING UNIT	414	1,000 CYCLES	41 CYCLES	
40M39515-119 EBW FIRING UNIT	387	1,000 CYCLES	44 CYCLES	
50M10697 No. 1 COMMAND RECEIVER (MCR 503)	144	2,000 HOURS	41.8 HOURS	
50M10697 No. 2 COMMAND RECEIVER (MCR 503)	140	2,000 HOURS	39.7 HOURS	
50M10698 No. 1 DECODER RANGE SAFETY CONTROL	0070	2,000 HOURS	41.8 HOURS	
50M10698 No. 2 DECODER RANGE SAFETY CONTROL	0065	2,000 HOURS	41.0 HOURS	
50M35076-1 No. 1 CONTROL RELAY PACKAGE	328	25,000 CYCLES	251 CYCLES	
50M35076-1 No. 2 CONTROL RELAY PACKAGE	329	25,000 CYCLES	317 CYCLES	
50M67864-5 SWITCH SELECTOR	120	250,000 CYCLES	77,452 CYCLES	

503 TABULATION OF TIME/CYCLE SIGNIFICANT ITEMS (Continued)

PART NAME & PART NUMBER	SERIAL NUMBER	ENGINEERING LIMITS	ACCUMULATED MEASUREMENT	REMARKS
103826 J-2 ENGINE (FOR GIMBAL CYCLES)	J-2 061	250-10,000	15.28%	THIS DATA INCLUDES ALL ENGINE GIMBAL CYCLES AT STC, PLUS CYCLES BROUGHT FORWARD FROM A3 AND R/NAA RECORDS. THE CYCLES DATA IS EXPRESSED AS A PERCENTAGE OF DESIGN LIMITS BASED ON A GIMBAL ANGLE, AND CAN VARY FROM 250 TO 10,000 + CYCLES AS NOTED. * THE INDICATED PERCENTAGE WAS COMPUTED FROM THE ENGINE LOG RECORDS UTILIZING THE GRAPH PER R/NAA ROCKET ENGINE DATA MANUAL R-3825-1.
A) CUSTOMER CONNECT LINES AND INLET DUCTS				
B) GIMBAL BEARING		250-10,000	15.95%	
C) FIRING TIME		3,750 SECONDS	468.8 SEC.	
RELIABILITY (1B55425-M)				
1A66241-507R PUMP HYDRAULIC, AUXILIARY MOTOR DRIVEN	X454672	120 HOURS 300 CYCLES	17.6 HOURS 58 CYCLES	
1A48858-1 SPEHERS HELIUM	1108	50 CYCLES	4 CYCLES	
	1128	50 CYCLES	4 CYCLES	
	1072	50 CYCLES	4 CYCLES	
	1064	50 CYCLES	4 CYCLES	
	1109	50 CYCLES	4 CYCLES	
	1115	50 CYCLES	4 CYCLES	
	1118	50 CYCLES	4 CYCLES	
	1119	50 CYCLES	4 CYCLES	
1A59562-505 POTENTIOMETER, BRIDGE, R1	1028	2,000 CYCLES	473 CYCLES	
1A59562-505 POTENTIOMETER, BRIDGE, R2	1026	2,000 CYCLES	610 CYCLES	

[redacted] SECTION 4 [redacted]

DETAILED NARRATIVES

4.0 Detailed Narrative - Stage Checkout

A detailed narration of stage checkout is presented in this paragraph. The major subparagraphs comprising the detailed narrative are: 4.1 Stage Checkout - STC; 4.2 Stage Checkout - SSC; and 4.3 Stage Manufacturing Tests. Each of these major subparagraphs is further subdivided to the degree required to present a complete historical record of stage checkout.

Permanent nonconformances and functional failures affecting the stage have been recorded on FARR's, and are referenced by FARR serial number throughout this paragraph (e.g. FARR A229757). The FARR's referenced in paragraph 4.1 are presented in serial number order in section 1 of Table I; and those referenced in paragraphs 4.2 and 4.3 are similarly presented in sections 2 and 3 of Table 1.

4.1 Stage Checkout - STC

Checkout of the stage at STC began in October 1966, and was terminated by the stage destruction on the Beta III Test Stand on 20 January 1967, following the placing of the stage on internal power. This paragraph covers those stage checkout drawings which were performed as part of the prefiring activity designed to ready the stage for static acceptance firing. Several procedures were incomplete at the time of the explosion, and were impounded. These procedures are not written up in this report.

4.1.1 Propulsion System Tests

The two prefiring propulsion system checkouts which had been completed and sold prior to the countdown were the automatic system checkout and the manual system leak check conducted preliminary to firing.

4.1.1.2 (Continued)

b. FARR's A218978 and A218979 noted that the LH_2 vent and relief valve, P/N 1A48257-507-002, S/N 0038, relieved at 38 psia. It should have relieved at 37 psia maximum. The valve was removed and replaced.

c. FARR A218986 contained the information that adapter assembly, P/N 1A49958-517, S/N 87, leaked, and that the LH_2 tank pressure switch pickup and dropout pressure would not hold at 37 psia. The adapter was returned to the vendor for rework.

d. FARR's A219036 and A219043 noted that the O_2H_2 burner control valve, P/N 1B43660-507, S/N 2704, leaked at 60 scim, which exceeded the 12 scim limit. The valve was removed and replaced, and returned to the vendor.

e. FARR A219041 reported that water was suspected on the actuator housing of propellant valve, S/N 107, on burner, P/N 1B59010. The valve was purged and tested for water content using an hygrometer.

f. FARR's A219046 and A229751 noted that the LH_2 bidirectional vent valve, P/N 1A49988-1, S/N 0018, leaked at the seat at the rate of 9000 scim. The valve was removed and replaced.

g. Per FARR A229729, a bolt was twisted off in the hole on tube assembly clamp bracket welded to the top of the dome of the O_2H_2 burner, P/N 1B62600-505, S/N 05. The broken section of bolt was removed, the threads were cleaned, and the clamp was fastened per B/P.

h. FARR A229732 reported on several scratches on the attach flange on the LOX chilldown shutoff valve, P/N 1A49965-521, S/N 0207. The flange face was resurfaced and refinished.

i. FARR A229738 noted a fast bubble leak at the junction of the LOX chilldown pump, P/N 1A49423-505, S/N X1761, and the shutoff valve. The pump was removed and replaced.

j. FARR A229740 reported on fuzz leaks at the interface between the microswitch and actuator housings, and between the control line adapter and the LOX prevalve housing. The leakages were accepted for use.

k. Per FARR A229764, there was no talkback from LOX shutdown valve, P/N 1B66485-1.1, S/N 02, in the closed psoition. A wire, which had been disconnected, was reterminated per B/P, correcting the condition.

4.1.2 Environmental Control System, Forward and Aft Skirt Purge (1B43749 A)

Between 10 and 15 November 1966, a manual H&CO procedure tested the environmental control system installation, P/N 1A77551, and the forward and aft skirt purge systems. The forward skirt purge system checkout included a visual inspection, a pressure check, a heater performance check, and a check of the GN_2 backup system. The aft skirt purge system checkout included a visual inspection, blower operation check, a heater performance check, and shop air supply system.

There were no revisions or discrepancies recorded.

4.1.3 Electrical/Electronic Systems Tests

Twelve prefiring H&CO's pertaining to stage electrical/ electronic systems were available for this report. For purposes of exposition they are subdivided as follows:

a. Power distribution tests - paragraph 4.1.3.1.

b. Umbilical interface compatibility check - paragraph 4.1.3.2.

c. Propellant utilization tests - paragraph 4.1.3.3.

d. Level sensor and control unit calibration - paragraph 4.1.3.4.

e. Cryogenic temperature sensor verification - paragraph 4.1.3.5.

f. Single sideband tests - paragraph 4.1.3.6.

g. Telemetry system test - paragraph 4.1.3.7.

h. Digital data acquisition system test - paragraph 4.1.3.8.

4.1.3.1 Power Distribution System Tests

The three power distribution system checkouts were performed to ensure the proper function of the system components; to verify the ability of the automated GSE to activate, control, and deactivate stage power; and to ensure

4.1.3.1 (Continued)

that power busses were not subjected to excessive static loads. The three procedures were:

a. Stage power setup.

b. Stage power turnoff.

c. Power distribution system.

4.1.3.1.1 Stage Power Setup (1B55813 B)

Performed on 7 November, accepted by Engineering on 8 November, and certified OK to file on 14 November 1966, this automatic checkout contained the steps which verified the operational capability of the ACS to control and activate the stage electrical power distribution system prior to automatic checkout activities. These procedures also ensured that the stage forward and aft power distribution systems were not subjected to excessive static loads during initial set up sequences, and verified capability of the GSE to control power switching to and within the stage. Nine revisions were made to this checkout as follows:

a. Seven revisions were written to correct program errors or change program parameters and tolerances.

b. Two revisions detected, investigated, and corrected for the dual talkback on the LOX prevalve.

There were no malfunctions reported.

4.1.3.1.2 Stage Power Turnoff (1B55814 A)

Automatic and manual procedures to shut down the stage power distribution system after the completion of stage system checkout verified the capability of the GSE to control power switching to and within the stage. Successfully conducted on 7 November 1966, the tests were accepted on 8 November, and the documentation was completed and accepted on 14 November 1966.

4.1.3.1.2 (Continued)

Of six revisions, four corrected program errors or altered program parameters, and two detected, explained, and corrected dual talkback of the LOX prevalve.

Three failure and rejection reports were prepared as a result of this test. They were:

a. FARR A218835 reported on five wires damaged, exposing the conductor, on cable assembly, P/N 1B63297-1. The wires were temporarily repaired for static firing.

b. FARR A218976 noted that module, P/N 1B40604-1, showed a voltage on the check bus, caused by an apparent short from pin J1R to pin J1F through the diode. The wires were relocated to the pins, externally to the module.

c. It was reported on FARR A218977 that nylafil cable standoff bracket, P/N 1B37286-501, had stripped screw threads. Cables, P/N's 1B66946-1 and 1B58264-1, therefore could not be clamped. A keensert was installed in the standoff. The cables were clamped in place.

4.1.3.1.3 Power Distribution System (1B55815 B)

The automatic and manual sequences provided in this procedure enabled checkout personnel to function the power distribution system and evaluate responses of items under test with the aid of the ACS. The tests established the capability of the ACS to control power switching to and within the stage; and the absence of excessive static loads.

The procedure was performed twice, because the first run, conducted on 10 November 1966, was not acceptable to Inspection and Test. Engineering comments indicated that two minor problems were encountered during run one. The pulse sensor off indicator was not on, and there was a loose connector P-28 on wire 404A2A28J-1.

4.1.3.1.3 (Continued)

Run two was successfully conducted on 11 November 1966, and the test documentation was filed on 1 December.

There were eight revisions written as follows:

a. One revision provided for rerunning the test.

b. Two made changes to the program in order to cope with changes in GSE and control circuit patching.

c. One revision changed the program because point level sensor disarm command 03141504 was placed on switch selector channel 98.

d. One revision corrected a program error.

e. Two provided for acceptance of out-of-tolerance parameters.

f. One revision corrected test parameters to account for the parameters of a newly substituted part.

There were no functional failures on record.

4.1.3.2 Umbilical Interface Compatibility Check (1B64316 A)

A manual H&CC procedure provided the steps to check the integrity of the stage umbilical wiring to assure that proper loads were present on all power busses, and that the control circuits for propulsion valves and safety items on the stage were within prescribed tolerances. The test was conducted between 7 and 27 November 1966.

Eight revisions were written, as follows:

a. Four revisions were made to accept slightly out of tolerance resistance values.

b. One corrected procedural errors.

c. Three revisions added and clarified steps in the procedure.

There were no deviations recorded.

4.1.3.3 Propellant Utilization System Tests

The prefiring checkout of the propellant utilization system was accomplished by means of a manual procedure, designed to set up and calibrate the system; and an automatic system checkout.

4.1.3.3.1 Propellant Utilization System Calibration (1B64368 A)

The PU system calibration and verification consisted of the following steps:

a. Verification of static inverter/converter output voltages.

b. LH_2 and LOX bridge empty and full calibration.

c. Data acquisition of the LH_2 and LOX bridge position.

d. LH_2 and LOX bridge slew checks (1/3 and 2/3 slew).

e. Reference mixture ratio (RMR) calibration.

f. LH_2 and LOX bridge linearity checks.

g. Verification of hardwire loading circuits.

The manual calibration procedure was run twice, as it was found during the bridge linearity checks that the PU test set, Model 248, S/N 00002, had a resistor shorted. The test was conducted between 30 November and 7 December 1966.

Three revisions were made to run one. One put a step into the procedure that had been left out in error; one required that helium with 99 per cent or greater purity be used to purge propellant tanks before PU calibration; and the third revision deleted steps to be completed during the second run.

The second run had one revision which revised coarse mass pot tolerance to compensate for the lower reading in the "full" ratio calibration point.

There were no FARR's recorded against this test.

4.1.3.3.2 Propellant Utilization System (1B55823 C)

Verification of propellant utilization system was conducted automatically on 6 December, and the test results were certified for filing on 22 December 1966. The following comprised the general test sequence:

a. Initial conditions were set and verified, power was applied, the PU electronic assembly static inverter/converter was allowed to stabilize, and the PU assembly and oven internal temperatures were checked.

b. The LOX and fuel bridges were checked for zero balance, along with the PU System ratio valve output null voltage.

c. Valve movement was verified.

Two runs were performed since the first run was unacceptable to Engineering due to a DDT error for NASA measurement M010. The DDT had a curve for 0 to 5 vdc in lieu of a zero to 15 vdc.

Four revisions were written as follows:

a. The first explained why run 1 was unacceptable, and allowed for run 2.

b. Another provided a check of the ability of the PU system to slew the PU ratio valve in either direction, to completely validate the ability of the system to make maximum ratio corrections. This revision was made to comply with a NASA request.

c. One revision corrected a program error.

d. The final revision reran the PU valve movement test with GIS strip chart 48 to provide necessary data.

No functional failures were reported on FARR's.

4.1.3.4 Level Sensor and Control Unit Calibration (1B44473 B)

A manual H&CO procedure was conducted between 8 November and 8 December 1966 to adjust the operating point of the point level sensor control units to an operating level well within the limits of the capacitance change created in these units by a simulated wet condition RACS command.

The procedure was successfully completed after two revisions and one FARR were written. One revision provided for the calibration of sensors not calibrated at SSC, and the second set up the fourth depletion sensors in the fuel and LOX tanks. FARR A229765 reported that on cable, P/N 1B56380-1, pin 11 of Deutsch connector 411W11P12 was broken. The damaged pin was removed and replaced per B/P.

4.1.3.5 Cryogenic Temperature Sensor Verification (1B44471 B)

The purpose of this manual procedure was to check out each temperature sensor whose normal operating range did not include ambient temperature. The checkout was conducted between 14 October and 7 December 1966.

One revision was made to delete parameters CO 382 and CO 390, since they no longer existed and had been deleted from the IPCL. There were no other discrepancies recorded.

4.1.3.6 Single Sideband System Tests

Two test procedures were performed to check out the single sideband system. The setup activities which required manual effort on the part of test personnel, as well as system calibration, were conducted as part of the manual operations procedure. The system was functionally inspected by means of the automatic system checkout procedure.

4.1.3.6.1 Single Sideband System Manual Operations (1B58685 A)

Conducted between 12 November 1966 and 6 January 1967, this manual checkout provided detailed coverage for energizing all necessary test equipment, verifying the ready state of the GSE demultiplexer, and the flight equipment. The flight equipment tested consisted of transducers, signal conditioners, a multiplexer, single sideband translator, composite signal amplifiers, and F/M transmitter with its attendant amplifier and RF switching equipment.

Eight revisions were made to this checkout as follows:

a. One reset amplifier gain in order to proceed with the checkout.

b. One revision recomputed rolloff characteristics, and corrected for ground station demultiplexer effect.

c. One specified that certain pieces of equipment were no longer time/cycle significant.

d. Another specified that this checkout was run in conjunction with run 2 of H&CO 1B55818.

e. A revision provided a method for manual verification of amplitude data.

f. One provided for connecting a reidentified cable connection.

g. A revision accepted some minor out-of-tolerance readings.

h. The final revision deleted parts not applicable to this checkout.

There were five failure and rejection reports written in conjunction with this checkout.

a. FARR's A218988, A218992, and A218997 reported on out-of-tolerance output voltages from amplifier, P/N 1A88599-5, and transducer, P/N 1A68707-5, S/N 720. The amplifier and transducers were removed and scrapped.

b. FARR A218991 noted that the auto calibration output from amplifier, P/N 1A68707-7, S/N 398, was 5.05 volts peak-to-peak instead of 4.0 volts. The amplifier was scrapped.

c. FARR A218999 reported on out-of-tolerance RACS output from transducer, P/N 1A88599-1, S/N MA04. The transducer was accepted following retest.

4.1.3.6.2 Single Sideband System (1B55818 B)

This test used the automatic checkout system (ACS) and the Model 126 FM T/M single sideband (SSB) station to recei stage vibration and acoustical information for reduction and evaluation. Each channel of the SSB transmitter was checked from the originating transducer and signal conditioning unit, through the multiplexer unit, and the translator unit, and finally at the output of the SSB transmitter at the antenna input connection.

The following comprised the general test equipment sequence followed:

a. Power distribution.

b. Sequencer commands.

c. Remote automatic calibration system (RACS).

d. Marker channel verification.

e. Preflight sweep calibration.

f. SS/FM channel verification.

g. SS/FM transmitter check.

The checkout was performed twice. The first run was conducted on 14 November, and the second run was conducted on 2 December 1966. The second run was required because of numerous data discrepancies caused by program errors, incomplete installations, and loose connections at the installations.

Nine revisions were written. Six corrected program errors; one allowed for the second run of the procedure; one allowed the disregarding of initial condition malfunctions that did not affect the tests; and one integrated some steps from manual H&CO 1B58685 into this procedure.

There were no discrepancies recorded against this procedure.

4.1.3.7 Telemetry System (1B55820 B)

An automatic H&CO of the telemetry system was conducted on 27 December 1966, and 5 and 7 January 1967, and certified for filing on 17 January 1967. Three runs had to be performed due to excessive program errors. The successful completion of the procedure verified the operational capability of the PAM/FM/FM and FM/FM portion of the digital data acquisition system.

Twenty seven revisions were made to update the procedure and to correct program errors.

There were two failure and rejection reports written as a result of this test.

a. FARR A219034 reported that power detector 411A97MT722, P/N 1A74776-503, S/N 2-0194, had low output with 2.5 watts input. The power detector was removed and replaced.

b. FARR A229731 noted that in FM/FM telemetry unit, P/N 50M60032-11, the VCO in the subcarrier oscillator shifted frequency after setup. The unit was removed for retest.

4.1.3.8 Digital Data Acquisition System (1B55817 C)

An automatic checkout of the DDAS verified the design integrity and operation of the system by testing the signal conditioning modules, multiplexers, digital data acquisition assembly, and the RACS.

The test was conducted on 30 December 1966 and certified for filing on 17 January 1967. Thirty-six revisions were made to expedite the procedure, update it, or correct program errors.

There were six failure and rejection reports written in conjunction with this procedure. Briefly, they were:

a. FARR A219048 noted that transducer 426MT637, P/N SA-13-125TA-120, could not be adjusted to meet low RACS requirements, and that

4.1.3.8 (Continued)

pins H to J and H to C were open rather than short. The transducer was removed and replaced.

b. FARR's A219049 and A229752 reported that vibration transducer 411MT605, P/N 1A88599-1, S/N MA06, had no amplifier output. The transducer was returned to the vendor for rework.

c. Per FARR A229733, no output was obtained at channel A2-10-05. P/C board, P/N 1B59981-1, was found to be at fault, and was removed and replaced.

d. FARR's A229757 and A229758 noted that gas generator pressure transducer D010, P/N NA5274T10T, S/N 48514, on the J-2 engine, P/N 103826, S/N J-2061, had out-of-tolerance high, low, and ambient outputs. The transducer was returned to R/NAA for rework to specs or replacement.

4.1.4 Structural Inspection (1B40654 A)

The purposes of this manual checkout were to verify that transportation and handling had no detrimental effect on the stage structure; and to establish the condition of the stage prior to firing for comparison with postfire condition.

The following prefire inspection requirements were defined:

a. Receiving inspection - electrical, propulsion and structural.

b. Visual inspection - LH_2 tank interior and installation.

c. Visual inspection - LOX tank interior and installations.

The checkout was started on 11 October 1966 and certified complete for filing on 6 January 1967. Nine revisions were written, as follows:

a. One set up inspection priorities.

b. Another deleted steps not required at this time.

c. A revision provided for using the hoist in the handling of the X-ray equipment.

4.1.4 (Continued)

d. One provided steps for X-raying all required areas.

e. One revision provided for re-X-raying of certain areas from a different angle.

f. One provided for photographing the reworked LOX sump for Engineering records.

g. Another provided for retorquing the helium storage tank straps and recording the torque values for Engineering information and records.

h. One deleted the APS fit check since that was to be done postfire.

i. The final revision deleted the LH_2 tank entry procedure since this was not required prior to static firing.

There was one failure and rejection report recorded against this procedure. FARR A229755 reported on two instances of misapplied thermoshrink and two instances of damaged insulation. The thermoshrink was reapplied per B/P, and the contacts at which the insulation was damaged were removed and replaced. There were no other malfunctions noted.

4.1.5 Hydraulic System (1B55824 B)

An automatic H&CO of the hydraulic system was performed twice because parameters G504 and G505 were not correctly calibrated in the DDT during run 1.

Successfully conducted on 16 November, and certified for filing on 28 November 1966, the checkout consisted of the following sequence of events:

a. Accumulator precharge test.

b. Reservoir oil volume switch test.

c. Reservoir oil pressure transducer test.

d. Inlet temperature test.

e. System pressure test.

f. Reservoir oil volume position transducer test.

4.1.5 (Continued)

g. Accumulator reservoir oil pressure test.

h. Polarity and linearity tests.

i. Frequency response tests.

j. Engine centering tests.

All the foregoing tests were performed only when the stage was in the vertical position. Eight revisions were made as follows:

a. Two cancelled run 1 and authorized run 2.

b. Four corrected program errors.

c. Two revisions corrected test parameters in order to obtain correct data.

There were no malfunctions recorded against this procedure.

4.1.6 Integrated Systems Test (1B55831 B)

The purpose of this procedure was to demonstrate the functional readiness of the stage and facility equipment to proceed with normal prefire checkout operations, culminating in formal countdown and acceptance firing. Specific tests performed included:

a. Stage power turn on.

b. Radio frequency system checkout and turn on.

c. Measurement group function checks, remote automatic checkout system (RACS) functional checks, and DDAS checks.

d. Power transfer and electrical systems functional tests.

e. Environmental control system checks.

f. Hydraulic system turn on, engine restrainer link drop (manual), and engine gimbal test.

g. Pneumatic console setup and checkout.

h. Propellant loading valve sled, water sled, deflector water, aspirator, and GH_2 torch checks.

4.1.6 (Continued)

i. Stage valve functional tests.

j. J-2 engine final sequence.

k. Reestablishment of stage tank and sphere blanket pressure.

Performed on 7 January and accepted on 12 January 1967, the integrated systems test was revised by twelve revisions as follows:

a. The first change removed two electrical connections to the LH_2 continuous vent valve, to secure the valve during debugging operations.

b. A revision deleted a step which was no longer required.

c. The program was stopped to allow propellant utilization constants to be loaded into the computer via paper tape.

d. A conditional hold was added to the program to allow an exit loop path for the computer.

e. The functional checkout of the stage forward and aft purge systems was deleted, as these were to be functionally checked as task 26 of the countdown manual.

f. An additional ten seconds were added to the time required to bleed down pressure in a GN_2 line from 165 psia to less than 30 psia.

g. A revision allowed the SSB transmitter to be turned on earlier in the program, to enable the transmitter time to synchronize with the ground station.

h. The last four revisions dealt with malfunction indications that were corrected by program changes, or by a rerun of that portion of the program with no repeat of the malfunction.

FARR A229773 was written against the SSB transmitter due to excessive warmup time required. This condition was accepted for use during static firing by Engineering. No other major defects were noted.

4.1.7 Static Acceptance Firing Countdown Procedures

This paragraph covers the static acceptance firing countdown procedure, as well as the critical tasks accomplished as part of the countdown.

4.1.7.1 Countdown, Acceptance Firing (1B70264)

The countdown manual was designed to control and regulate the sixty separate tasks required to accomplish stage preparation, propellant loading, static acceptance firing, residual propellant off-loading, and stage securing. The events controlled were:

a. Critical components cycle testing.

b. Propellant loading.

c. LOX tank ullage pressure control.

d. Normal engine start.

e. Proper operation of the propellant utilization system.

f. Initiating an engine gimbal exercise.

g. Automatic engine cutoff.

The countdown, number 614078, was initiated on 19 January 1967. On 20 January 1967, at 1622:40 hours, the stage exploded (reference paragraph 4.1.7.1.3).

4.1.7.1.1 Countdown Task 35 - Integrated Systems Test (1B55831 A)

Performed on 20 January 1967, the integrated systems test (IST) verified the functional readiness of the stage and facility systems to proceed with countdown operations and acceptance firing.

Fifteen revisions were written to the procedure; briefly, they were:

a. Three deleted steps which were not required.

b. One provided for the loading of PU constants via paper tape.

4.1.7.1.1 (Continued)

c. One revision added a conditional hold point to allow an exit loop for the computer.

d. One allowed an additional ten seconds to the time required to bleed down pressure in the GN_2 line from 165 psia to 30 psia.

e. A revision allowed for turning on the SSB transmitter prior to the programmed point, to allow the translator sufficient time to synchronize with the ground system.

f. One revision set a breakpoint to provide a delay when the program went from FM/FM 2 to FM/FM 3, prior to making frequency checks.

g. One provided for obtaining RF sensitive measurements when the VEN transmitters were turned off.

h. A revision provided for the manual verification that the FM/FM IRIG channel 07 was within tolerance.

i. Another explained that a malfunction of the switch selector output monitor was caused by a defective VCO.

j. One changed the altitude ejection segment to agree with the static reading program.

k. A revision was written to explain the failure of the LOX repress system to depressurize in the allotted time.

l. The final revisions provided for rechecking an apparent malfunction in the LH_2 chilldown inverter frequency output. The malfunction did not occur upon retest.

No functional failures were recorded against this procedure.

4.1.7.1.2 Countdown Tasks 40 and 41 - Propellant Loading (1B55834)

At 0718 hours on 20 January 1967, the propellant loading checkout was conducted to verify the safe transfer of propellants and gasses to the stage. Included were the following:

a. LH_2 pretest purge.

b. LOX loading.

c. LH_2 loading, cold and ambient helium fill.

4.1.7.1.2 (Continued)

d. LOX and LH_2 tank overfill sensor checks, and flow check of all cold gas circuits.

e. LH_2 and LOX umbilicals purge.

There were seven revisions to the procedure, as recorded in the documentation log sheet:

a. Four corrected program errors.

b. One changed pressure requirements for the stage 3 GN_2 regulator from 60 psia to 70 psia, and the tolerance from ± 10 to ± 20 psia.

c. One revision change a part callout from "engine control bottle fill" to "APS helium bottle supply," as the wrong valve had been called out.

d. The last revision provided for changing certain hydraulic system parameters from telemetry to hardwire.

The propellant loading was completed at 1124:50 hours, with no malfunctions reported.

4.1.7.1.3 Countdown Tasks 43 and 44 - Acceptance Firing (1B55834)

The acceptance firing countdown procedure provided the automatic and manual test sequences required to verify propulsion and systems integrated performance, and the capability of all systems to function in a hot firing environment generated by the J-2 engine under full thrust and full duration conditions.

Task 43, "Static Firing Preparations," was started at 1144:30 hours on 20 January 1967. With a wind reported at 12 to 15 mph from the southeast, an inspection crew proceeded to the test stand for stage and stand inspection. This crew also installed a wind screen for thrust chamber chill protection. At 1245, all personnel were cleared from the test stand. Static firing

4.1.7.1.3 (Continued)

preparations program was initiated at 1257, and, at 1340, Task 44, "Terminal Countdown and Firing," was started.

The computer gave a cutoff indication at 1424:30 hours (T-150 seconds of Run 1A). The cutoff was attributed to a check sum error which was detected by the computer on the Saturn Test Oriented Language Library Tape. Such an error causes the executive to discontinue tape reading. To determine the source of the problem, the tape was read on the Beta I tape unit. The tape was verified on the Beta I computer, and was subsequently read into the Beta III computer. At 1531 hours, Task 43, Run 1B, was initiated. Terminal countdown was started at 1555:50.

The following is the sequence of events from T-20 minutes:

a. 1602:10 - Resume at T-20 minutes, 30 seconds.

b. 1616:20 - Begin thrust chamber chilldown.

c. 1617:20 - Repressurize engine start bottle.

d. 1619:50 - LOX and LH_2 tank prepressurization.

e. 1620:50 - LOX flow.

f. 1622:20 - Place stage on internal power.

g. 1622:40 - Explosion resulting in destruction of stage.

4.2 Stage Checkout, Space Systems Center

Paragraph 4.2 narrates the tests performed on the stage, from the conclusion of basic assembly to the beginning of those operations performed in preparation of the stage for shipment to STC. The stage entered tower 6 of the SSC/VCL on 15 July, 1966. System checkouts were initiated on 21 July 1966, and continued until 14 September 1966. Final acceptance testing activities consumed 44 two-shift working days. The stage was removed from the tower and prepared for shipment on 14 September 1966.

All thirty-nine tests required by the End Item Test Plan, 1B66170, were completed. The following lists the parts which were short at the time of the all systems test, together with the interim use parts installed for testing purposes:

a. LOX mass probe, P/N 1A48430-509, was short. Simulator, P/N 1B40424-1, was installed for checkout per SEO 1A49553-001.

b. LH_2 continuous vent regulator module, P/N 1A51753, was not installed. Interim use part, P/N 1B51753-501-006A was installed per the authority of the 006A SEO.

c. LOX feed duct, P/N 1A49969-503, was not installed. Interim use part, P/N 1A49969-501, was installed per SEO 1A39300-003.

Paragraph 4.2.1 through 4.2.6 describe the following six major areas tested: Umbilical Mechanical Mating; Environmental Control System; Electrical/Electronic Systems; Propulsion System; Hydraulic System; and All Systems.

4.2.1 Umbilical Mechanical Mating

Two test procedures were conducted to ensure that the forward and aft umbilical kits were mated properly. The umbilical kits are the interface link connecting the stage to GSE electrical, pneumatic, and air conditioning functions, and must be properly mated before stage systems tests can be conducted.

4.2.1 (Continued)

The two test procedures were:

a. Umbilical kit, aft - checkout stand.

b. Umbilical kit, forward - checkout stand.

4.2.1.1 Umbilical Kit, Aft - Checkout Stand (1B57918 F)

The aft umbilical kit was installed on 27 July and removed on 10 September 1966. Engineering acceptance was certified on 15 September 1966.

There were no revisions incorporated in the log sheet; however, one failure and rejection report was written. FARR A216761 noted that the plug on wire harness 404W15J1, P/N 1B50233-1, S/N 00004, was damaged at the keyway. The damaged end was deburred and finished per MIL-C-5541. Retermination was effected, and the rework was accepted.

4.2.1.2 Umbilical Kit, Forward - Checkout Stand (1A57920 C)

The installation of the forward umbilical kit on the stage was accomplished on 27 July 1966. The kit was removed, at the completion of system checkouts, on 14 September 1966, and the results of the procedure were accepted by Engineering on 15 September 1966.

There were no revisions or failures recorded.

4.2.2 Environmental Control Systems Tests

Three test procedures were performed to: check out the forward skirt thermo-conditioning system prior to stage systems checkouts; operationally verify the system; and check out and secure the system subsequent to final acceptance checkouts. A fourth procedure was run to establish the function and integrity of the aft skirt and interstage thermo-conditioning and purge system.

4.2.2.1 Forward Skirt Thermo-Conditioning System Pre-Checkout Procedure (1B41926 A)

The ability of the forward skirt thermo-conditioning system to sustain automatic systems checkout activities was ascertained on 25 July 1966. Acceptance was made by Engineering on 26 July 1966.

The only revision to the procedure noted that the "off" position on the temperature control switch was marked "normal". There were no functional failures requiring the preparation of rejection reports.

4.2.2.2 Forward Skirt Thermo-Conditioning System Operating Procedure (1B42124 A)

The setup and operation of the Model 359 thermo-conditioning servicer for normal operation during automatic system checkout was detailed in this procedure. Servicer setup and hook-up took place on 26 July 1966, and disconnection was accomplished and verified on 15 September 1966.

One revision to the procedure specified that the fluid temperature control switch should be set on "normal". No failure and rejection reports were written.

4.2.2.3 Forward Skirt Thermo-Conditioning System Postcheckout (1B62965 A)

A system cleanliness check, a leak check, and a humidity check were conducted on the forward skirt thermo-conditioning system, subsequent to stage system checkouts, between 14 and 16 September 1966. All three checks were performed satisfactorily, with no revisions or functional failures reported.

4.2.2.4 Aft Skirt and Interstage Thermo-Conditioning and Purge System 1B40544

The proper flow distribution and integrity of the aft skirt and interstage purge system were confirmed between 27 and 28 July 1966.

Five revisions, noted in the log sheet, included three pertaining to the fact that the thrust structure purge supply could not be clamped, and two involving a flow test on the thermo-conditioning shroud.

There were no malfunctions noted.

4.2.3 Electrical/Electronic Systems Tests

In the following thirteen major subparagraphs, the check out of each electrical/electronic system on the stage is described:

a. Power distribution system tests - paragraph 4.2.3.1.

b. Continuity compatibility checks - paragraph 4.2.3.2.

c. Propellant utilization system tests - paragraph 4.2.3.3.

d. Level sensor and control unit calibration - paragraph 4.2.3.4.

e. Exploding bridgewire system - paragraph 4.2.3.5.

f. Range safety system tests - paragraph 4.2.3.6.

g. Cryogenic temperature sensor verification - paragraph 4.2.3.7.

h. Signal conditioning setup - paragraph 4.2.3.8.

i. Single sideband system tests - paragraph 4.2.3.9.

j. Telemetry system tests - paragraph 4.2.3.10.

k. Digital data acquisition system tests - paragraph 4.2.3.11.

l. Telemetry and range safety antenna system test - paragraph 4.2.3.12.

m. APS simulator test - paragraph 4.2.3.13.

4.2.3.1 Power Distribution System Tests

The function and integrity of the stage power distribution system, as well as the ability of the automatic checkout system (ACS) to activate, control, and deactivate stage electrical power, were verified by three tests as follows:

a. Stage power setup.

b. Stage power turnoff.

c. Power distribution system automatic checkout.

4.2.3.1.1 Stage Power Setup (1B59040)

The ability of the automatic checkout system (ACS) to activate and control stage power distribution was ascertained on 1 August 1966. Engineering acceptance of the test results was made on 4 August 1966.

Thirteen revisions to the procedure can be recapped briefly as follows:

a. One added the Model DSV-4B-239 electrical network display unit to the list of end item test equipment.

b. One added a step which had been omitted from the procedure.

c. A revision written in error was voided.

d. Four steps which were no longer required were deleted.

e. A revision specified moving a DDAS ground station switch to 72 khz.

f. Five revisions corrected errors in the procedure, program, and data description tape.

A second issue of this test, conducted on 10 September, and accepted on 16 September 1966, was performed to provide an open, working document in which to enter all DDT changes which were required on other automatic tests. Twelve of the thirteen revisions were the same as those written for the first run, while one incorporated corrections of all the noted DDT errors.

There were no functional failures reported.

4.2.3.1.2 Stage Power Turnoff (1B59041)

The automatic checkout system was used, per this procedure, to shut down the power distribution system. Accomplished on 28 July 1966, the steps involved demonstrated that the ACS was capable of power termination after the completion of stage system checkouts.

There were five revisions noted in the documentation log sheet, of which three involved deleting a portion of the test which was not required. A revision added the Model DSV-4B-239 electrical network display unit to the list of end item test equipment, and the fifth revision corrected a program error.

The results of the test were accepted by Engineering on 4 August 1966. No malfunctions were noted.

4.2.3.1.3 Power Distribution System (1B59042)

Begun on 4 August 1966, the power distribution system testing activities were terminated on 8 August after four runs. The first run was ended with the failure of relay module, P/N 1A74211-505, noted on FARR A184794. The module was removed and a replacement was installed. The second and third runs were conducted to verify the performance of the new LOX level sensor No. 1 controller, as the old part, P/N 1A68710-501, had been rejected per FARR's A184796 and A196139. The final run verified that the 100 millisecond delay was adequate for an "internal forward power on" measurement. The results of testing were accepted on 16 August 1966.

There were five revisions noted in the log sheet. One added the Model 239 electrical network display unit to the list of end item test equipment; one each turned transmitter power on and turned it off; one revision corrected a procedure error; and the final revision deleted a step due to a parts shortage.

4.2.3.1.3 (Continued)

As noted above, there were three failure and rejection reports written against this procedure. FARR A184794, as already described, replaced relay module, P/N 1A74211-505, after the module failed to complete the circuit between pins X and H. FARR's A184796 and A196135 noted that the LOX point level sensor, P/N 1A68710-501, S/N D25, failed to turn off on command. The sensor was returned to the vendor for rework to specs.

4.2.3.2 Continuity Compatibility Tests

The tests performed to ascertain the integrity of the stage electrical wiring were:

a. The continuity compatibility check, which confirmed the soundness of the wiring on the stage, through all component boxes.

b. The umbilical interface compatibility checks, which established that a suitable electrical interface existed between the stage and umbilical electrical systems.

4.2.3.2.1 Continuity Compatibility Check (1B59777 A)

This procedure provided for a wire-by-wire checkout of the continuity of all electrical conductors on the stage. Measurements were taken between connectors, through component boxes, and between the pins in each connector.

The test, conducted and accepted between 21 July and 23 August 1966, was modified by forty-two revisions. Briefly, they were:

a. Two changing required resistance readouts to compensate for variations in wire length and gauge, and for 49.9 ohm resistance modules in the line.

b. Ten revisions corrected schematic errors, and twenty-five rectified minor errors in the procedure.

c. Four items were deleted because they were no longer required, and two were deleted because the wires were inaccessible.

4.2.3.2.1 (Continued)

d. A last revision provided for an added ground wire.

There were no malfunctions on record.

4.2.3.2.2 Umbilical Interface Compatibility Check (1B59779)

On 28 July 1966, the continuity and compatibility of the electrical conduits connecting the stage to ground electrical sources were verified.

Three revisions to the test included one which clarified a test setup, and two correcting and clarifying the procedure. No defects were discovered.

4.2.3.3 Propellant Utilization System Tests

The two test procedures described in this paragraph include:

a. The propellant utilization system manual calibration, which provided the setup of the system.

b. The PU system automatic checkout.

4.2.3.3.1 Propellant Utilization System Calibration (1B64367 B)

The manual calibration of the propellant utilization system, run and accepted on 4 August 1966, consisted of the following:

a. Verification of static inverter/converter output voltage.

b. LH_2 and LOX bridge empty and full calibration.

c. Data acquisition of the LH_2 and LOX bridge position.

d. LH_2 and LOX bridge slew checks (1/3 and 2/3 slew).

e. RMR calibration.

f. LH_2 and LOX bridge linearity checks.

g. Verification of hardwire loading circuits.

No revisions were written, nor were any failures discovered.

4.2.3.3.2 Propellant Utilization System (1B59048)

On 27 August 1966, the ability of the propellant utilization system to regulate the fuel to oxidizer mixture ratio was verified. The results were certified by Engineering on 6 September 1966. The steps comprising this verification were:

a. Oven internal temperature check.

b. LOX and LH_2 bridge zero balance.

c. Ratio valve output null voltage.

d. Loading system integrity check.

e. LOX and LH_2 servo loop portions of the PUEA.

f. Valve movement check.

In the documentation log sheet, four revisions were recorded. Two specified data obtained from manual H&CO 1B64367; one changed a tolerance to account for a noisy PU coarse loading pot; and one deleted a step due to a parts shortage.

Two failure and rejection reports were written during this test. FARR A196148 reported that PUEA, P/N 1A59358-517.2, S/N 05, was defective. The assembly was reworked per B/P 1A74597, and retested acceptably. FARR A196194 noted that the LH_2 fine mass reading on PUEA, P/N 1A59358-517.2, S/N 07, was low. The assembly was reworked to a 1A59358-525, S/N 025. The rework was acceptable.

4.2.3.4 Level Sensor and Control Unit Calibration (1B44546 B)

Run and [illegible]pted on 4 August 1966, this procedure verified the proper operation of the sensor systems for the liquid level and liquid/gas differentiator, for the LOX and LH_2 point level, and for the tanks overfill and fast fill.

4.2.3.4 (Continued)

Two revisions included one correcting a minor error, and one modifying a schematic-to-ground a wire.

There was one failure and rejection report written. FARR A184795 reported that control units 411A91A66A212 and 411A91A66A210 could not be adjusted to 5.0 ± 0.5 vdc. Also, control unit, P/N 1A68710-511, S/N D24, could not be adjusted to 28.0 ± 2.0 vdc. Rewiring all three units brought their adjustment to within tolerance.

4.2.3.5 Exploding Bridgewire System (1B59047)

The exploding bridgewire system automatic verification was accomplished on 6 August 1966 with the completion of the following:

a. Preliminary EBW firing unit and pulse sensor test.

b. EBW firing unit ignition pulse sensor self test.

c. Ullage rocket EBW firing unit test.

d. Ullage rocket jettison firing unit test.

The results of testing were accepted on 9 August 1966.

The six revisions entered in the log sheet included:

a. Four deleting items, of which three were not required, and one was impractical due to a parts shortage.

b. A revision specified that the "resume" button be pressed to end the test.

c. A final revision corrected an error in the program.

There were no functional failures reported.

4.2.3.6 Range Safety System Tests

There were two tests performed to verify the operation of the range safety receivers. The manual procedure provided the test and equipment setup required to perform the automatic procedure. In addition to these two tests, an automatic checkout of the entire range safety system was conducted.

4.2.3.6.1 Range Safety Receiver, Manual Operations (1B64634)

Between 8 and 19 August 1966, the manual test setup required for the range safety receiver checkout was effected and accepted.

In the log sheet, eleven revisions were recorded. There follows a brief description of each:

a. Two specified resetting the signal generator to the correct center frequency.

b. A step which was to be done later was deleted.

c. Two revisions added steps which had been omitted from the procedure, and one corrected a minor error.

d. One specified disconnecting the antenna to allow checking of AGC drift without antenna noise.

e. Two called for the reinstallation of the 20 db attenuator.

f. One revision changed a tolerance, and a final revision returned the stage to its pretesting configuration.

There were no malfunctions on record.

4.2.3.6.2 Range Safety Receiver Test (1B59116 A)

The automatic checkout of the range safety receivers, run and accepted on 17 August 1966, verified their ability to receive flight termination commands and initiate propellant dispersion.

4.2.3.6.2 (Continued)

Five items were incorporated in the revision log sheet, as follows:

a. A step was added per NASA request.

b. Instructions were given to use fault routines if "off" commands were not received.

c. Two revisions corrected minor errors in the program.

d. A measurement was deleted because of a parts shortage.

No failure and rejection reports were prepared.

4.2.3.6.3 Range Safety System (1B59049)

The automatic checkout conducted on 16 August 1966, to verify the performance of the range safety system consisted of:

a. EBW and receiver external/internal power transfer test.

b. Engine cutoff test.

c. Pulse sensor and propellant dispersion command inhibit test.

d. In-flight turnoff command test.

e. Arm and engine cutoff command test.

f. Propellant dispersion command test.

g. Safe and arm device test.

The results of testing were accepted on 19 August 1966, after the following eleven revisions had been incorporated:

a. Four corrected minor program errors, and one added an item which had been omitted.

b. Two measurements were deleted, one because it was no longer required, and one because of parts not installed.

c. Four revisions added steps to: correct the destruct system set operation; verify stage cutoff circuitry; verify the safe and arm device; and check a talkback function.

4.2.3.6.3 (Continued)

There was one failure and rejection report prepared in conjunction with this test. FARR A196143 reported on PC board 411A96A200, P/N 50M65000-1, S/N 0849B, in A1 multiplexer, P/N 1B62513-521, S/N 00001, which was defective. The board was removed and replaced; however, the multiplexer was still defective, and was replaced.

4.2.3.7 Cryogenic Temperature Sensor Verification (1B64624)

Those temperature probes whose normal operating range did not include ambient (room) temperature were tested between 26 July and 4 August 1966. Engineering certification of the results was made on 11 August 1966. The probes were tested by measuring their resistance output at ambient (known) temperature, and comparing this output to a calculated value based upon their calibration curves.

There were eight revisions to the original document, modifying the procedure to:

a. Correct a minor error.

b. Ensure complete checkout of each sensor.

c. Take into account changes peculiar to the 503 configuration.

d. Delete items which were previously considered.

There was one failure and rejection report prepared as a result of this test. FARR A196136 noted that temperature transducer, P/N 1B34473-1, S/N 119, failed. The resistance output should have been within 5 per cent of 5000 ohms. It read open. The transducer was returned to the vendor for rework.

4.2.3.8 Signal Conditioning Setup (1B64628)

Between 5 August and 15 September 1966, all signal conditioning equipment which was either found out of tolerance during system checkout, or was out of tolerance as replacement equipment, was calibrated.

According to twenty-eight revisions, the procedure was modified as necessary for this stage. The revisions covered:

a. Proper reference drawings were called out in one revision.

b. Several pieces of non-end item test equipment were added according to another.

c. Seventeen revisions changed measurement callouts to conform to the latest Instrumentation Program and Components List, dwg. 1B43568L.

d. A revision specified completing a step which was not described in the procedure.

e. Four corrected minor errors, and one clarified the procedure.

f. A tolerance was narrowed by one revision.

g. One changed the procedure to comply with the production test requirements.

h. A revision written unnecessarily was deleted.

Testing per this procedure revealed three defects which were described on failure and rejection reports. FARR A184793 noted that the output from 20 volt excitation module 411A91A63A241, P/N 1A74036-1.1, S/N 0240, was 25.0 vdc. The module was scrapped. FARR's A196141 and A196193 reported that extensiometer 404MT630, P/N 1A68709-1, S/N 00022, would not extend or retract. The extensiometer was removed, re-taped, calibrated, and accepted.

4.2.3.9 Single Sideband System Tests

There were two tests performed to verify that the single sideband telemetry system, transmitting acoustical and vibrational data, was functional. The checkout consisted of a manual procedure providing test equipment setup, and an automatic procedure.

4.2.3.9.1 Single Sideband System Manual Operations (1B64643 A)

The test equipment setup required for the automatic checkout of the single sideband system was accomplished between 24 August and 6 September 1966.

Forty-three revisions were entered in the log sheet, recapped as follows:

a. Nine corrected minor errors in the procedure.

b. Fourteen steps which were not required were deleted.

c. Steps were added by thirteen revisions to: add end item test equipment (Model 141 cable network, Model 127 tape unit, and Model 296 signal distribution unit); verify the frequency of the 400 Hz signal; take into account errors in GSE; check the service channel marker; and correct cable designations.

d. The remaining seven revisions pertained to incorporating items which had been omitted from the procedure.

There were eight failure and rejection reports written against defects found while testing per this procedure. They were:

a. FARR A196184 noted a loose connection at the accelerometer end of coaxial cable 411M1605C, P/N 1A88599-1, S/N 04, which was suspected of causing voltage deflections. The loose connector was tightened, and the deflections continued. The accelerometer was then removed and replaced.

b. FARR A196186 reported that the above accelerometer was returned to the vendor for rework to specs.

c. FARR A196192 noted that wires D8824A22 and D8825A22 of wire harness 411W297D8, P/N 1B58290-1, S/N 00001, were reversed. Pins D and N of plug P8 were removed and reinstalled per B/P, correcting the discrepancy.

4.2.3.9.1 (Continued)

d. FARR A196199 observed that the amplitude signal level of transducer kit, P/N 1A68708-1, S/N 312, was zero. It should have been 80 volts ± 10 per cent.

e. FARR A196200 reported that the forward right-hand mounting stud for transducer, P/N 1A68708-1, was loose and turned with the nut. The stud was secured successfully.

f. FARR A216753 noted that a coaxial connection was damaged at amplifier, P/N 1A68707-7. Transducer kit, P/N 1A68707-601, S/N 1508, containing the connector, was returned to the vendor for rework to specs.

g. Per FARR A216756, coaxial cable 411MT675, at panel, P/N 1A68707-577, S/N 513, had a loose connector causing intermittent operation. The connection was tightened, correcting the condition.

h. FARR A216757 reported that coaxial cable 411MT705, P/N 1A68708-507, S/N 356, had a loose connector. The connection was tightened and retested acceptably.

4.2.3.9.2 Single Sideband System (1B59045)

The Model DSV-4B-126 FM T/M single sideband (SSB) station was used to receive vibrational and acoustical signals from the stage for reduction and evaluation. This automatic checkout, run on 30 August and accepted on 7 September 1966, consisted of:

a. Power distribution.

b. Sequencer commands.

c. Remote automatic calibration assembly.

d. Marker channel verification.

e. Preflight sweep calibration.

f. SS/FM channel verification.

g. SS/FM transmitter check.

4.2.3.9.2 (Continued)

There were fifteen revisions written to modify the procedure, including five correcting minor program errors. The remaining ten were:

a. Three added steps to: insert the inflight calibration test; turn SSB power on; and do the channel marker verification immediately subsequent to power on.

b. Three deleted steps, because they were no longer required, because they were to be done later, or because of parts shortages.

c. A revision changed an item to conform to the instrumentation program and components list.

d. One specified verification that certain manual steps had been accomplished per H&CO 1B64643.

e. Two revisions added breakpoints to allow for the sweep cal command.

No functional failures were noted.

4.2.3.10 Telemetry System Tests

The final acceptance checkout of the telemetry system included a manual test setup and an automatic checkout.

4.2.3.10.1 Telemetry System, Manual Operations (1B64637)

Between 2 and 7 September 1966, those portions of the telemetry system checkout which required manual activity were performed and verified. Included were adjustment of the subcarrier oscillators, verification of channel assignments, verification of SCO pre-emphasis, adjustment of transmitters, and verification of flight recorder and program plugs.

Noted in the documentation log sheet were twenty-one revisions, which are recapped as fo[illegible]:

a. One added the Model 296 telemetry signal distribution unit to the list of end item test equipment.

4.2.3.10.1 (Continued)

b. Ten revisions pertained to deleting steps which were no longer required, or which had previously been done.

c. Two corrected errors in the procedure, and one added an item which had been omitted.

d. A revision specified certain test stand adjustments.

e. The remaining six revisions pertained to returning the 70 kHz VCO to the operational mode; the transition from manual to automatic testing; measuring the tape speed of the 120 kHz recorder; specifying the oscillograph channel for the special service channel; and making it the responsibility of Engineering to evaluate strip charts.

Three failure and rejection reports were written against this test. FARR's A196179 and A196180 reported that oscillator assemblies, P/N's 1B33187-553 and -557 respectively, had no response. The oscillators were reworked acceptably. FARR A216751 noted that adjusting the gain on the wideband amplifier of oscillator assembly, P/N 1B33187-555, S/N 00001, caused the output voltage to vary. The unit was reworked to the 1B52717-1 configuration, and accepted for use.

4.2.3.10.2 Telemetry System, Automatic Checkout (1B59050)

Four runs of this procedure were required to functionally check out the telemetry system. The three runs prior to final acceptance, completed on 20, 24, and 27 August 1966, were inconclusive due to a program error, non-linearity of the No. 2 70 kHz VCO, and out-of-tolerance channel outputs. The final run, performed on 2 September and accepted on 7 September 1966, was completed without difficulties, incorporating the following fifty-eight revisions:

a. Twenty-two corrected procedure, program, and operator errors.

b. Nine items were deleted because they were not required, because they had previously been done, or because parts shortages precluded accurate measurements.

4.2.3.10.2 (Continued)

c. Three revisions written in error were voided.

d. Seven called for starting the tape recorder prior to resuming the program.

e. Six revisions inserted necessary breakpoints.

f. Five called for running steps requested by the Data Reduction Group.

g. The remaining six revisions involved: Transferring data to VCL tape unit 1; noting that the flight recorder was time significant; adding an item omitted from the procedure; changing a tolerance; and adjusting the antenna input GSE switch.

The following two failure and rejection reports were written to record defects found while testing per this procedure. FARR A196196 noted that coaxial switch 411A89A201, P/N 1A69213-1, S/N 0062, read 70 per cent due to noise pickup. It should have read 58 per cent; however, retest per B/P A659-1A69213-PDS1 failed to reproduce the defect, and the switch was accepted as is. FARR A196197 reported that the 70 kHz VCO in FM/FM/PAM No. 2 transmitter was nonlinear in its middle range. The VCO was reworked to B/P and accepted.

4.2.3.11 Digital Data Acquisition System Tests

The three test procedures conducted to ascertain the function of the digital data acquisition automatic checkout system were:

a. DDAS manual calibration.

b. DDAS automatic calibration.

c. DDAS automatic checkout.

4.2.3.11.1 Digital Data Acquisition System Manual Calibration (1B64629)

Run in conjunction with automatic H&CO 1B59113, the DDAS manual calibration included checkout of the Model 270 multiplexers and the Model 301 PCM/DDAS assembly. Channel outputs were determined multiplexer by multiplexer. These operations were completed on 1 August 1966, with acceptance taking place on 3 August 1966.

The purpose of the manual checkout was to provide setups and other non-automatic functions as necessary to supplement the automatic system calibration H&CO 1B59113, using the D924A computer and the RACS.

The only revision made changes as necessary to reflect the new number of the automatic calibration procedure.

There were no functional failures on record.

4.2.3.11.2 Digital Data Acquisition System Automatic Calibration (1B59113 A)

The automatic calibration of the digital data acquisition system was run for the first time on 29 July, and accepted on 3 August 1966. Four revisions to this run included:

a. One requiring that the stage power setup test results tape remain loaded.

b. One allowing measurements because the LH_2 point level, overfill, and fast fill sensors had yet to be calibrated.

c. One deleting a step because of a parts shortage, and one deleting a step which was no longer required.

The second run, begun and accepted on 15 August 1966, was conducted only as necessary to verify the calibration of the A1 multiplexer, which had been replaced (reference FARR A196143). There were three revisions to this run, including one deleting a step due to a parts shortage; one ensuring that the

4.2.3.11.2 (Continued)

power setup tape remained loaded; and one deleting all portions of the checkout not relevant to the A1 multiplexer.

The above referenced FARR A196143, replacing the multiplexer is described in paragraph 4.2.3.6.3. There were no other malfunctions.

4.2.3.11.3 Digital Data Acquisition System Automatic Checkout (1B59044 A)

The D924A computer was used, first on 1 and 2 August, and finally on 11 August 1966, to automatically check out the digital data acquisition system. The first run was terminated due to extensive program errors which were rectified, resulting in the "A" revision of the H&CO. The results of the final run were accepted by Engineering on 8 September 1966; however, 103 revisions were incorporated at this time. Briefly, they covered:

a. Seven changed tolerances to reflect the installation of simulators.

b. Two pertained to the inclusion of the Model DSV-4B-279 vehicle instrumentation checkout unit in the list of end item test equipment.

c. Three revisions written in error were voided.

d. Seven added items omitted from the procedure, and thirty-three corrected errors in the procedure, program, or data description tape.

e. Five revisions were written to bring the procedure into compliance with the revised instrumentation program and components list.

f. Three changed the program to conform to new strain gauge modules which had been installed.

g. Four revisions were written because newly installed temperature patches had different temperature-to-resistance ratios, and two revisions noted that several temperature probes could not be RACS tested due to proximity to the cold plates.

h. Eleven revisions were necessitated because of incorrect channel assignments.

4.2.3.11.3 (Continued)

i. Eleven deleted steps and/or measurements which were either no longer required, or were affected by parts shortages.

j. Five revisions pertained to defective transducers which were replaced. (Reference FARR's A196195 and A196198).

k. The remaining ten revisions pertained to: adjustment of calibration signal voltage for correct load; accounting for the new J-2 engine analog position indicators; multiplexer input decay after RACS removal; 13.6 in. offset of the 340 in. extensiometers; tables for entering the results of hardwire measurements; new RACS codes; rewiring the EBW pulse sensor; a wiring error; and nominal drift of the Model 296 signal generator.

FARR A196195 noted that the output from accelerometer, P/N 1A88769-503, S/N 207, was 0.5 vdc. It should have been 4.850 ± 0.100 vdc. The accelerometer was returned to the vendor for rework to specs. FARR A196198 reported that transducer, P/N 1B40242-507, S/N 507-5, had out-of-tolerance high and low RACS outputs. The transducer was retested without duplicating the defect, and it was therefore accepted for use. No other functional failures were discovered.

4.2.3.12 Telemetry and Range Safety Antenna System Test (1B64625)

The antenna system designed for the reception of telemetry and flight termination signals was operationally tested between 22 July and 9 August 1966. The results were accepted on the latter date.

There were forty-three entries in the revision log sheet, summarized as follows:

a. Two were written because the transmitter and amplifier were now one item.

b. Four added items omitted from the procedure.

c. Twenty-five revisions corrected minor errors.

d. Two steps which were no longer required were deleted.

e. A revision provided a meter with required sensitivity.

4.2.3.12 (Continued)

f. One called for a transmitter frequency check, two specified range safety insertion loss measurements, and two described a final system VSWR check.

g. Two revisions incorporated allowances for cable insertion loss.

h. The final two revisions pertained to turning transmitter power off.

There were two failure and rejection reports written against this procedure. FARR A184792 noted that the phase angle of coax cable, P/N 1A82204-505, S/N 0025, was 85°. It should have been 30°. The cable was scrapped. FARR A196138 reported that reflected power detector 411A97MT720, P/N 1A74776-501, S/N 2-0200, could not be adjusted. The detector was retested, and the defect was not duplicated. It was therefore accepted for use.

4.2.3.13 APS Simulator Test (1B59051)

The Model DSV-4B-188 APS module simulators were used to verify the continuity and compatibility of the wiring through the stage/APS interface. The specific tests performed were:

a. Verification that application of bus power did not result in excessive static loads.

b. Verification that attitude control commands from the IU controlled the proper sets of quad-redundant solenoids.

c. Verification of proper APS telemetry measurements.

Run on 8 August and accepted on 10 August 1966, the test was completed with the addition of the following five revisions:

a. Two specified steps to ensure that the relays in the attitude control module had operated.

b. Two revisions noted compensations for wiring IR drop.

c. The last revision corrected a minor programming error.

There were no functional failures found while testing per this procedure.

4.2.4 Propulsion System Tests

The following nine tests were performed to establish the function and integrity of the propulsion system components, and the alignment of the J-2 engine:

a. Propulsion system control console/stage compatibility test - paragraph 4.2.4.1.

b. Fuel tank pressurization system leak check - paragraph 4.2.4.2.

c. Pneumatic control system leak check - paragraph 4.2.4.3.

d. Cold helium system leak check - paragraph 4.2.4.4.

e. Propellant tanks system leak check - paragraph 4.2.4.5.

f. Repressurization system leak check - paragraph 4.2.4.6.

g. J-2 engine system leak check - paragraph 4.2.4.7.

h. Propulsion system automatic checkout - paragraph 4.2.4.8.

i. Engine alignment - paragraph 4.2.4.9.

4.2.4.1 Propulsion System Control Console/Stage Compatibility Check (1B59454)

The check of the compatibility between the propulsion system control console and the stage propulsion system involved throwing switches on the console and verifying proper solenoid responses on the stage. This was accomplished and certified on 4 August 1966, with four revisions incorporated. Of these, two deleted steps which were not required, one corrected an error, and one clarified a statement.

There were no malfunctions on record.

4.2.4.2 Fuel Tank Pressurization System Leak Check (1B59456)

A manual leak check of the LH_2 tank pressurization system was performed between 1 and 8 August 1966, with acceptance of the results occurring on the latter date.

4.2.4.2 (Continued)

There were five entries on the leak check log, all of which were cleared after specified rework. Five revisions to the procedure included one which was later voided, two describing a setup to prevent backflow into the system, one correcting an error, and one deleting a step which was no longer required.

Four failure and rejection reports, FARR's A184797, A184798, A184799, and A184800, pertained to galling and scratches on pipe assembly, P/N 1B64112-1, check valve, P/N 1B65673-1, and quick disconnect, P/N 7851861-1, which caused leakage between the pipe assembly, and both the check valve and the disconnect. The damaged areas were reworked acceptably.

4.2.4.3 Pneumatic Control System Leak Check (1B59457)

Between 11 August and 6 September 1966, this procedure was run and accepted, verifying the integral status of the pneumatic control system.

There were twenty-nine leaks noted in the log sheet, all of which were resolved through rework. Nine revisions modified the procedure, as follows:

a. One provided for updating a drawing.

b. Three deleted leak checks on connections which were inaccessible, and two checks were deleted due to parts shortages.

c. A revision clarified the procedure, and another added an item omitted from a procedure.

d. The final revision provided for checking out orifice, P/N 1A48854-1.

The following three failure and rejection reports were written against this procedure:

a. FARR A196142 noted that actuation control module 411A2, P/N 1B65292-1, S/N 012, leaked at 200 scim. The module was returned to the vendor for replacement.

4.2.4.3 (Continued)

b. FARR A196145 reported that excessive leakage was noted around the screws mounting the actuation port adapter on prevalve, P/N 1A49968-509, S/N 102. The prevalve was returned to the vendor for rework to specs.

c. FARR A196146 observed that LOX prevalve, P/N 1A49968-509, S/N 011, leaked at the screws holding the actuation port adapter to the body of the valve. A slight leak remained after rework. This was accepted for use.

4.2.4.4 Cold Helium System Leak Check (1B59458)

Confirmation of the integrity of the cold helium LOX tank pressurization system was made on 6 August 1966, with Engineering acceptance taking place on 6 September 1966.

One revision was written to clarify a step, and twelve leakage conditions were noted in the log sheet. All were resolved satisfactorily following rework. One was described on FARR A196140, which reported on a rough, galled spot in the upstream flare seat of tube assembly, P/N 1B52441-1, causing leakage in excess of 0.001 cc per second. A Voi'shan seal was installed, rectifying the condition.

4.2.4.5 Propellant Tanks System Leak Check (1B59459)

The equipment setup and instructions required to leak check the vacuum ducts, common bulkhead, propellant tanks, and associated valves, are described in this procedure.

Run between 23 August and 6 September 1966, the checkout was completed with no entries in the leak check log sheet, and no functional failures.

There were three revisions recorded. Two changed the procedure to use freon instead of helium, for leak checks; and one rectified an omission.

4.2.4.6 Repressurization System Leak Check (1B59460)

Run and accepted between 16 August and 6 September 1966, this procedure established the leak free condition of the LOX and LH_2 tank repressurization systems.

Six entries in the leak check log sheet were resolved by changing seals or retorquing "B" nuts, except for two noted below. Three revisions to the original document pertained to adding items omitted from the procedure, and leak checking the connection between the LOX repressurization control module and the pressurization line.

The above mentioned leakage conditions were noted at unions, P/N's MC160C12W and MC177C12W. Crush washers, P/N MC185C12, were installed to correct the conditions per FARR's A196189 and A196190.

4.2.4.7 J-2 Engine System Leak Check (1B59461)

There were two distinct tests involved in checking the J-2 engine system for leakage. The J-2 engine leak check involved checking all lines, valves, and hardware, and the thrust chamber leak check included testing the chamber and the main fuel and oxidizer valves.

Testing began on 12 August 1966, with acceptance taking place on 6 September 1966. Three entries in the leak check log included two which were resolved immediately. The third was recapped to FARR A196147, which noted that the connection between the pneumatic control package and the fine regulator outlet pressure line leaked at 4 scim. A new seal and fitting were installed.

Six revisions to the procedure were entered in the revision documentation log sheet. Two rectified procedure omissions, two deleted steps which had already

4.2.4.7 (Continued)

been done, one changed a step to comply with memo 190C, and the final revision corrected a minor error.

Four other failure and rejection reports, not noted in the leak check log, were:

a. FARR A196178 noted shreds of metal and plastic in the engine control bottle fill system. The fill line was purged.

b. FARR A196181 reported scratches on both ends of tube assembly, P/N 1B52566-1, and damage to the teflon insulation in several places. The flared ends were hand polished per DPS 10001, and the teflon wrapping was removed and replaced per B/P.

c. FARR A196182 observed imperfections in the threaded end of the nipple seat of quick disconnect assembly, P/N 1A49958-523, S/N 29. The surface was polished with No. 400 paper.

d. FARR A196183 noted the same problem for disconnect assembly, P/N 1A49958-515, S/N 12. It, too, was polished out.

4.2.4.8 Propulsion System Test (1B64396)

The automatic functional checkout of the propulsion system consisted of six distinct procedures, as follows:

a. Pressure switches test, run on 20 August and again on 22 August 1966. The first run was repeated due to a malfunction of the engine pump purge pressure switch. The second run was completed satisfactorily.

b. The LH_2 tank pressurization system test, performed on 22 August 1966. The only problem was a transducer in GSE Model 321, which was replaced.

c. The LOX tank pressurization system test, conducted on 25 August 1966, was completed with no malfunctions.

d. The J-2 engine system test, run between 26 and 31 August 1966. This test was rerun three times due to GSE and program problems.

e. The pneumatic control system test, performed on 31 August 1966. FARR A216752 noted a broken wire from the LOX prevalve, which was repaired by replacing pin 11 of plug 26.

4.2.4.8 (Continued)

f. The repressurization system test was run on 2 September 1966 with no malfunctions.

The results of testing the propulsion system components were verified and accepted by Engineering on 7 September 1966.

There were fifty-one revisions to the procedure recorded in the documentation log sheet, as follows:

a. Two provided positive verification of valve travel.

b. Nineteen corrected procedure, program, and operator errors, and one added an item which had been omitted.

c. Four revisions were written to conform to Rocketdyne manual R-3825-1B.

d. Five inserted breakpoints and time delays as required.

e. Four revisions provided manual checkout of pressure switches.

f. Five items were deleted because of parts shortages, because of having been previously done, or because they were no longer required.

g. A revision written in error was voided.

h. The remaining ten revisions pertained to: Reducing the number of loops; allowing for pressure due to gravity; elevating the second stage pressurization spike; clarifying hookup between towers 5 and 6; changing the engine control bottle pressure; revalidating the repressurization and pneumatic control system H&CO's 1B59460 and 1B59457; and loosening a tolerance.

No other defects were noted.

4.2.4.9 Engine Alignment (1B39126)

This procedure contained instructions for measuring and adjusting actuator lengths in order to align the J-2 engine properly with the stage. The alignment and verification were completed on 26 July 1966, with Engineering acceptance taking place on the following day.

4.2.4.9 (Continued)

One revision entered in the log sheet changed one of the locations at which the elevation of datum plane G was measured, due to structural interference.

No malfunctions were reported.

4.2.5 Hydraulic System Tests

The two procedures performed to verify the integrity, cleanliness, and function of the stage hydraulic system were:

a. Fill, flush, bleed, and fluid samples test.

b. Hydraulic system automatic checkout.

4.2.5.1 Hydraulic System Fill, Flush, Bleed, and Fluid Samples (1B40973 B)

The cleanliness of the hydraulic fluid, as well as the clearance between the engine and the stage structure, were certified between 5 August and 15 September 1966.

There were thirteen revisions to the document, including ten which added steps because the gimbal control unit had been reworked. The other three pertained to changing paragraphs because the J-2 engine feed bellows was disconnected from the stage, and because the Model 699 servo valve squealed.

There were no functional failures reported.

4.2.5.2 Hydraulic System (1B59122 A)

The automatic and manual tests required to confirm the function of the hydraulic system were:

a. Accumulator precharge test.

b. Reservoir oil volume test (unpressurized).

4.2.5.2 (Continued)

c. Reservoir oil pressure test (unpressurized).

d. Coast mode thermal switch test.

e. Mid-stroke lock tolerance check.

f. System pressure test (pressurized).

g. Reservoir oil pressure test (pressurized).

h. Reservoir oil volume test (pressurized).

i. Polarity, linearity, and clearance checks.

j. Transient response test.

k. Frequency response tests.

Performed on 18 August and certified on 7 September 1966, the aforementioned tests were accomplished as modified by the following ten revisions:

a. One replaced a 2° step with a 3° step.

b. Four steps which were no longer required were deleted, and a step was deleted due to a parts shortage.

c. A revision required that the stage power setup test results tape remain open.

d. Another specified that the command relay be subscripted in the fault routine of the frequency response crossover logic.

e. A revision corrected a minor program error.

f. The final revision corrected the halves balance ratio limit printout.

There were no malfunctions on record.

4.2.6 All Systems Test (1B59060 A)

The all systems simulated flight test was conducted on 8 and 9 September 1966. The first run, on 8 September, was terminated due to a facility power failure. The second and successful run was completed with 103 revisions, and was finally accepted by Engineering on 27 September 1966.

The test consisted of operating all stage systems, together, under conditions such as those prevailing during prelaunch activities, liftoff, powered flight, hydraulic gimballing, restart, and coast. The stage was connected to facility sources through the umbilicals until simulated liftoff, at which time the umbilical cables were ejected and the systems continued to operate on stage-mounted power and air conditioning supplies.

The above mentioned revisions included:

a. A correction to the reference drawing list.

b. Additions to the list of end item test equipment.

c. Twenty-four revisions deleting steps which were not required, or which had been previously done, or where parts shortages made accurate measurements impossible.

d. Three revisions changed the procedure to reflect special cable installations.

e. Three inserted up-to-date tolerance changes.

f. Two revisions added steps which were necessitated because the umbilicals were ejected during the test.

g. A revision authorized an increase in power input to the range safety receivers due to antenna relocation.

h. Five revisions pertained to checkout of the single sideband ground station.

4.2.6 (Continued)

i. Thirty-two revisions clarified or added items omitted from the procedure, or corrected procedure and program errors.

j. Eighteen inserted breakpoints and time delays as necessary.

k. Two revisions written in error were voided.

l. The remaining eleven revisions pertained to: checkout of PAM channels; a modification to the procedure per NASA request; ensuring recording of all active channels; testing the APS; accurate positioning of source selector switches; manually verifying reworked transducers; and a defective DC amplifier (reference FARR A216760).

FARR A216759 reported that the output from transducer, P/N 1A88599-1, S/N MA04, was 0.6 vrms. Output should have been 1.4 vrms. Retest failed to duplicate the defect, and the transducer was accepted for use.

FARR A216760, mentioned above, noted that the high output from DC amplifier, P/N 1A82395-1, S/N 2145, was 2.989 vdc; it should have been 4.000 vdc. The amplifier was returned to the vendor for rework to specs.

4.3 Stage Manufacturing Tests

All manufacturing and test records for the stage are reviewed and presented in this paragraph. Also included are those procedures pertaining to preparation of the stage for shipment to STC. Table II contains narrated description of the permanent nonconformances recorded on FARR's during manufacturing and test, while those nonconformances discovered during final inspection and pre-shipment activities are narrated in table I, section 3. The dispositioning of these FARR's was accomplished by the Material Review Board. A review has been made of acceptance test data pertaining to the weight, balance, and shipment requirements, hydrostatic proof tests, and subsequent leak check of the propellant tanks.

4.3.1 Stage Preparation for Shipment

Five procedures were conducted to prepare the stage for shipment, by transporter, to Los Alamitos Naval Air Station, and by Super Guppy from there to Sacramento. These procedures were:

a. Stage preparation, air transport.

b. Stage transportation, transporter, air carry pallet.

c. Stage loading, air carrier.

d. Preparation of the stage for the weigh and balance procedure.

e. Weigh and balance procedure.

4.3.1.1 Stage Preparation for Air Transportation (1B57355 A)

The preparation of the stage for air carrier transportation to Douglas STC took place between 5 and 10 October 1966. The following steps were included:

a. Installation of the air carry roller transfer kit onto the transporter.

b. Installation of the air carry support assembly (pallet) onto the transporter.

4.3.1.1 (Continued)

c. Installation of the stage hoist equipment.

d. Loading of the stage onto the air carry pallet/transporter.

No revisions or malfunctions were reported.

4.3.1.2 Stage Transportation - Transporter (1B57356)

On 11 October 1966, the stage was moved from Douglas SSC to NAS Los Alamitos in preparation for loading the stage onto the Super Guppy. Two major sequences specified in the procedure, the transporter checkout and the prime mover to transporter hookup, were deleted per the only revision. They had previously been accomplished. The other steps in the procedure were:

a. Stage transportation procedure.

b. Prime mover to transporter disconnect.

4.3.1.3 Stage Loading, Air Carrier (1B57357 C)

The stage was loaded onto the Super Guppy air carrier, for transportation from Douglas SSC to STC, on 11 October 1966. The loading procedure consisted of the following steps:

a. Transferring the stage, with its pallet, from the transporter to the cargo lift trailer (CLT).

b. Positioning the CLT, with the stage, in preparation for loading into the air carrier.

c. Loading the stage, with its pallet, into the air carrier.

d. Removal of ground support equipment.

e. Approval of flight status.

Five revisions changed the procedure by: adding two items; deleting one step; eliminating a referenced document; and reversing the order of two steps.

No functional failures were noted.

4.3.1.4 Preparation for Stage Weigh and Balance (1B37831 C)

The preparation of the stage for horizontal weigh and balance, completed on 4 and 5 October 1966, consisted of:

a. Installation of stage handling rings.

b. Preparation of the weighing area in the VCL.

c. Installation of the stage and handling rings on the cradles.

d. Installation, checkout, and removal (after weighing operation) of weighing equipment.

e. Installation of the stage support assembly (engine protective cover).

f. Installation of the stage, with rings and cradles, on the transporter.

The preparation was accomplished with no revisions or other discrepancies.

4.3.1.5 Weigh and Balance (1B64539 A)

On 6 October 1966, the stage was weighed, and the horizontal center of gravity was determined, in preparation for stage shipment to STC. The predicted accuracy of the weight measurement was ± 0.1 per cent.

The stage weight in air was found to be 28,011.1 pounds, and the calculated weight adjusted for Standard Locality in a vacuum was 28,075.3 pounds. The longitudinal center of gravity was located at station 338.57.

Seven revisions were noted, of which three pertained to a revised tare weight, three changed steps to clarify the procedure, and one deleted a step.

No malfunctions occurred.

4.3.2 GN_2 - Electrical Preshipment Purge - Air Carry (1B65783 A)

Between 5 and 10 October 1966, the stage was purged and dried to a -25° F dewpoint (300 ppm by volume) in preparation for shipment to STC. A desiccant was installed in order to maintain a clean, dry, and safe differential pressure environment during air transportation.

There were fourteen revisions noted in the log sheet. Eight deleted steps which were no longer required, or because of parts not installed; two added items which had been omitted; one pertained to resequencing parts of the procedure; one lowered pressure to obtain more accurate dewpoint readings; and two were written because the LH_2 vent could not be operated electrically.

No malfunctions were encountered.

4.3.3 Final Inspection

A final inspection of all mechanical and electrical areas was performed before the stage was weighed and prepared for shipment. There were 215 discrepancies noted during final inspection of which 95 were of a mechanical nature, and 120 were electrical. The mechanical discrepancies were minor deviations involving loose parts, lack of torquing, excess materials, torn or missing ID bands, and areas requiring cleaning and paint touch-up. The electrical problems, also minor, were wires riding the structure, ground studs not torqued, loose or tight clamps, damaged and chaffing wires, missing ID, terminals improperly served, wires improperly coiled and stowed, excess parts, and areas requiring cleanup and paint. All problems were quickly resolved, except for the following three:

a. FARR A216705 noted damaged insulation on coax cables 410MT600 and 403MT751, and dings on the exterior of the thrust chamber. The damaged wires were wrapped with teflon tape per DPS, and the dings were accepted as is.

4.3.3 (Continued)

b. FARR A216706 reported on insulation damage to coax cables 425MT601 and 403MT708. The damaged areas were wrapped with teflon tape per DPS 1.357-15.

c. FARR A216707 noted cracks, trimmed cap, and an excess hole in the aft skirt. The cracked area was scarved, the trimmed cap was sealed with DPM 2531, and the excess hole was covered by a doubler.

4.3.4 Propellant Tank Leak and Hydrostatic Proof Tests

The structural integrity of the propellant tanks assembly was verified using hydrostatic proof tests and several kinds of leak checks. The hydrostatic test consisted of exposing points throughout the assembly to differential water pressures, in order to determine their stress patterns. Helium, freon, and bubble solution, as well as dye penetrants, were used to leak check the tanks.

4.3.4.1 Propellant Tanks Hydrostatic Proof Test (1B38414)

The hydrostatic proof checkout of the propellant tanks assembly, conducted to determine leakages and their structural stress patterns, was performed twice. The first run was aborted on 24 February 1966 when the LOX tank aft dome failed the test (reference FARR A188495). The second issue, with a replacement tank assembly, S/N 1007A, was run to completion on 29 and 30 March 1966, and contained three revisions. Two pertained to LH_2 tank emergency drain and refill, and one changed the procedure to allow Engineering to record strain gauge readings during LOX tank pressurization.

Performed per the specifications of acceptance test procedure A659-1B38414-1-PDS 7, the test consisted of the following:

a. Proof of the common bulkhead to a positive (internal) pressure differential of 27.5 + 0.5 - 0.0 psi, and the LOX tank at the common bulkhead joint to 28.7 + 0.5 - 0.0 psi.

4.3.4.1 (Continued)

b. Proof of the common bulkhead to a negative (external) pressure differential of -20.6 + 0.0 -0.5 psi, and the LH_2 tank at the common bulkhead joint to 22.5 + 0.5 -0.0 psi.

c. Proof of the LOX tank to a positive (internal) pressure differential of 51.0 + 0.5 -0.0 psi, and the common bulkhead at the aft dome joint to 19.2 + 0.5 -0.0 psi.

d. Proof of the LH_2 tank aft dome to 38.0 + 0.5 -0.0 psi, and the common bulkhead at the aft dome joint to a positive (internal) pressure differential of 5.2 + 0.0 -0.5 psi.

FARR A188495 was written to report on aft dome, S/N 1007, which was cracked when pressurized to 50 psi. The 1007 tank assembly was removed and reworked to salvage SEO 1A39303-014, and tank assembly, S/N 1007A, was installed in its place.

4.3.4.2 Leak Check

The propellant tanks assembly was both leak and dye checked, subsequent to hydrostatic testing, to ensure the structural integrity of its components and welds. Direction and results of these tests were recorded on Quality Engineering Charts (QEC), which are included in the Stage Log Book.

QEC papers 751, 753, 754, 755, 756, 757, 758, 759, 761, 794, 932, 1520, 1521, 1522, 1523, 1524, 1537, 1553, 1554, 1555, 1556, 1557, and 1558 were used for the halogen, helium, and bubble solution leak checks. Three minor leaks were noted and were reworked. The dye check of all tank welds was conducted per QEC's 799, 902, 904, 905, 908, 915, 916, 917, 920, 921, 924, 935, 968, 986, 1579, 1580, 1684, 1687, 1691, 1693, 1694, 1695, 1696, and 1697. Several dye check indications were noted, but were accepted. However, six required the generation of failure and rejection reports, as follows:

a. FARR A197779 noted greater than No. 3 porosities in the aft dome ring weld. The indications were ground out and accepted.

4.3.4.2 (Continued)

b. FARR A197905 reported on greater than No. 3 porosities and a 1/8 in. linear indication in the forward dome ring weld. The defects were ground and blended out.

c. FARR A197924 pertained to three cracks and greater than No. 3 porosity in the LOX fill line fitting to aft dome segment 3 weld. The defects were ground out and accepted.

d. FARR A197990 indicated that QEC 1697 revealed a crack in the inside weld of fitting, P/N 1B44178-1, to the forward dome. The crack was ground out, polished, and etched.

e. FARR A197991 noted connected linear porosity and two small transverse cracks in the external flange fitting, P/N 1B33284-501, to forward dome segment 2 weld. The indications were ground out, etched, and blended.

f. FARR A197996 revealed two longitudinal cracks in the LOX fill line fitting to aft dome segment 3 weld. The condition was reworked per salvage SEO 1A39303-015.

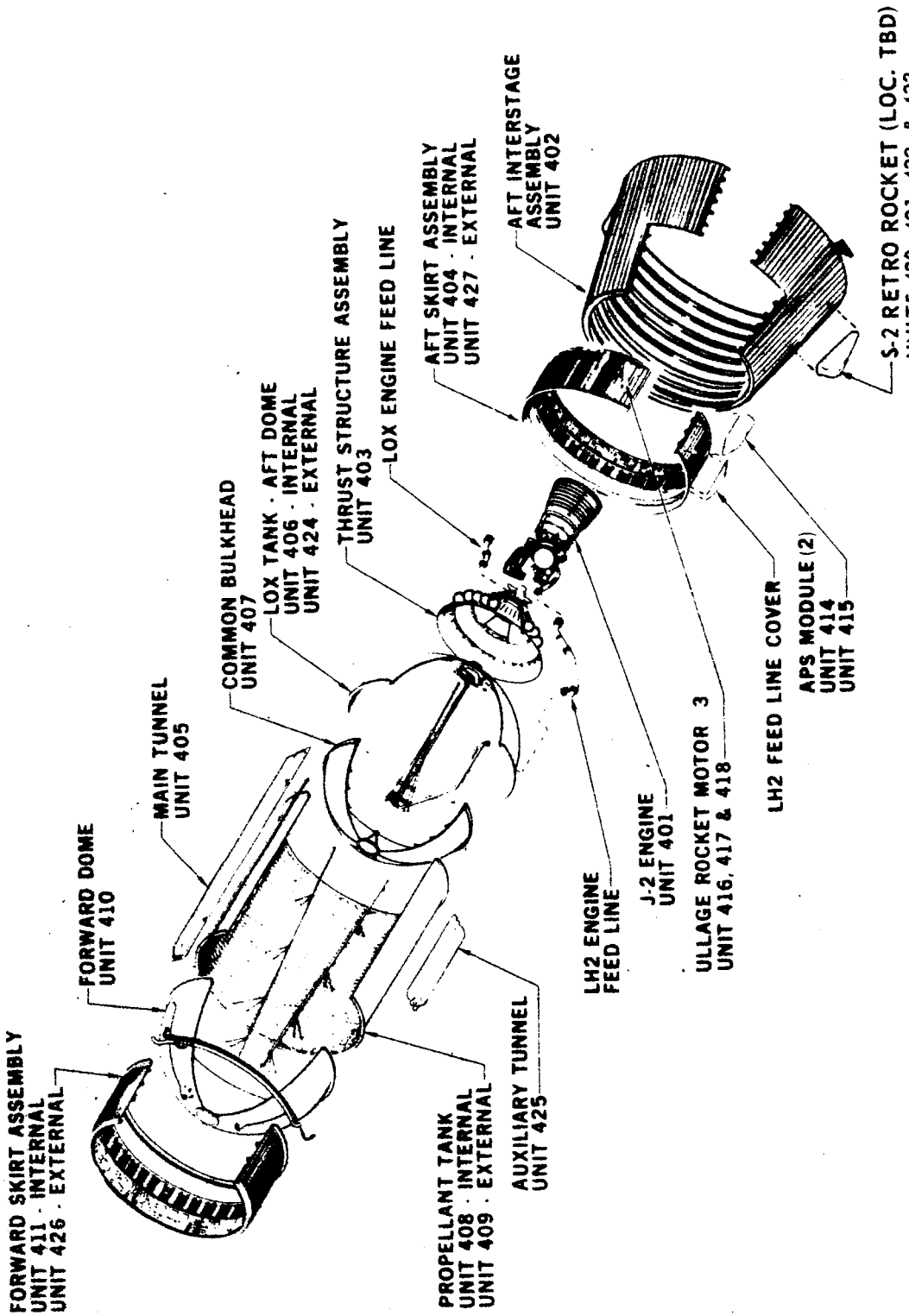


Figure 1. Exploded View of Stage, Showing Major Assemblies and Area Codes

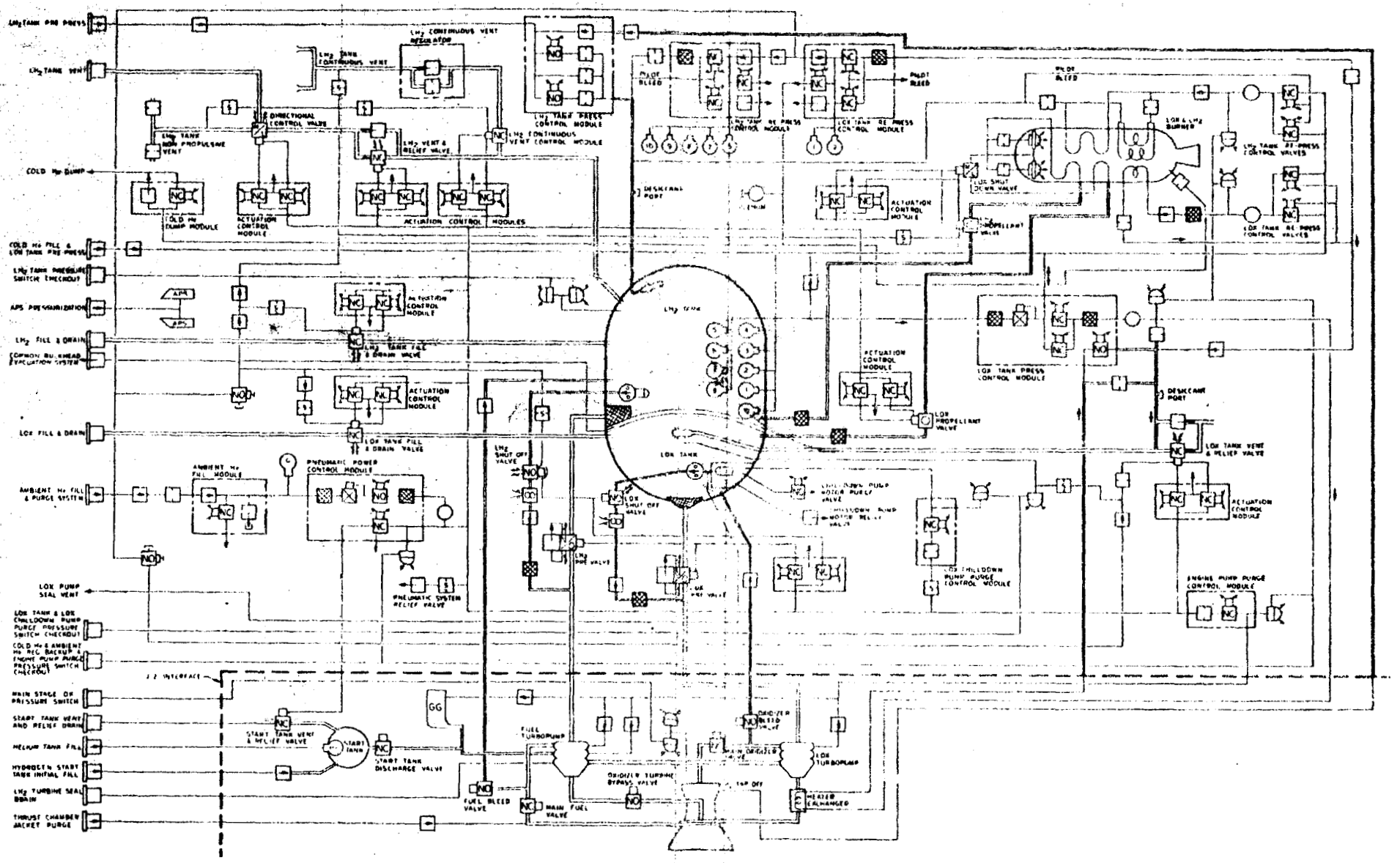


Figure 2. Propulsion System Schematic

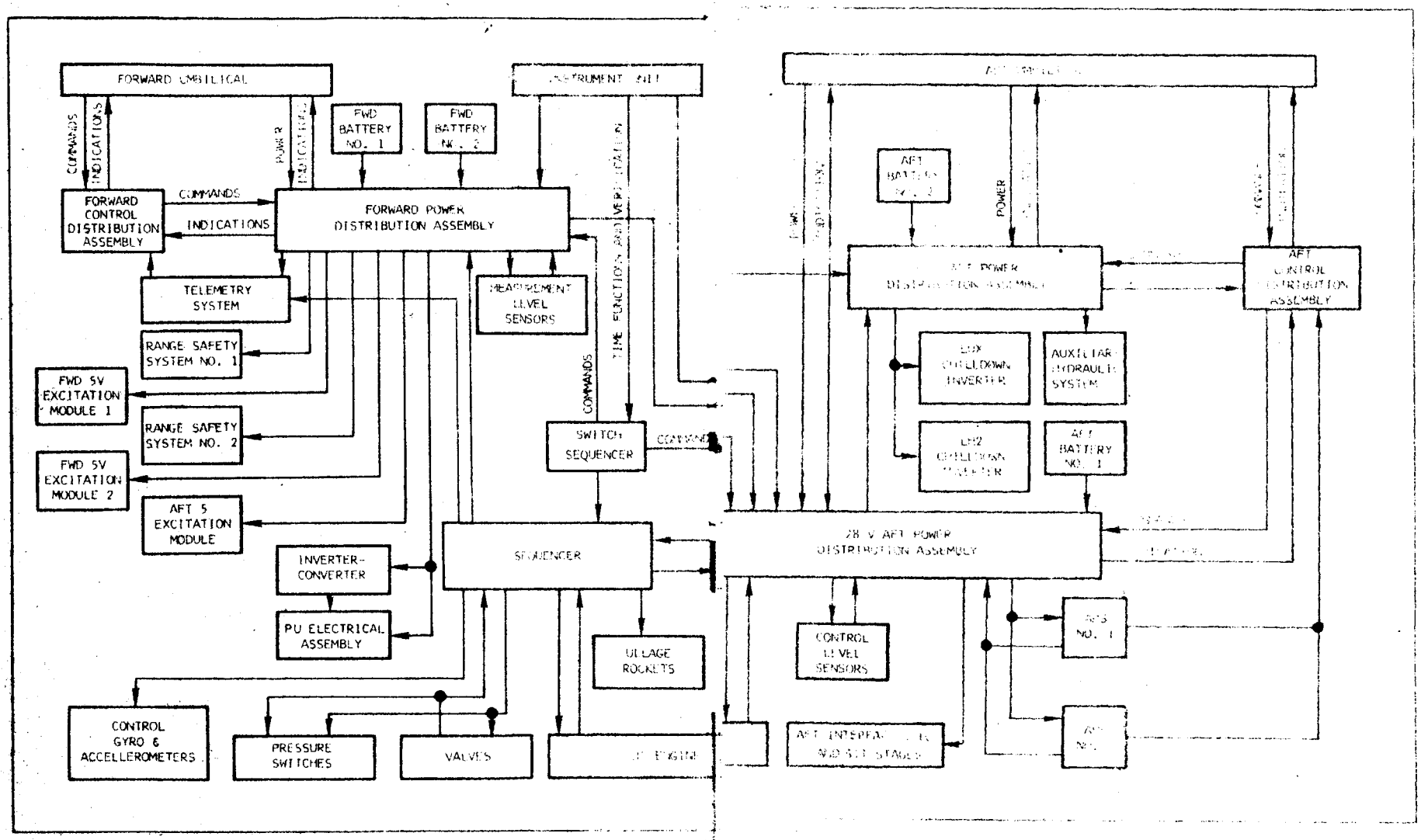


Figure 5. [illegible] System

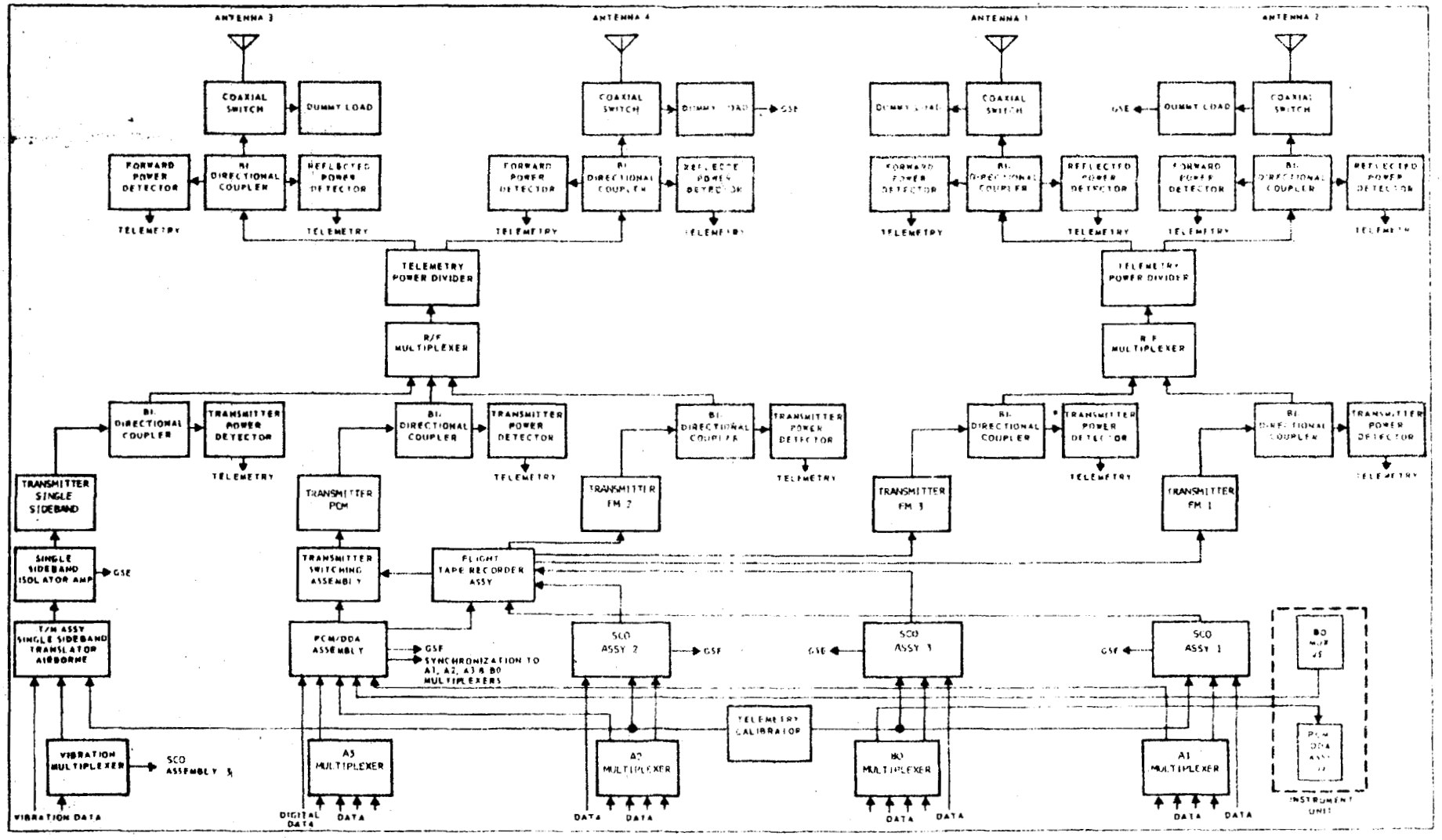


Figure 4. Telemetry System

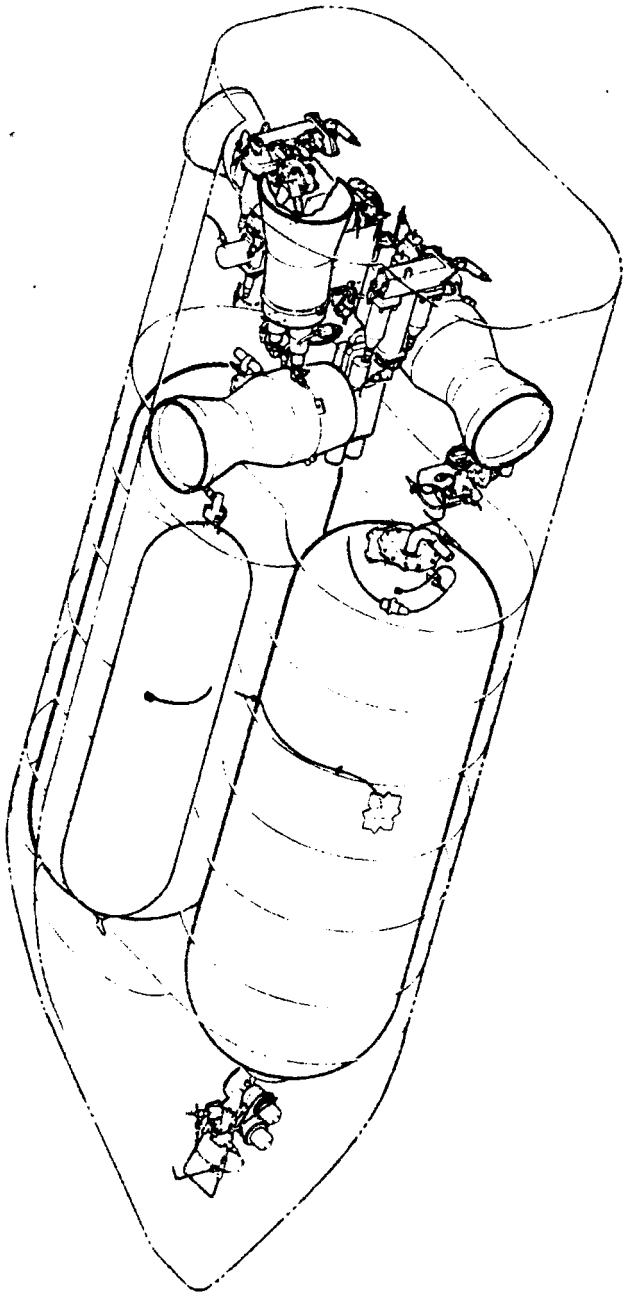


Figure 5. Auxiliary Propulsion Module

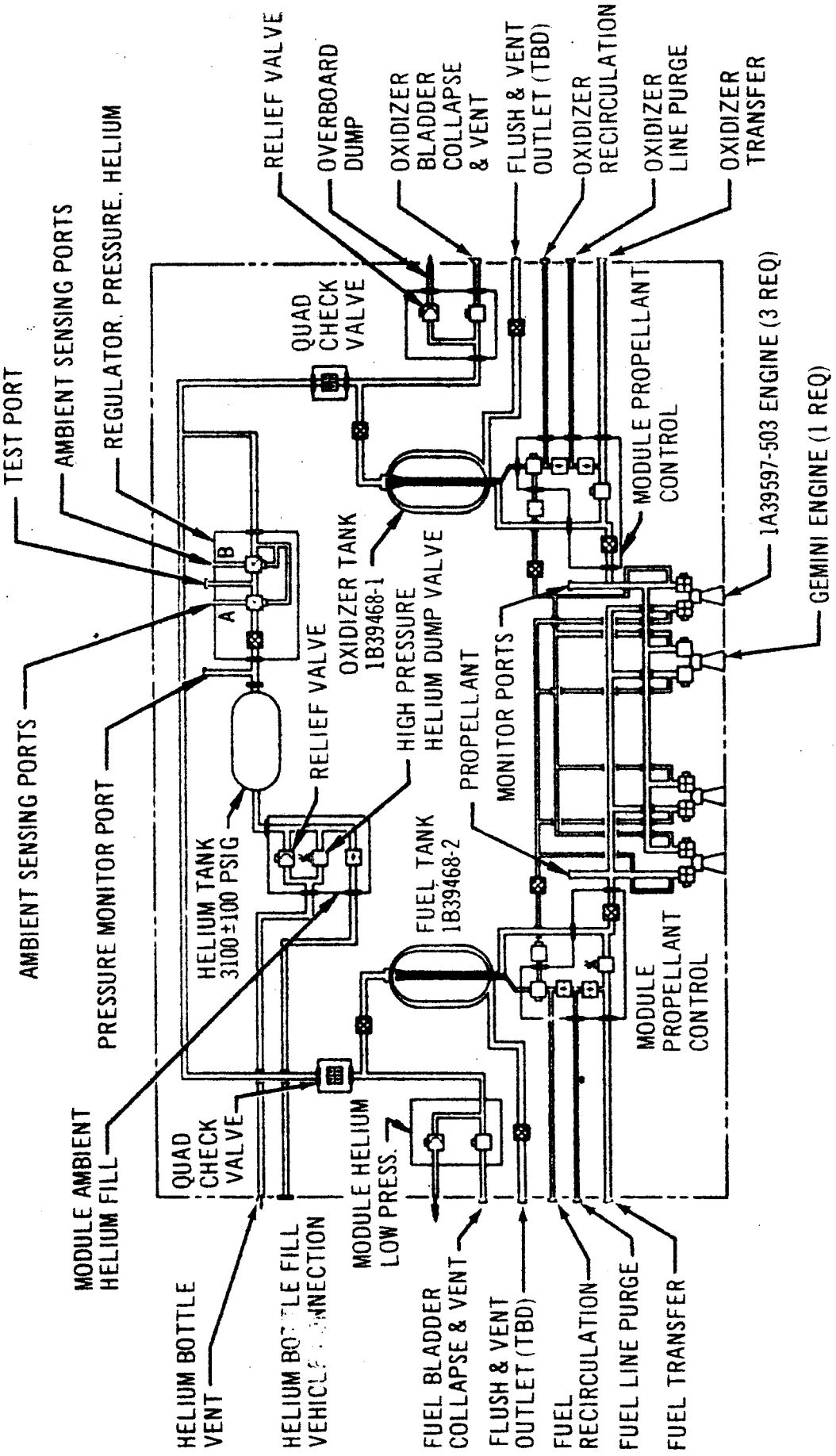
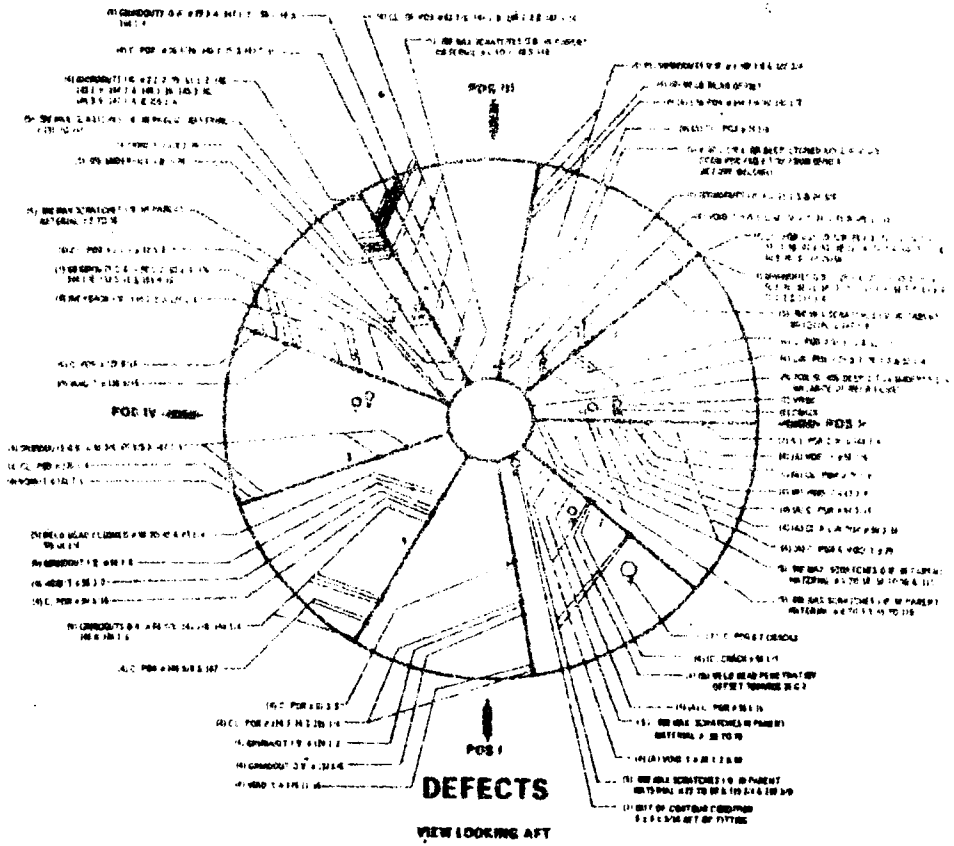
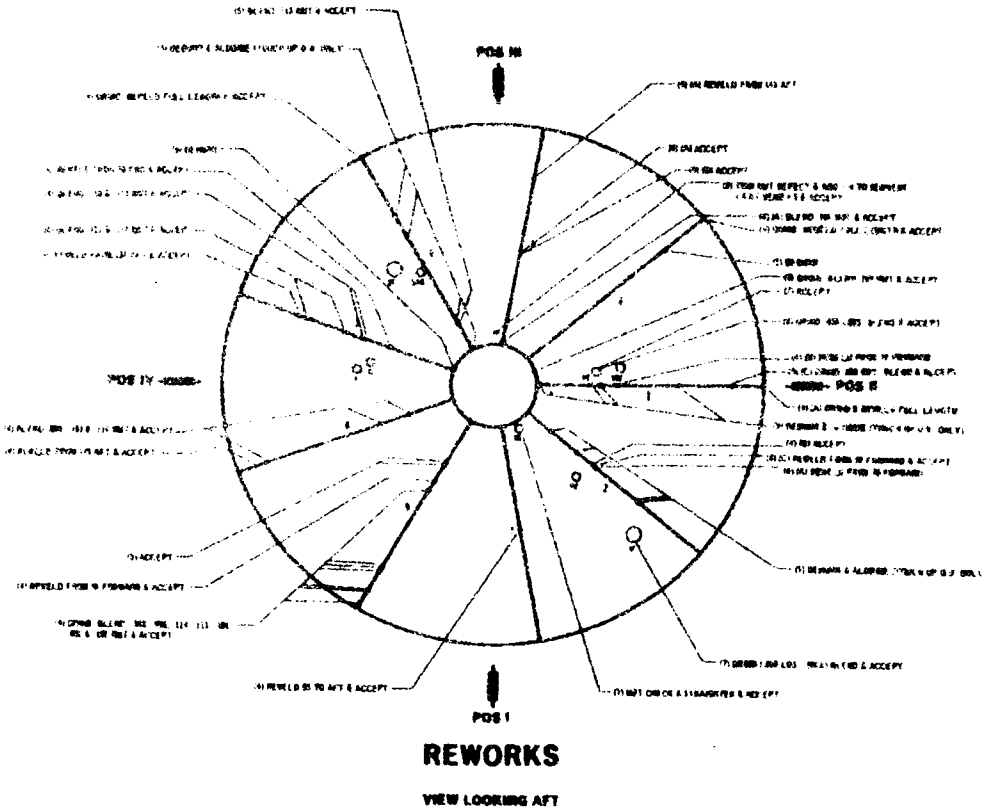


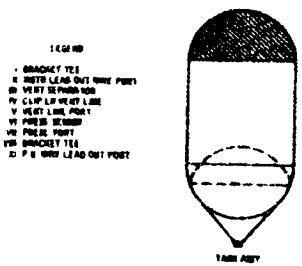
Figure 6. APS Module Schematic tic

[redacted] APPENDIX 2 [redacted]

CHARTS



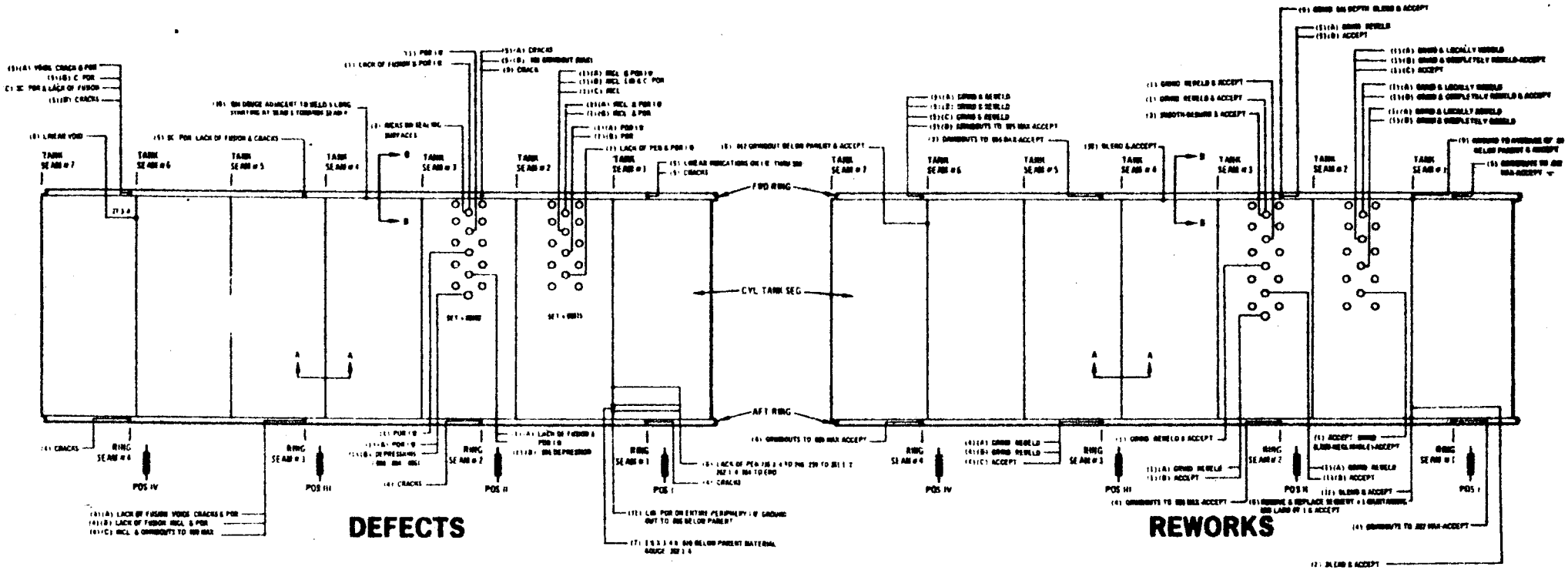


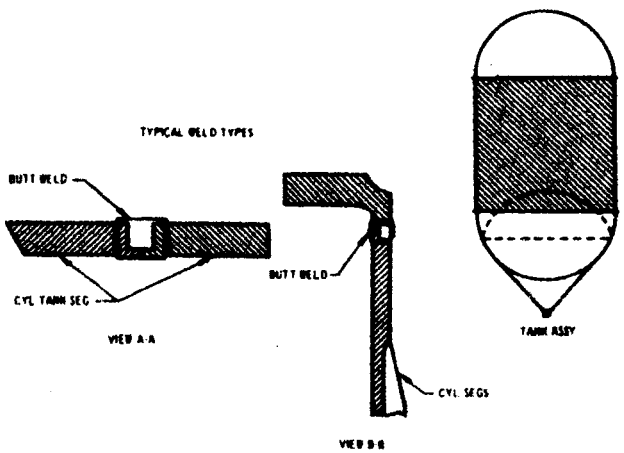


ITEM	FARR NUMBER	INITIATION DATE	DEFECTS	REWORKS REQUIRED	HOW REWORKED	REWELDS
1	417986	12-20-65	1	1	N A	0
2	417988	12-21-65	1	0	N A	0
3	417987	12-28-65	1	1	N A	0
4	417988	1-3-66	112	78	AUTOGENOUS	17
5	418047	1-10-66	16	16	N A	0
6	418259	1-19-66	1	1	N A	0
7	419791	5-16-66	1	1	N A	0
8	420498	5-24-66	1	1	N A	0

ITEM	FARR NUMBER	INITIATION DATE	DEFECTS	REWORKS REQUIRED	WELDING REWORK	REWELDS

Chart 1. Forward Dome Assembly

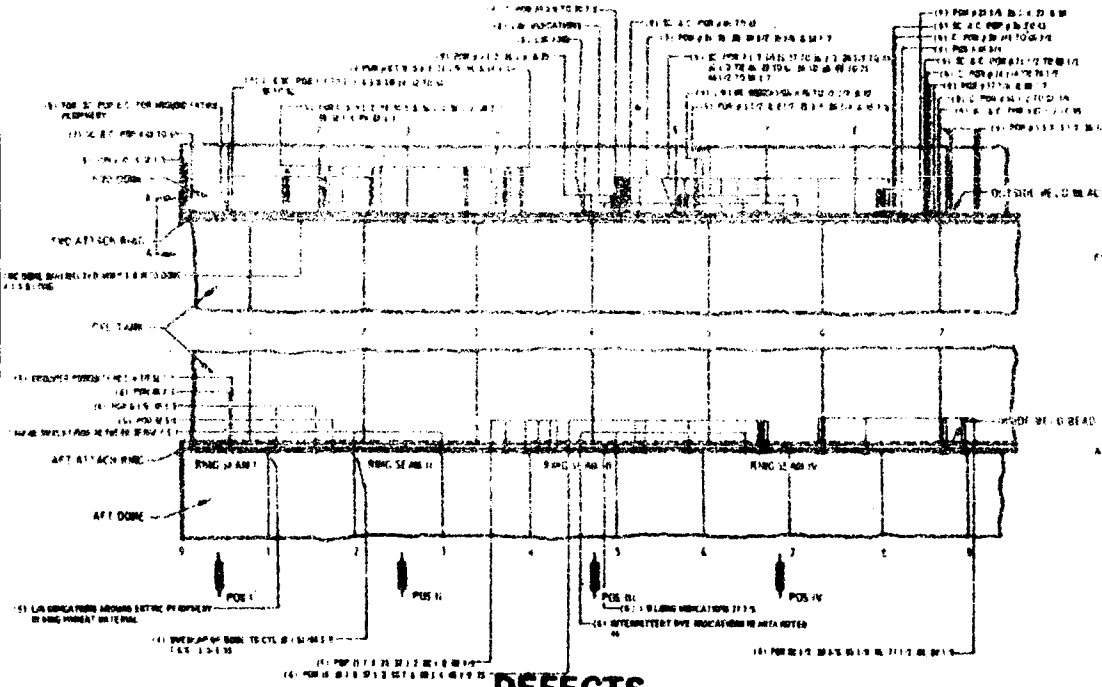




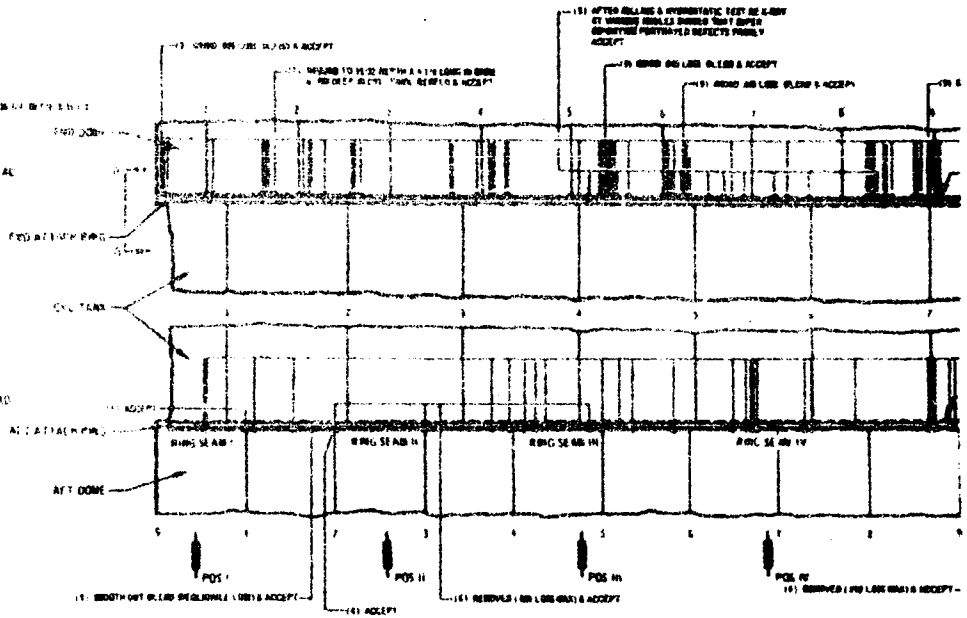
ITEM	TANK NUMBER	INITIATION DATE	DEFECTS	REWORKS REQUIRED	WELDING REWORK	REWELDS
(1)	[illegible]	[illegible]	[illegible]	[illegible]	AUTO TIG	[illegible]
(2)	[illegible]	[illegible]	[illegible]	[illegible]	AUTO TIG	[illegible]
(3)	[illegible]	[illegible]	[illegible]	[illegible]	M A	[illegible]
(4)	[illegible]	[illegible]	[illegible]	[illegible]	MANUAL GTA	[illegible]
(5)	[illegible]	[illegible]	[illegible]	[illegible]	MANUAL GTA	[illegible]
(6)	[illegible]	[illegible]	[illegible]	[illegible]	AUTO TIG	[illegible]
(7)	[illegible]	[illegible]	[illegible]	[illegible]	M A	[illegible]
(8)	[illegible]	[illegible]	[illegible]	[illegible]	M A	[illegible]
(9)	[illegible]	[illegible]	[illegible]	[illegible]	M A	[illegible]
(10)	[illegible]	[illegible]	[illegible]	[illegible]	M A	[illegible]

ITEM	TANK NUMBER	INITIATION DATE	DEFECTS	REWORKS REQUIRED	WELDING REWORK	REWELDS
(1)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

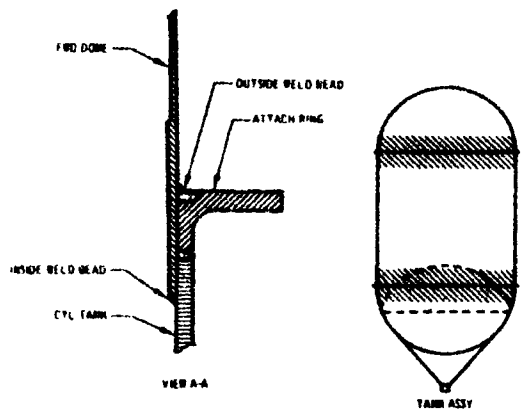
Chart 7. Cylindrical Tank Assembly



DEFECTS



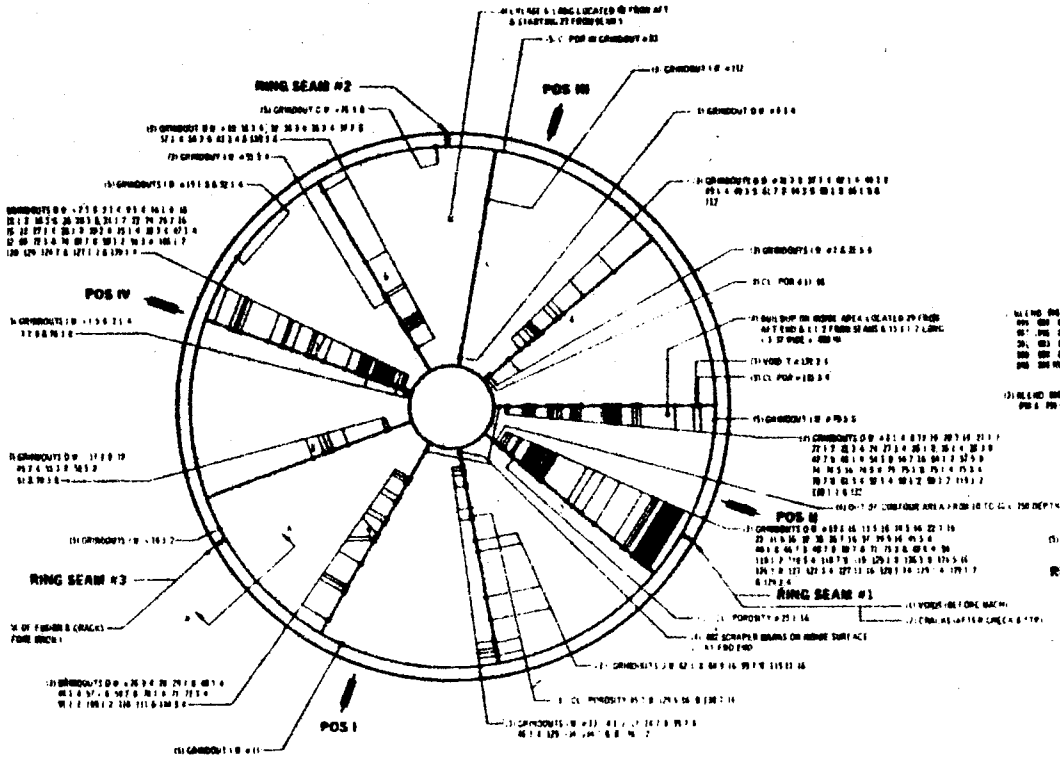
REWORKS



ITEM	PART NUMBER	INITIATION DATE	DEFECTS	REWORKS REQUIRED	WELDING REWORK	REWELDS
(1)	A19871	3-3-65		SEE CYL TANK ITEM (16)		
(2)	A19874	3-4-65		SEE CYL TANK - ITEM (11)		
(3)	A19875	4-21-65		COMMON GIRLAND TO AFT DOME ITEM (5)		
(4)	A19876	4-12-65	1	0	N A	0
(5)	A19878	4-15-65	2	1	N A	0
(6)	A19879 - METAL MILLING	4-19-65	25	25	N A	0
(7)	A19871	4-27-65	1	1	AUTO WL	1
(8)	A19872	4-27-65	11	0	N A	0
(9)	A19905	4-29-65	50	50	N A	0
(10)	A19901	5-14-65		SEE FWD DOME ITEM 7		

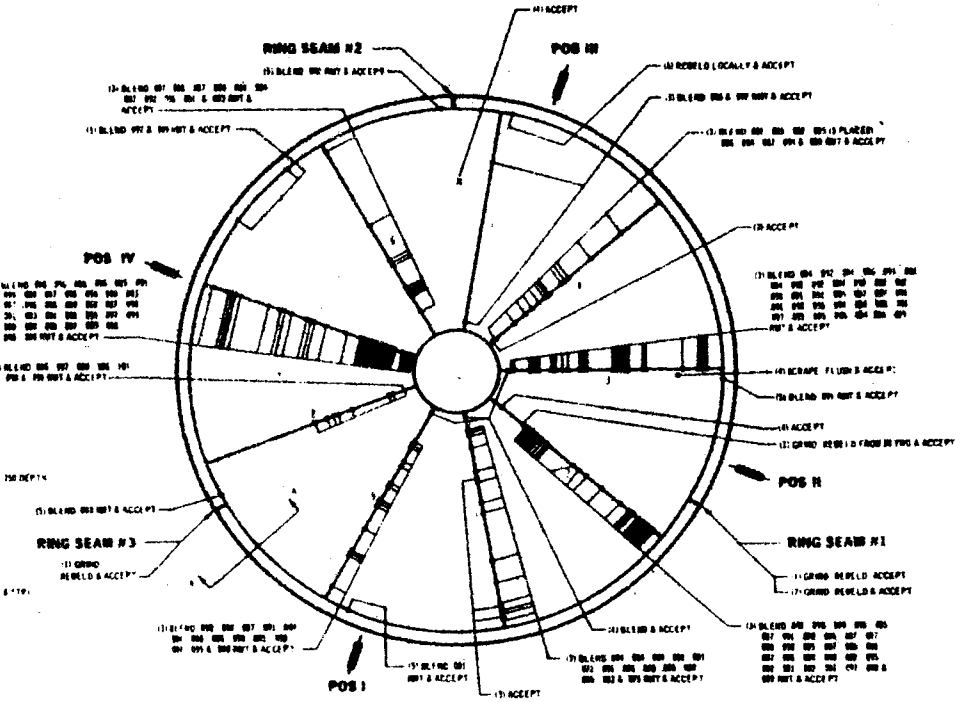
ITEM	PART NUMBER	INITIATION DATE	DEFECTS	REWORKS REQUIRED	WELDING REWORK	REWELD
(11)	A19906	5-14-65		SEE FWD DOME ITEM 9		
(12)	A19869	5-27-65		SEE COMMON GIRLAND TO AFT DOME ITEM 5		

Chart 3. LOX Tank and Forward Dome to Cylinder Welds



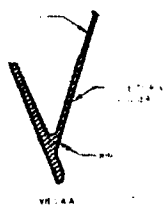
DEFECTS

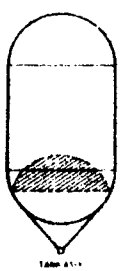
VIEW LOOKING AFT



REWORKS

VIEW LOOKING AFT

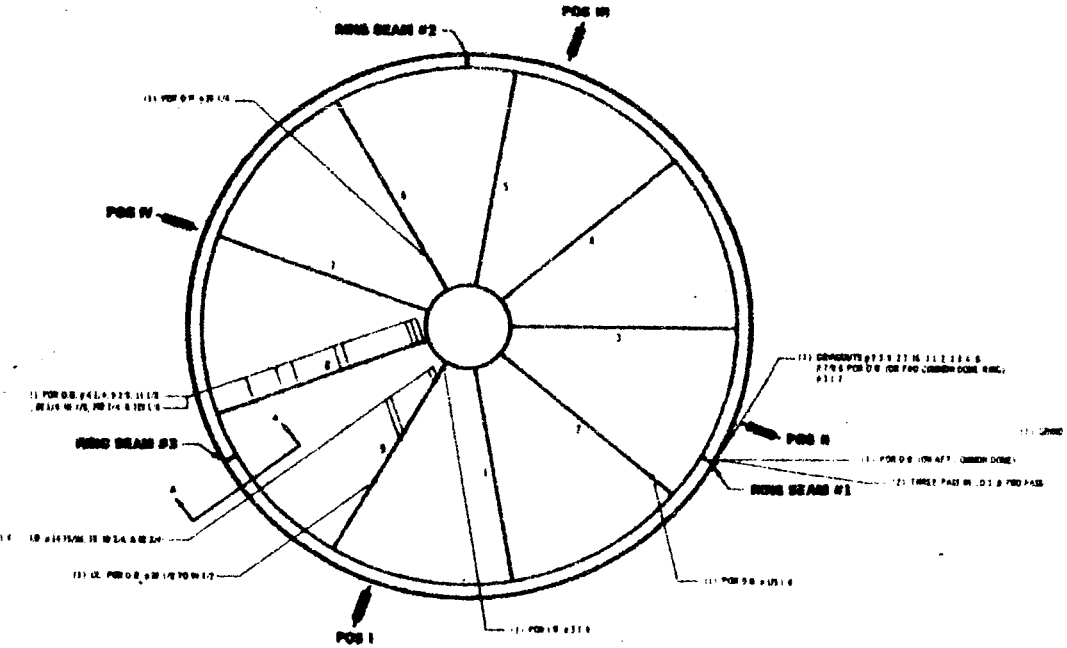




ITEM	PART NUMBER	INITIATION DATE	DEFECTS	REWORKS REQUIRED	HOW REWORKED	REBELDS
(1)	A186630	10-5-66	1	1	GRINDING, DYE	1
(2)	A171150	10-12-66	1	1	GRINDING, DYE	1
(3)	A172055	12-14-66	171	164	GRIND DYE	1
(4)	A177009	12-28-66	8	6	D.P.	8
(5)	A177009	1-3-67	1	1	GRIND DYE	1

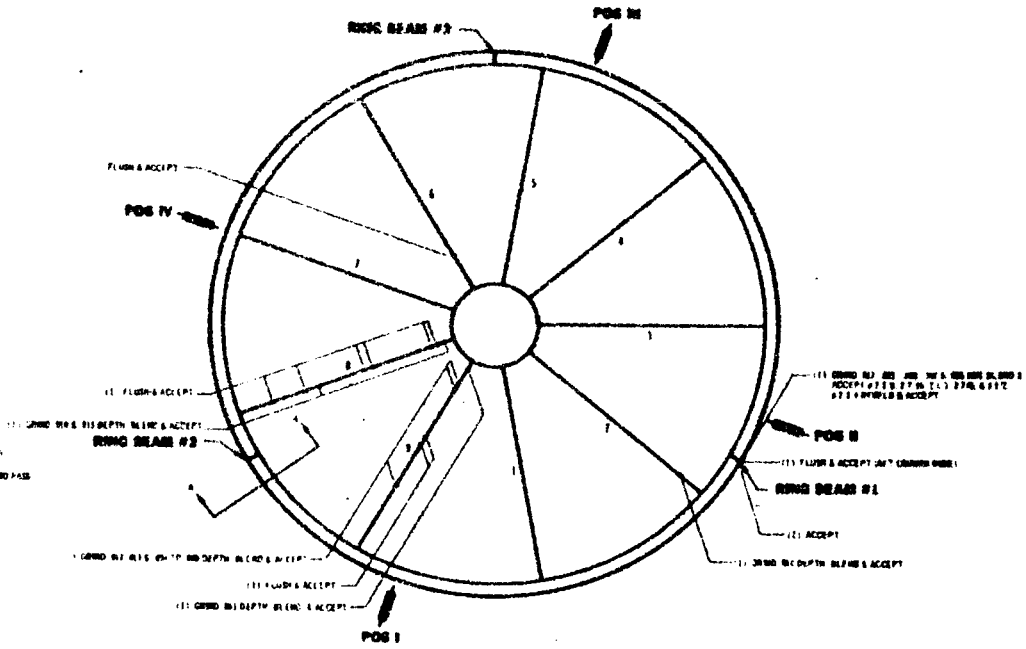
ITEM	PART NUMBER	INITIATION DATE	DEFECTS	REWORKS REQUIRED	WELDING REWORK	REBELDS

Chart 4. Forward Face Assembly



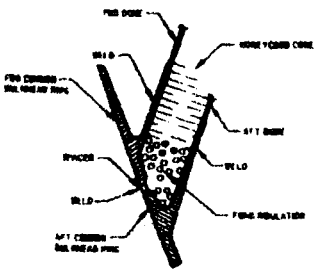
DEFECTS

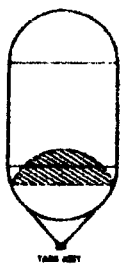
VIEW LOOKING AFT



REWORKS

VIEW LOOKING AFT



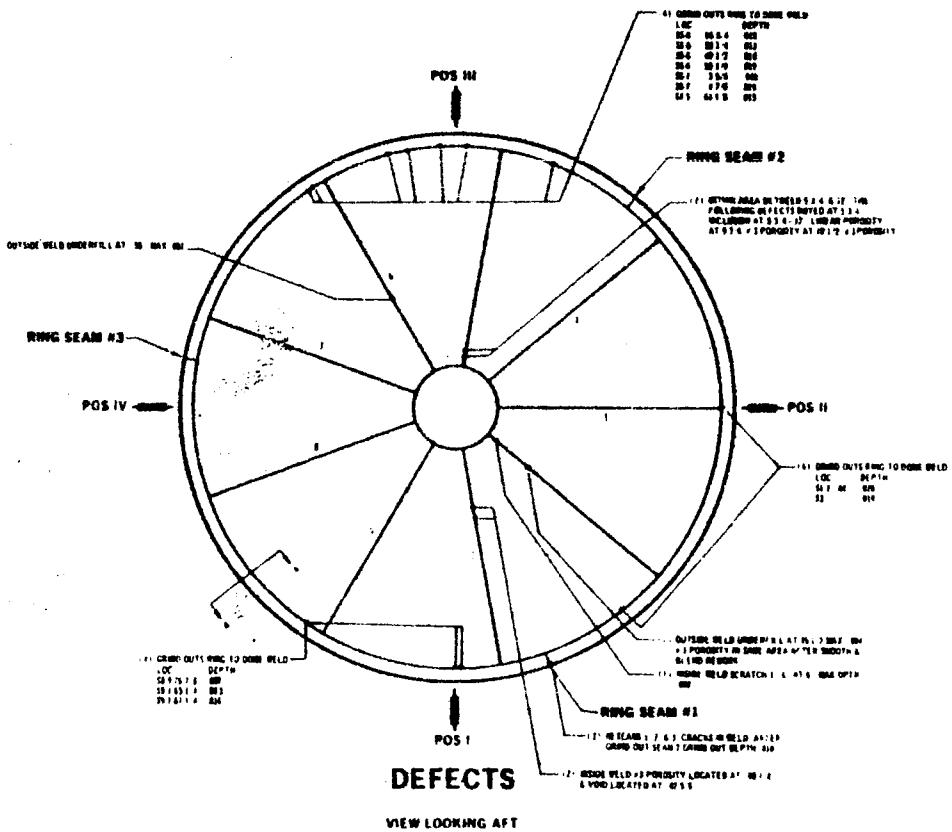


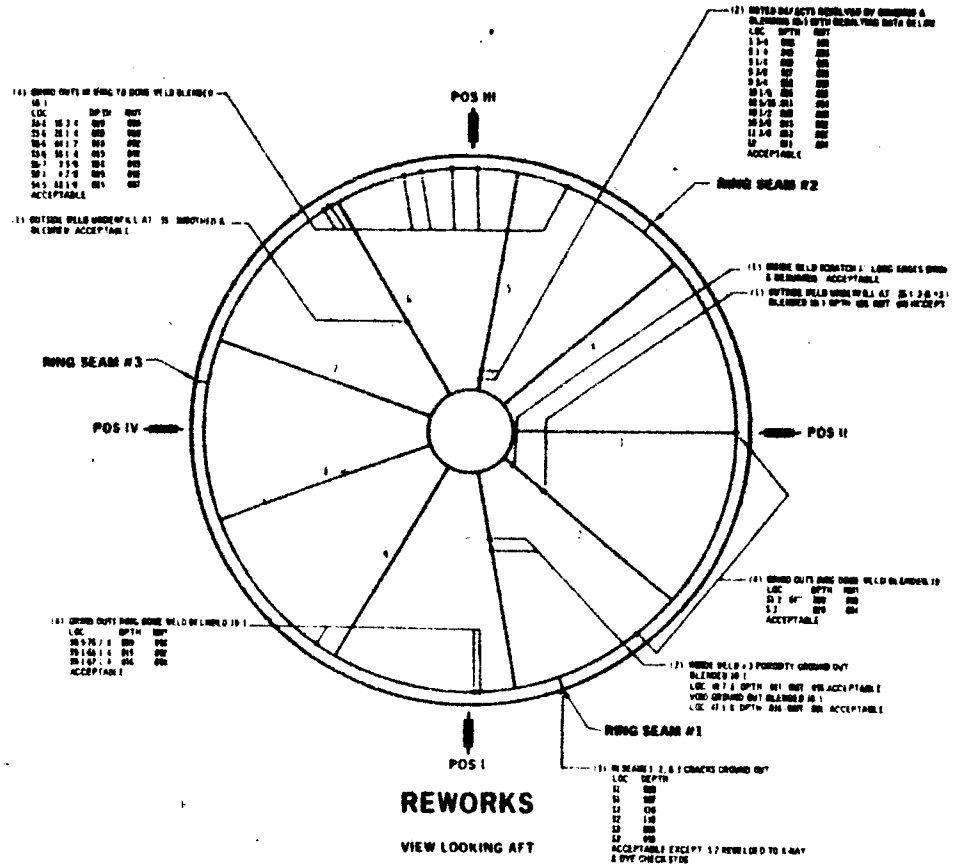
ITEM	FARR NUMBER	INITIATION DATE	DEFECTS	REWORKS REQUIRED	HOW REWORKED	REWELDS
#1	ASSY*	7-11-86	72	13	MANUAL WELD	1
#2	ASSY	7-21-86	1	0	N A	0

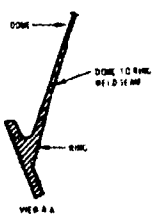
* RING WELD SEAMS ON FWD & AFT ARE 60 DEG OF PHASE & MAY BE ROTATED 120° IN EITHER DIRECTION

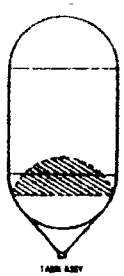
ITEM	FARR NUMBER	INITIATION DATE	DEFECTS	REWORKS REQUIRED	WELDING REWORK	REWELDS

Chart 5. Common Bulkhead Assembly





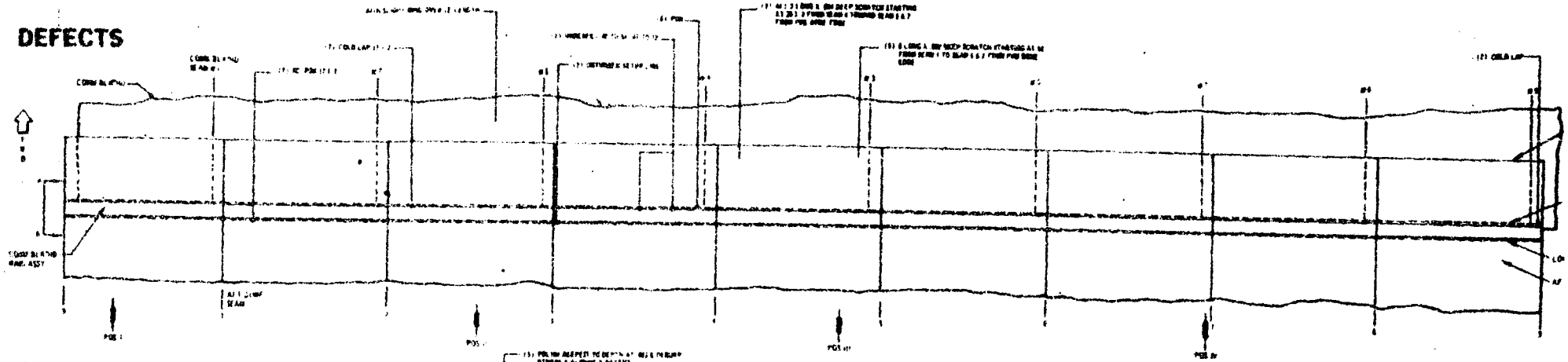


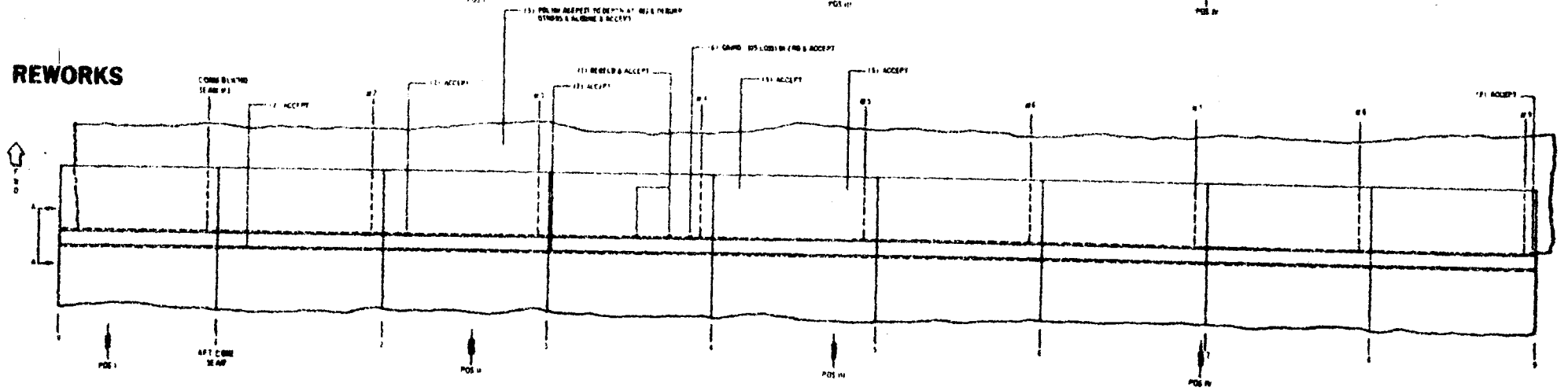


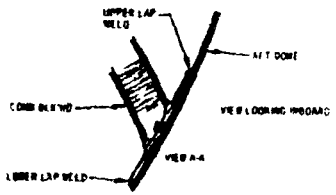
ITEM	FAAR NUMBER	INITIATION DATE	DEFECTS	REWORKS REQUIRED	HOW REWORKED	REWELDS
1	A17986	1 NOV 1985	3	3	R A	0
2	A17154	10 OCT 1985	13	13	R A	0
3	A17535	23 OCT 1986	6	1	AUTOMATIC WG	1
4	A17781	5 DEC 1986	12	12	R A	0

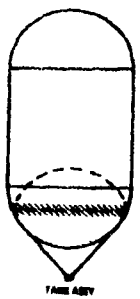
ITEM	FAAR NUMBER	INITIATION DATE	DEFECTS	REWORKS REQUIRED	WELDING REWORK	REWELDS

Chart 6. Aft Face Assembly





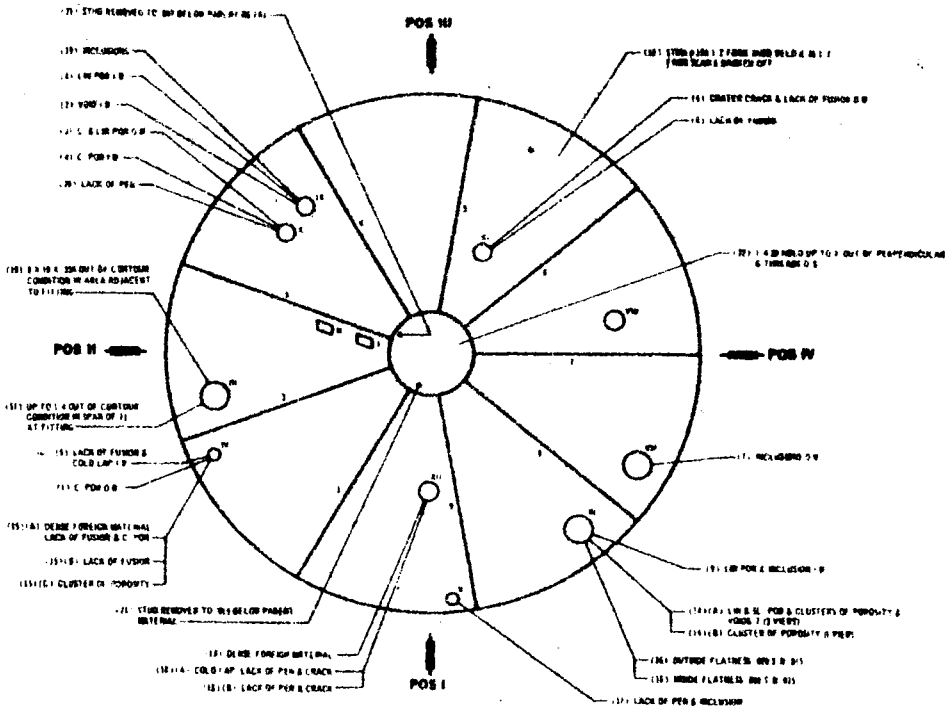




ITEM	PART NUMBER	INITIATION DATE	DEFECTS	REWORKS REQUIRED	WELDING REWORK	REMARKS
(1)	ALWARD	7-24-66	1	1	AUTO WE	1
(2)	ALWARD	7-25-66	4	9	N A	9
(3)	ALWARD	7-26-66			SEE AFT SHEET	
(4)	ALWARD	7-7-66			ITEM 21	
(5)	ALWARD	7-7-66			ITEM 22	
(6)	ALWARD	9-12-66	2	1	N A	2
(7)	ALWARD	9-21-66	1	1	N A	1

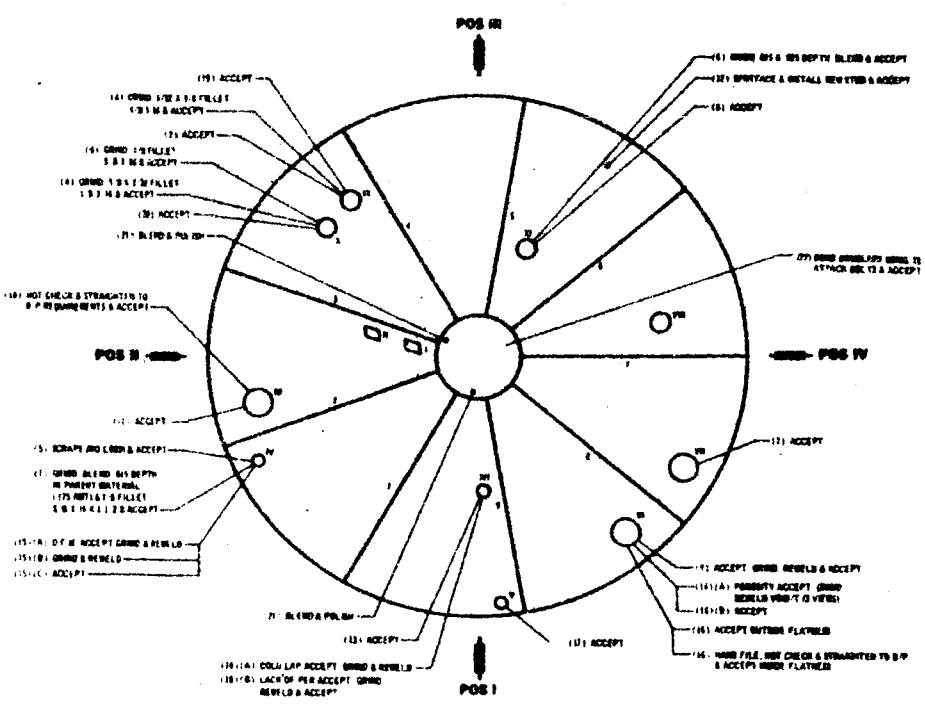
ITEM	PART NUMBER	INITIATION DATE	DEFECTS	REWORKS REQUIRED	WELDING REWORK	REMARKS

Chart 7. Common Bulkhead to Aft Dome Weld



DEFECTS

VIEW LOOKING FWD

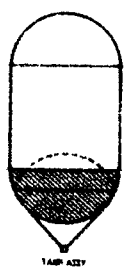


REWORKS

VIEW LOOKING FWD

LEGEND

- B BRACKET
- FITTING ASSY (LOX FILL LINE)
- ELBOW ASSY (LH2 FILL LINE)
- ELBOW ASSY (LH2 CHILL RETURN)
- FITTING ASSY (LH2 FEED LINE)
- FLANGE (LH2 CHILL PUMP)
- FLANGE (LOX VENT)
- LOX HELIUM HEATER
- LH2 HELIUM HEATER
- PU PROBE
- LOX CHILL RETURN



TANK ASSY

ITEM	FAIR NUMBER	INITIATION DATE	DEFECTS	REWORKS REQUIRED	HOW REWORKED	REWELDS
(7)	A171302	11-20-65	1	1	N A	0
(2)	A171305	12-2-65	1	0	N A	0
(5)	A171305	12-2-65	1	1	N A	0
(4)	A171302	12-3-65	2	2	N A	0
(3)	A171300	1-3-66	1	1	N A	0
(6)	A171300	1-7-66	2	2	N A	0
(7)	A171305	1-8-66	1	0	N A	0
(8)	A171302	1-10-66	1	0	N A	0
(9)	A180054	1-12-66	2	1	AUTO TIG	1
(10)	A180137	1-20-66	1	1	N A	0
(11)	A180142	1-20-66	1	1	N A	0

* ORIGINAL WELDS

ITEM	FAIR NUMBER	INITIATION DATE	DEFECTS	REWORKS REQUIRED	WELDING REWORK	REWELDS
(12)	A180196	1-6-66	1	1	STUD WELDER	1
(13)	A180189*	1-9-66	1	0	N A	0
(14)	A180189*	1-9-66	1	1	MANUAL TIG	1
(15)	A180189*	1-9-66	2	2	MANUAL TIG	2
(16)	A180189	1-11-66	1	2	N A	0
(17)	A180189*	1-13-66	1	0	N A	0
(18)	A180189*	1-15-66	1	1	MANUAL TIG	1
(20)	A180189*	1-19-66	1	0	N A	0
(19)	A180189*	1-19-66	1	0	N A	0
(21)	A180190	1-24-66	2	2	N A	0
(22)	A180190	1-27-66	2	1	N A	0

Chart 8. Aft Dome Assembly

[redacted] APPENDIX 3 [redacted]

TABLES

TABLE I. PERMANENT NONCONFORMANCES AND FUNCTIONAL FAILURE AND REJECTION REPORTS DURING STAGE SYSTEM CHECKOUTS

Section 1.. Sacramento Test Center Installation and Checkout

FARR NO.	DESCRIPTION OF DEFECTS	DISPOSITION
A214862 10-14-66	Receiving Inspection of the main tunnel area revealed numerous defects including loose screws and nuts, missing or damaged parts, discoloration, rust, and parts riding the structure.	All defects were reworked acceptably per Engineering instructions.
A214863 10-18-66	On the O_2H_2 burner, P/N 1B62600-505, S/N 05, mounting bracket bolt, P/N NAS1004-8H, was galled within the bolt hole.	The bolt was removed, the burner hole was cleaned, and a new bolt was installed. The rework was acceptable.
A214864 10-19-66	On vacuum jacketed duct, P/N 1B59005-1, S/N 1: a. There was a 1/4 in. X 0.025 in. ding on the second elbow from the aft end. b. There was a hole in the poly bag on the upper end.	a. Acceptable to Engineering for use. b. The area was cleaned and repackaged per DPS 43000. The rework was acceptable.
A214865 10-19-66	Manifold assembly, P/N 1B68668-507, could not be installed per B/P 1B64423. The assembly was 3/8 in. off centerline of two bottom mounts, P/N's 1B31141-1.	The mounts were removed and replaced with supports, P/N's 1A95639-3 and -5. The manifold assembly was clamped in place. The rework was acceptable.
A214866 10-20-66	There were 1/8 in. X 3/8 in. dents in tube assembly, P/N 1B66264-1, on the O_2H_2 burner, P/N 1B62600-505, S/N 05, located at 1 in. and 2 1/2 in. from the flare at the upper end.	The tube assembly was removed and replaced. The rework was acceptable.
A214867 10-22-66	Tube assembly, P/N 1B66264-1, located on the O_2H_2 burner, P/N 1B62600-505, S/N 05, had dents 1 in. from the flare on the long end, and in the bend radius.	The tube assembly was used to mock up a new part, and was then scrapped.

TABLE I, Section 1 (Continued)

FARR NO.	DESCRIPTION OF DEFECTS	DISPOSITION
A214868 10-22-66	Plenum, P/N 1A49991-1, S/N 22, was wrapped to within 1/2 in. of the neck in two locations. Wrapping should not have extended within 1 in. of the neck per B/P 1B62778.	The plenum was removed from plenum and valve assembly, P/N 1B62778-1, S/N 6. It was reworked to specs, and replaced. The rework was acceptable.
A214869 10-24-66	Tube assemblies, P/N's 1B62880-1, 1B62869-1, 1B62883-1, 1B62888-1, and 1B62876-1, did not fit in next assembly, O_2H_2 burner, P/N 1B62600-505.	P/N's 1B62880-1, 1B62883-1, and 1B62869-1 were accepted for use. P/N 1B62888-1 was reformed to fit per DPS 10003, and P/N 1B62876-1 was removed and replaced per B/P. The rework was acceptable.
A214870 10-24-66	a. At forward skirt stringer 50, 3 1/2 in. aft of station 554.702, X-ray 66-B135 revealed a nail. b. At stringer 95, small debris was wedged between the joint bolt aft of the stringer.	a and b. Acceptable to Engineering for use.
A214871 10-24-66	Tube assembly, P/N 1B62876-1, was approximately 3/16 in. too short.	The tube assembly was scrapped.
A214872 10-25-66	a. Pipe assembly, P/N 1B66839-1, on the O_2H_2 burner, P/N 1B62600-505, was too long to mate with pipe assembly, P/N 1B62895-1. b. The above assembly was also preloaded and riding hard against the mounting bracket.	a and b. The assembly was trimmed to fit, reflared, and mated. The rework was acceptable.
A214873 10-26-66	The Deutsch connector at the LH_2 feedthru assembly was not assembled per DPS 54002-10. The inner support sleeve was not removed, consequently, the seal plugs would not seat.	The connector was removed for rework, and reinstalled. The rework was acceptable for use.

TABLE I, Section 1 (Continued)

FARR NO.	DESCRIPTION OF DEFECTS	DISPOSITION
A214874 10-28-66	The tube clamp attachment hole pattern for tube assembly, P/N 1B64446, was opposite of B/P callout.	The holes were relocated per B/P, with adjacent two-hole groups being slotted. The rework was acceptable.
A214878 10-14-66	There was evidence of brown discoloration on all weld areas of low pressure duct, P/N 1A49969-501, S/N 18.	The duct was returned to the vendor for rework to the -503 configuration.
A214881 10-31-66	A bolt was broken off in the tube assembly mounting support above tube assembly, P/N 1B62593-1, on O_2H_2 burner, P/N 1B62600-505, S/N 05.	The bolt was removed and replaced. The rework was acceptable.
A214882 10-31-66	There was a 2 1/2 in. X 0.003 in. scratch in bellows assembly, P/N 1A49985-505, running forward from 2 3/4 in. above the aft flange.	The scratch was polished out using No. 180 grit paper. The rework was acceptable.
A214883 11-3-66	There were foreign particles noted on the flange end of tube assembly, P/N 1B66247-1, where a temperature transducer was installed.	The tube assembly was cleaned per DPS 43000. The rework was acceptable.
A214884 11-4-66	Two scratches were noted on the No. 2 LOX repressurization bottle, P/N 1A49990-501, S/N 68.	Acceptable to Engineering for use.
A214885 11-4-66	Strap assembly, P/N 1B27629-501, rode hard on the phenolic block for pipe assembly, P/N 1B66824-1. The result was that the strap would not lay flat on the No. 2 repressurization bottle for torquing.	The phenolic block was trimmed to clear the strap assembly by 1/16 in. The trimmed area was treated with DPM 499 per DPS 42000. The rework was acceptable.

TABLE I, Section 1 (Continued)

FARR NO.	DESCRIPTION OF DEFECTS	DISPOSITION
A214886 11-7-66	The following discrepancies pertained to the bonded standoff areas on the forward dome: a. Ambient temperatures of 51°F to 53°F were recorded on three consecutive nights. A minimum of 55°F was allowed per DPS 32330. b. Temperature readings were not taken between cures. c. Humidity indicators were not installed with desiccant bags.	a, b, and c. The bonded standoffs involved were removed and replaced per B/P and DPS, after coupon tensile test results were found to be unacceptable. The rework was satisfactory.
A214890 11-11-66	Tube assembly, P/N 1B64604-1, was 7/32 in. too short at the downstream end, and rode check valve, P/N 1B40824-503.	The tube assembly was scrapped.
A214891 11-15-66	a. Prevalve actuation control module, P/N 1B65292-1, S/N 010, leaked at the vent port in both the open and closed positions. b. Propellant control module, P/N 1B65292-501, S/N 080, leaked at the vent port in both the open and closed positions.	a. Acceptable to Engineering for use. b. The module was removed and replaced. The rework was acceptable.
A214892 11-17-66	10-amp relay module 404A3A46, P/N 1B40887-501, S/N 224, was incorrectly wired. There was continuity between pins C and M of plug J1. No continuity should have existed.	The module was scrapped.
A214893 11-17-66	10-amp relay module 404A3A46, P/N 1B40887-501, S/N 224 was miswired. An open state should have existed between pins C and M of plug J1; instead, continuity existed.	The module was removed and replaced. The rework was accepted.

TABLE I, Section 1 (Continued)

FARR NO.	DESCRIPTION OF DEFECTS	DISPOSITION
A214896 12-28-66	Pipe assembly, P/N 1B67135-1, was 1 in. out of alignment, and could not be clamped at B/P attach points.	A new tube assembly was fabricated and installed acceptably.
A214897 12-30-66	Pipe assembly, P/N 1B67135-1, was misaligned 1 in., and could not be clamped at B/P attach points.	The pipe assembly was scrapped.
A214898 1-7-67	There was a fast bubbling leak at the seal, and a 2 scim leak at the leak check port on the LOX recirculating pump and shutoff valve mating surfaces.	The valve was removed and replaced. Reference FARR A229736 for further disposition.
A218826 10-28-66	a. Cable assembly 404W7, P/N 1B58317-403, S/N 1811, had a bent pin Z in connector P4. b. Plug J4 of cable assembly 404A2W1 had a damaged rubber insert at socket Z, owing to the above bent pin.	a. The pin was straightened per DPS 54002. b. The plug was removed and replaced per B/P. The rework was acceptable.
A218828 10-28-66	a. Tube assembly, P/N 1B66799-1, rode hard on bottle mount, P/N 1B39870-407, when connected point to point. b. The alignment between the tube assembly and bottle No. 2 could not be determined.	The tube assembly was reformed as required to install without preload. The alignment was then satisfactory.

TABLE I, Section 1 (Continued)

FARR NO.	DESCRIPTION OF DEFECTS	DISPOSITION
A218829 10-31-66	On cable, P/N 1B63297-1, S/N 1038-1: a. Lead wires were too short from the A-23 diode module to plugs P-45, P-46, and P-47. b. The above connectors had been previously used, and were splashed with excessive solder.	a and b. Both the diode module and the connectors were removed and replaced. The rework was acceptable.
A218831 11-2-66	The Model 188 APS simulator could not be installed at fin line III because nutplate, P/N NAS1032A6, had a stripped locking device.	The nutplate was removed and replaced per B/P. The rework was acceptable.
A218832 11-3-66	Foreign particles were detected at the flange end of the tube assembly, P/N 1B66247-1.	The tube assembly was removed and replaced per B/P. The rework was acceptable.
A218835 11-4-66	There were five wires damaged, exposing the conductor, on cable assembly, P/N 1B63297-1.	The wires were temporarily repaired for static firing purposes.
A218836 11-7-66	a. Diode assembly, P/N 1B54522-1, S/N 0108, had wire insulation damaged, exposing the conductors, on the white/brown, white/green, and white/orange wires. b. Diode assembly, P/N 1B54522-1, S/N 0147, had white/brown wire insulation damaged, exposing the conductor.	a and b. Both diode assemblies were scrapped.
A218839 11-7-66	Wires were cut too short to allow diode assembly, P/N 1B54522-1, S/N 0145, to be installed into cable assembly, P/N 1B63297-1.	The diode assembly was scrapped.

TABLE I, Section 1 (Continued)

FARR NO.	DESCRIPTION OF DEFECTS	DISPOSITION
A218840 11-7-66	Cable 411W17, P/N 1B57292-1, had insulation damaged, exposing and shorting the conductors.	The damaged portion of the cable was removed. Splice, P/N NAS1389-3, was installed per DPS 1.357-4. The splice was covered with vinyl tubing and potted with DPM 1177-3. The cable was reidentified as a 1B50983-A45-1.
A218841 11-9-66	Two inserts on mounting panel, P/N 1B52621-401, turned when the screws inserted in them were turned.	The inserts were reseated per B/P. The rework was acceptable.
A218846 11-14-66	a. Rubber inserts in connectors 411W6P23 and P33 had puncture damage. b. Receptacle 411S4J1 on pressure switch, P/N 1B52624-501, had one pin bent 45°.	a. The connectors were removed and replaced per B/P. b. The pressure switch was removed and replaced. Both reworks were acceptable.
A218847 11-16-66	On pressure switch, P/N 1B52624-501, S/N 007, pin D was bent 20°.	The switch was returned to the vendor for rework to specs.
A218848 11-16-66	Fuel tank inlet pressure transducer 410MT600-D054, P/N 1B40242-523, S/N 523-11, was faulty. The resistance between pins C and D was 710 ohms; should have been 350 ohms.	The transducer was removed and replaced per B/P. The rework was acceptable.
A218849 11-17-66	On pressure transducer, P/N 1B40242-523, S/N 523-11, the resistance reading between pins A and B was open. It should have measured 350 ohms.	The transducer was acceptable for use after retest failed to indicate the defect.
A218976 11-17-66	Module, P/N 1B40604-1, showed a voltage on the check bus, caused by an apparent short from pin J1R to pin J1F through the diode.	The wires were relocated external to the module per B/P 1B66939. The rework was acceptable.

TABLE I, Section 1 (Continued)

FARR NO.	DESCRIPTION OF DEFECTS	DISPOSITION
A218977 11-18-66	Nylafil cable standoff bracket, P/N 1B37286-501, had stripped screw threads. Consequently, cables, P/N's 1B66946-1 and 1B58264-1, could not be clamped.	Keensert was installed in the standoff per B/P 1B53312. The cables were installed, and the rework was accepted.
A218978 11-18-66	LH_2 vent and relief valve, P/N 1A48257-507-002, S/N 0038, relieved at 38 psia. It should have relieved at 37 psia maximum per H&CO 1B70410.	The valve was removed and replaced per B/P. The rework was acceptable.
A218979 11-18-66	LH_2 vent and relief valve, P/N 1A48257-507, S/N 0038, relieved at 38 psia. It should have relieved by the time the pressure reached 37 psia.	The valve was returned to the vendor for rework to the latest configuration per PO 7A-867.
A218982 11-21-66	Plug P39 on wire harness 404W240, P/N 1B58267, had a punctured insert.	The plug was removed and replaced with a new part per B/P. The rework was acceptable.
A218984 11-28-66	Pin 12 of connector, P/N 1B37872-513, in cable, P/N 1B50917-403, was loose and was not flush.	The connector was replaced after being damaged during rework.
A218985 11-28-66	On connector, P/N 1B37872-513, S/N 1102, the insert assembly was badly damaged.	The connector was scrapped.
A218986 12-1-66	Adapter assembly, P/N 1A49958-517, S/N 87, leaked in excess of the tolerances allowed per H&CO 1B70410, and pressure switch pickup and dropout pressure for the LH_2 tank would not hold at 37 psia.	The adapter was returned to the vendor for rework to specs.

TABLE I, Section 1 (Continued)

FARR NO.	DESCRIPTION OF DEFECTS	DISPOSITION
A218987 12-2-66	Transducer 426MT659A-S066, P/N SA-12-125TA-120, would not adjust properly while performing H&CO 1B44474.	The transducer was removed and replaced per B/P. The rework was acceptable.
A218988 12-2-66	a. The auto calibration output from amplifier, P/N 1A88599-5, was 1.5 volts rms with a 5.0 vrms input. b. The auto calibration output from vibration transducer, P/N 1A68707-591, S/N 720, was 5.05 vrms with a 5.0 vrms input. Both outputs should have been 4.0 vrms per H&CO 1B58685.	The amplifier and transducer were removed and replaced. The rework was acceptable.
A218989 12-5-66	Actuation control module, P/N 1B65292-501, S/N 080, leaked at the vent port in excess of the allowable 1.2 scim at 600 psi.	The module was returned to vendor for rework or replacement.
A218990 12-5-66	a. Tube assembly, P/N 1B67143-1, was 1/2 in. too long at the attach point to the LOX vent valve. The 90° bend rode the thrust structure at stringer 17A. b. Tube assembly, P/N 1B67142-1, was 3/4 in. too long at the tee attach point at thrust structure stringer 15A.	a. 1/2 in. was trimmed off each end of the tube assembly. It was then cleaned and reinstalled per B/P. b. The assembly was removed, cleaned, reinstalled, and leak checked per H&CO 1B70410. Both reworks were acceptable.
A218991 12-6-66	The auto calibration output from amplifier, P/N 1A68707-7, S/N 398, was 5.05 volts peak-to-peak, instead of 4.0 volts peak-to-peak, with a 5.0 vrms input.	The transducer was removed but not replaced.

TABLE I, Section 1 (Continued)

FARR NO.	DESCRIPTION OF DEFECTS	DISPOSITION
A218992 12-6-66	The auto calibration output from vibration transducer, P/N 1A88599-5, S/N MA04, was 1.5 volts with 5.0 vrms input. It should have been 4.0 volts peak-to-peak output.	After retest, the vibration transducer was accepted for use.
A218993 12-17-66	Valve assembly, P/N 1B59010-1-001, S/N 110, had excessive leakage through the piston seal in both the open and closed positions.	Leakages were acceptable to Engineering for use.
A218994 12-9-66	Transducer 427MT701A-S081, P/N SA-12-125TA-120, S/N A14AF36, would not adjust during execution of H&CO 1B44474.	The transducer was removed and replaced per B/P.
A218995 12-8-66	At thrust structure stringer 12 1/2, plastic standoff, P/N 1B37286-503, was stripped and would not accept the clamp tie-down screw.	The standoff was repaired per B/P. The rework was acceptable.
A218997 12-9-66	RACS output from amplifier, P/N 1A68707-7, S/N 398, was 5.05 volts peak to peak with 5.0 vdc input. Output should have been 4.0 volts p-p.	The transducer was scrapped. It was a vendor supplied part, however, a replacement was not ordered.
A218999 12-9-66	Transducer, P/N 1A88599-1, had out-of-tolerance RACS output when tested per H&CO 1B58685.	After retest, the vibration transducer was accepted for use.
A219000 12-12-66	There was damage to the insulation and shielding of cable, P/N 1B40242-67, S/N 523-7.	The cable was returned to the vendor for replacement.
A219026 12-13-66	LOX propellant control valve, P/N 1B59010-1-001, S/N 110, and filter, P/N 1B59008-501, were contaminated with metal chips.	The contamination was removed per Engineering instructions. The rework was acceptable.

TABLE I, Section 1 (Continued)

FARR NO.	DESCRIPTION OF DEFECTS	DISPOSITION
A219027 12-15-66	The inner LOX vent duct did not align with the cutout in the exterior skin of the stage, and did not allow the outer LOX vent duct to fully seat for proper seal.	The duct was realigned per Engineering instructions. The rework was acceptable.
A219028 12-15-66	The helium heater spark exciter unit 2, P/N 30229B, S/N 015, pressure OK talkback was off. It should have been on.	The spark exciter was removed and replaced. The rework was acceptable.
A219030 12-16-66	Two subcarrier oscillators in assemblies, P/N's 1B33187-555 and -557, had oscillators which drifted out of tolerance after setup per H&CO 1B44478.	The oscillators were removed and replaced per B/P. The rework was acceptable.
A219031 12-20-66	Subcarrier oscillator 411A96A202, P/N 50M60032A-25, S/N F688, drifted out of tolerance after being set up per H&CO 1B44478.	After retest failed to verify the defect, the oscillator was accepted for use.
A219032 12-20-66	Subcarrier oscillator 411A96A203, P/N 50M60032A-11, S/N 11334, drifted out of tolerance after being set up per H&CO 1B44478.	The oscillator was discarded due to having exceeded its useful life.
A219034 12-21-66	Power detector 411A97MT722, P/N 1A74776-503, S/N 2-0194, had low output with 2.5 watts input. Output, which should have been 125 millivolts, was 6 millivolts.	The power detector was removed and replaced per B/P.
A219035 12-21-66	During an Engineering run of the integrated systems test, the O_2H_2 burner spark exciters were left on for thirty minutes due to a programming error. Per B/P, the exciters should have had a duty cycle consisting of five seconds on and five minutes off.	Acceptable to Engineering for use.

TABLE I, Section 1 (Continued)

FARR NO.	DESCRIPTION OF DEFECTS	DISPOSITION
A219036 12-21-66	During checkout of the O_2H_2 burner, control valve, P/N 1B43660-507, S/N 2074, was found to leak at the rate of 60 scim. The allowable leakage rate, per H&CO 1B70410, was 12 scim.	The valve was removed and replaced per B/P. The rework was acceptable.
A219037 12-21-66	When 2.5 watts were applied to power detector, P/N 1A74776-503, S/N 2-0194, the output was 6 millivolts. Output should have been 125 mv per H&CO 1B55820.	Disposition had not been rendered at the time of this printing.
A219041 12-22-66	It was suspected that there was water on the actuator housing of propellant valve, S/N 107, on burner, P/N 1B59010.	The valve was purged with gas and tested for moisture content using an hygrometer. The rework was acceptable.
A219043 12-22-66	Solenoid valve, P/N 1B43660-507, S/N 2074, had a seat leakage rate of 60 scim. The maximum allowable leakage per H&CO 1B70410 was 12 scim.	The valve was returned to the vendor for rework to specs or replacement.
A219044 12-27-66	DC amplifier 404A67A206-C190, P/N 1A82395-1, S/N 2255, could not be adjusted to 4.000 ± 0.005 vdc.	The amplifier was removed and replaced per B/P. The rework was acceptable.
A219046 12-28-66	Fuel bi-directional vent valve, P/N 1A49988-1, S/N 0018, had seat leakage of 9000 scim. There was no leakage permissible per H&CO 1B70410.	The valve was removed and replaced per B/P. The rework was acceptable.
A219047 12-28-66	DC amplifier, P/N 1A82395-1, S/N 2255, could not be adjusted to 4.000 ± 0.005 vdc. Voltage drifted 50 millivolts.	After retest failed to verify the defect, the amplifier was accepted for use.
A219048 12-29-66	a. Transducer 426MT637, P/N SA-13-125TA-120, could not be adjusted per the low cal requirements of H&CO 1B44474. b. On the same transducer, pins H to J and H to C were open. They should have been short.	The transducer was removed and replaced per B/P. The rework was acceptable.

TABLE I, Section 1 (Continued)

FARR NO.	DESCRIPTION OF DEFECTS	DISPOSITION
A219049 12-29-66	Transducer 411MT605, P/N 1A88599-1, S/N MA06, had no amplifier output.	The transducer was removed and replaced. Reference FARR A229771 for further disposition.
A229726 1-6-67	O_2H_2 burner exciter ignition system, P/N 1B59986-501, S/N 14, exceeded its B/P duty cycle. It was on for 30 consecutive minutes. Per B/P, its duty cycle should have been 5 seconds on and 5 minutes off.	The ignition system was returned to the vendor for rework to specs or replacement.
A229728 1-6-67	With 25 watts input to plug J-1, bi-directional coupler 411A97A201, P/N 1A69214-503, S/N 00120, there was no output at plug J-3. Output should have been 25 milliwatts per H&CO 1B55831.	The coupler was removed and replaced. The rework was acceptable.
A229729 1-6-67	A bolt was twisted off in the hole on tube assembly clamp bracket welded to the top of the dome of O_2H_2 burner, P/N 1B62600-505, S/N 05.	The broken off bolt section was removed. The threads were cleaned and lubed, and the clamp was reinstalled. The rework was acceptable.
A229730 1-7-67	Bi-directional coupler 411A97A201, P/N 1A69214-503, S/N 00120, had no output when a 25 watt input was applied. Output should have been 25 milliwatts.	After retest failed to verify the defect, the coupler was accepted for use.
A229731 1-7-67	In FM/FM telemetry unit, P/N 50M60032-11, the VCO in the subcarrier oscillator shifted frequency after setup.	The unit was removed for retest per B/P.
A229732 1-9-67	On the LOX chilldown shutoff valve, P/N 1A49965-521, S/N 0207, there were several scratches on the attach flange.	The inlet flange face was resurfaced and refinished to remove scratches. The rework was acceptable.

TABLE I, Section 1 (Continued)

FARR NO.	DESCRIPTION OF DEFECTS	DISPOSITION
A229733 1-9-67	No output was obtained from A2 multiplexer channel A2-10-05 while performing automatic H&CO 1B55817.	PC board, P/N 1B59981-1, was removed and replaced per B/P, correcting the condition. The rework was acceptable.
A229734 1-9-67	No output was obtained from accelerometer 427MT624, P/N 1A68708-501, S/N 501-9, while performing H&CO 1B55831. Output should have been 0 to 2.5 vdc.	The accelerometer was removed and replaced per B/P. The rework was acceptable.
A229736 1-10-67	Fuzz and bubble leaks were noted at the seal between the LOX chilldown pump and the shutoff valve.	The pump was removed and replaced. The rework was acceptable.
A229737 1-10-67	Low pressure quick disconnect, P/N 1A68448-519, S/N 9568, leaked oil.	The quick disconnect was removed and replaced. The rework was acceptable.
A229738 1-10-67	A fast bubble leak was noted at the junction of the LOX chilldown pump, P/N 1A49423-505, S/N X1761, and the shutoff valve. Replacement of the seal at that location did not cure the defect.	The pump was removed and replaced. The work was acceptable.
A229739 1-11-67	Quick disconnect, P/N 1A68448-519, S/N 9568, leaked hydraulic oil.	The disconnect was returned to the vendor for rework to specs or replacement.
A229740 1-12-67	There were fuzz leaks at the interface between the micro-switch and actuator housings, and between the control line adapter and the LOX prevalve housing.	Acceptable to Engineering for use.
A229742 1-12-67	The LOX chilldown pump purge flow rate was 46 scim. It should have been 37 ± 4 scim per B/P 1A48854.	Acceptable to Engineering per "E" change EO to B/P 1A48854.

TABLE I, Section 1 (Continued)

FARR NO.	DESCRIPTION OF DEFECTS	DISPOSITION
A229745 1-13-67	The helium heater ignition system ignitors, P/N 30299B, S/N's 016 and 018, were turned on for 5 minutes, 18 seconds. The life duty cycle was on 5 seconds, off 5 minutes.	The ignitors were removed and replaced. The rework was acceptable.
A229751 12-29-66	LH_2 bi-directional vent valve, P/N 1A49988-1, S/N 0018, leaked through the seat at 9000 scim. No leakage was permissible per H&CO 1B70410.	The valve was returned to vendor for rework or replacement.
A229752 12-30-66	The amplifier of vibration transducer kit, P/N 1A88599-1, S/N MA06, had no output.	The transducer was returned to the vendor for rework to specs or replacement.
A229754 12-30-66	The cable was suspected damaged at the amplifier connection on transducer kit 411MT685, P/N 1A68707-533, S/N 582. Further investigation revealed a broken micro-dot connection at the amplifier.	The transducer kit was removed and replaced per B/P. The rework was acceptable.
A229755 12-30-66	During prefiring structural inspection per H&CO 1B40654, two instances of misapplied thermo-shrink insulation and two instances of damaged insulation were noted.	The thermo-shrink was reapplied per B/P. The contacts at which there was insulation damage were removed and replaced per B/P. The rework was acceptable.
A229757 12-30-66	In J-2 engine, P/N 103826, S/N J-2061, the gas generating chamber pressure transducer, P/N NA5274T10T, measurement D010, had out-of-tolerance high and low RACS and ambient outputs.	The transducer was removed and replaced. The rework was acceptable.
A229758 1-3-67	Pressure transducer, P/N NA5-27412T10T-1, S/N 4851A, had out-of-tolerance high and low RACS and ambient outputs.	The transducer was returned to R/NAA for rework to specs.

TABLE I, Section 1 (Continued)

FARR NO.	DESCRIPTION OF DEFECTS	DISPOSITION
A229759 1-3-67	Vent valve, P/N 1B51753-501, S/N 008, had a broken mounting stud.	The stud was removed and replaced.
A229760 1-3-67	DC-DC converter, P/N 50M60040A-1, S/N 509009, on the FM/FM No. 2 subcarrier, was unstable.	The converter was removed and replaced. The rework was acceptable.
A229761 1-3-67	DC-DC converter, P/N 50M60040A-1, S/N 509009, had unstable frequency.	The converter was returned to the vendor for replacement or rework.
A229762 1-4-67	Range safety controller No. 2, P/N 1B33084-501, S/N 013, had internal damage due to excessive current flow during SSC checkouts.	The controller was removed and replaced. The rework was acceptable.
A229763 1-4-67	Range safety controller 411A97A19, P/N 40M32016-1, S/N 2B260, had possible internal damage due to excessive current flow during SSC final acceptance testing.	The range safety controller was removed, retested, found to be acceptable and returned to stock.
A229764 1-4-67	There was no talkback from LOX shutdown valve, P/N 1B66485-1.1, S/N 02, in the closed position.	A disconnected wire was determined to be the problem. The wire was reterminated, and the valve retested acceptably.
A229765 1-4-67	On cable, P/N 1B56380-1, pin 11 of Deutsch connector 411W11P12 was broken at the base. The mating connector 411A92A27J1 was also damaged.	The damaged pins were removed and replaced per B/P. The rework was acceptable.
A229766 1-5-67	On transducer amplifier, P/N 1A68707-7, S/N 327, the threaded connection for the microdot cable was broken.	The transducer kit, P/N 1A68707-533, S/N 582, was returned to the vendor for rework to specs.
A229767 1-5-67	Pin 11 of connector 411W11P12, P/N DS07-19-2S-9, was broken at the base, and the female portion of the coax contact was malformed.	The connector, a vendor part, was returned for replacement.

TABLE I, Section 1 (Continued)

FARR NO.	DESCRIPTION OF DEFECTS	DISPOSITION
A229768 1-5-67	The attach point for accelerometer E555 boss was tapered 0.263 in. deep. They should have been 0.44 in. deep.	The condition was reworked per R/NAA drawing 458161. The rework was acceptable.
A229769 1-5-67	Cable assembly, P/N 1A68708-15, S/N 211, had a broken connector pin at the microphone end.	The cable assembly was removed and replaced per B/P. The rework was acceptable.
A229770 1-5-67	On the O_2H_2 burner support installation, two holes were elongated through bracket, P/N 1B67457-1. 0.295/0.307 in. diameter holes were 0.362 in. and 0.365 in., respectively.	The 0.362 in. hole was drilled out to 0.3720/0.3745 in. for installation of bolt, P/N NAS 1306. The other hole was accepted for use.
A229771 1-5-67	Cable assembly, P/N 1A68708-15, S/N 311, had a broken connector at the mike end. This cable was part of accelerometer kit, P/N 1A68599-1, installed per FARR A219049.	The cable assembly was scrapped.
A229773 1-6-67	SSB T/M assembly 411A95A200, P/N 1B55252-1, S/N 00007, did not warm up in 15 seconds per H&CO 1B55231. Warmup time was 5 to 20 minutes.	The assembly was removed and replaced. The rework was acceptable.
A229774 1-6-67	Helium heater exciter ignition system, P/N 1B59906-501, S/N 015, exceeded its duty cycle. It was run for 30 minutes; should have been on 5 seconds, off 5 minutes. Also, there was erratic talkback from the exciter.	The system was returned to the vendor for rework to specs or replacement.
A229780 1-13-67	On control relay package, P/N 50M35076-1, S/N 329, there were noise spikes on the engine control and ignition bus talkbacks.	After retest failed to verify the defect, the control relay package was accepted for use.

TABLE I, Section 1 (Continued)

FARR NO.	DESCRIPTION OF DEFECTS	DISPOSITION
A229783 1-16-67	The LOX tank vent valve, P/N 1A48312-505, S/N 0006, gave no open indication on normal or emergency command.	Microswitch, P/N 519-67, was replaced, correcting the defect.
A229794 1-18-67	Helium heater igniters, P/N 1B59986-501, S/N's 016 and 018, exceeded their life duty cycle. They were on consecutively for 5 minutes, 18 seconds. They should have been on 5 seconds, off five minutes.	The parts were returned to the vendor for replacement.

TABLE I (Continued)

Section 2. Space Systems Center, Ventura Checkout Laboratory

FARR NO.	DESCRIPTION OF DEFECTS	DISPOSITION
A184792 7-26-66	The phase angle measurement of coax cable, P/N 1A82204-505, S/N 0025, was 95°. Phase should have been 30° per H&CO 1B64625	The cable was scrapped.
A184793 7-28-66	The output from 20-volt excitation module 411A91A63A241, P/N 1A74036-1.1, S/N 0240, was 25.0 vdc.	The module was scrapped.
A184794 8-3-66	Relay module, P/N 1A74211-501, S/N 282, failed to complete the circuit between pins X and H.	Relay K1 was removed and replaced. The rework was acceptable.
A184795 8-3-66	a. Control units 411A91A66A210, P/N 1A68710-509, S/N's D13 and D12, could not be adjusted to 5.0 ± 0.5 vdc. b. Control unit, P/N 1A68710-511, S/N D-24, could not be adjusted 28.0 ± 2.0 vdc.	After trouble shooting, the units were rewired, remedying the problem.
A184796 8-5-66	LOX point level sensor No. 1, P/N 1A68710-511, S/N D25, malfunctioned when tested per H&CO 1B59042. It failed to turn off on command.	The sensor was removed and replaced per B/P. The rework was acceptable.
A184797 8-5-66	There was excessive leakage at the connection between pipe assembly, P/N 1B64112-1, and check valve, P/N 1B65673-1, and between the pipe assembly and the aft umbilical quick disconnect. The leakage was noted while testing per H&CO 1B59456.	The pipe assembly and check valve were removed and replaced. The rework was acceptable.
A184798 8-6-66	The surface of the flare on the downstream pipe assembly, P/N 1B64112-1, was galled.	The surface was polished with No. [illegible] paper, and cleaned. The rework acceptable.

Douglas Report DAC-56505

TABLE I, Section 2 (Continued)

FARR NO.	DESCRIPTION OF DEFECTS	DISPOSITION
A184799 8-6-66	The flare seat on the upstream end of check valve, P/N 1B65673-1, S/N 7, was damaged.	The valve was reworked to an acceptable condition.
A184800 8-6-66	There were circumferential scratches on the flare seat surface of disconnect assembly, P/N 7851861-1, S/N 47, noted while performing H&CO 1B59456.	The flare seat was reworked to an acceptable condition.
A196135 8-6-66	Liquid level control unit, P/N 1A68710-511, S/N D25, failed to turn off on command per H&CO 1B59042.	After several retests, the unit was returned to the vendor for rework to specs.
A196136 8-8-66	Temperature transducer 403MT686, P/N 1B34473-1, S/N 119, failed resistance tests per H&CO 1B64624. The required 5000 ohm reading was open.	The transducer was returned to the vendor for rework to specs.
A196138 8-9-66	Reflected power detector 411A97MT720, P/N 1A74776-501, S/N 2-0200, could not be adjusted per H&CO 1B64625.	After retesting failed to duplicate the defect, the condition was accepted by Engineering for use.
A196140 8-9-66	A rough galled spot in the upstream flare seat of tube assembly, P/N 1B52441-1, caused leakage in excess of 0.001 cc/sec.	A Voi'shan seal was installed, curing the leakage.
A196141 8-11-66	Extensiometer 404MT630, P/N 1A68709-1, S/N 00022, would not extend or retract.	The extensiometer was removed and replaced to B/P requirements.
A196142 8-12-66	Actuation control module 411A2, P/N 1B65292-1, S/N 012, leaked at 200 scim, exceeding the allowable maximum of 6 scim per H&CO 1B59457.	The module was returned to the vendor for replacement.
A196143 8-13-66	Printed circuit board 411A96A200, P/N 50M65000-1, S/N 0849B, located in A1 multiplexer assembly, P/N 1B62513-521, S/N 00001, was found to be defective while testing per H&CO 1B59049 and B/P 1B37743.	The PC board was removed and replaced. The multiplexer was retested, found to be still defective and was replaced. The rework was acceptable.

TABLE I, Section 2 (Continued)

FARR NO.	DESCRIPTION OF DEFECTS	DISPOSITION
A196144 8-13-66	On EBW firing unit 411A99A20, P/N 40M39515-119, S/N 383, pin E was bent over 90°.	The unit was returned to MSFC for replacement.
A196145 8-13-66	Excessive leakage was noted around the screws mounting the actuation port adapter on prevalve, P/N 1A49968-509, S/N 102.	The prevalve was returned to the vendor for rework to specs.
A196146 8-15-66	LOX prevalve, P/N 1A49968-509, S/N 011, leaked at the screws holding the actuation port adapter to the body of the valve. This condition was observed while testing per H&CO 1B59457.	After rework by the vendor, an unmeasurable leak was still noted. This was accepted by Engineering for use.
A196147 8-15-66	On J-2 engine, P/N 103826, S/N J-2061, there was leakage at the rate of 4 scim at the connection between the pneumatic control package and the engine fine regulator outlet pressure line. The condition was found during final acceptance checkout per H&CO 1B59461.	New seal and fitting were installed, correcting the leakage.
A196148 8-15-66	PUEA, P/N 1A59358-517.2, S/N 05, was found to be defective during testing per H&CO 1B59048.	After rework per B/P 1A74597 and retest, the assembly was accepted for use.
A196178 8-15-66	Shreds of metal and plastic materials were found in the J-2 engine control bottle fill system while testing per H&CO 1B59461.	The fill line was purged per Engineering instructions. The rework was acceptable.
A196179 8-16-66	There was no response from oscillator assembly, P/N 1B33187-553, S/N 00001, while running H&CO 1B64637. Output should have been at 14.5 KC.	Configuration programming was in error, and was reworked acceptably.
A196180 8-16-66	There was no response from oscillator assembly, P/N 1B33187-557, S/N 00001, instead of 14.5 KC per H&CO 1B64637.	The assembly was reworked and retested acceptably.

TABLE I, Section 2 (Continued)

FARR NO.	DESCRIPTION OF DEFECTS	DISPOSITION
A196181 8-16-66	a. There were scratches at both the upstream and downstream flares on pipe assembly, P/N 1B52566-1. b. The teflon insulation was damaged in several places.	a. The flares were hand polished per DPS 10001. b. The teflon wrapping was removed and replaced per B/P. The rework was acceptable.
A196182 8-16-66	On quick disconnect assembly, P/N 1A49958-523, S/N 29, imperfections in the threaded end of the nipple seat caused leakage.	The surface was polished with No. 400 paper. The rework was acceptable.
A196183 8-16-66	Imperfections in the threaded end of the nipple seat on quick disconnect, P/N 1A49958-515, S/N 12, caused leakage.	The surface was polished with No. 400 paper. The rework was acceptable.
A196184 8-17-66	There was a loose connection at the accelerometer end of coax cable 411MT605C, P/N 1A88599-1, S/N 04, suspected of causing voltage deflections.	After tightening the connector, the deflections continued, and the accelerometer was removed and replaced. The rework was acceptable.
A196185 8-17-66	There were numerous imperfections in the down-stream flare of tube assembly, P/N 1B52571-1.	The imperfections were hand polished out per DPS 10001. The rework was acceptable.
A196186 8-18-66	Accelerometer, P/N 1A88599-1, S/N MA-04, had intermittent coax voltage.	The accelerometer was returned to the vendor for rework to specs.
A196188 8-18-66	Pressure transducer 410MT600, P/N 1B40242-523, S/N 523-20, read 19.922 psia at ambient.	After retest, the transducer was returned to the vendor for rework to specs.

TABLE I, Section 2 (Continued)

FARR NO.	DESCRIPTION OF DEFECTS	DISPOSITION
A196189 8-19-66	There was excessive leakage at the union, P/N MC160C12W, between pipe assemblies, P/N's 1B64873-1 and 1B64876-1.	A crush washer, P/N MC185C12, was installed. The rework was acceptable.
A196190 8-19-66	There was excessive leakage at the cap assembly, P/N MC177C12W, on the LOX tank pressurization module.	A crush washer, P/N MC185C12, was installed, correcting the leakage.
A196192 8-19-66	Wires D8824A22 and D8825A22 on wire harness 411W297P8, P/N 1B58290-1, S/N 00001, were reversed.	Pins N and D of plug P8 were removed and reinstalled per B/P, correcting the wiring arrangement.
A196193 8-23-66	Extensiometer, P/N 1A68709-1, S/N 00022, would not extend or retract, and was bent and wrinkled in numerous places.	The extensiometer was re-taped, adjusted per calibration requirements, and accepted.
A196194 8-23-66	The LH_2 fine mass reading on PUEA, P/N 1A59358-517.2, S/N 07, was 2.251 vdc. It should have been 2.686 ± 0.4 vdc per H&CO 1B59048.	PUEA, P/N 1A59358-517.2, was repaired and reworked to a P/N 1A59358-525, S/N 025. The rework was acceptable.
A196195 8-23-66	The output from accelerometer, P/N 1A88769-503, S/N 207, was 0.5 vdc. It should have been 4.850 ± 0.100 vdc per H&CO 1B59044.	The accelerometer was returned to the vendor for rework to specs.
A196196 8-23-66	Coaxial switch 411A89A201, P/N 1A69213-1, S/N 0062, read 70 per cent due to noise pickup. It should have read 98 per cent per H&CO 1B59050.	Retest per B/P A659-1A69213-PDS1 failed to duplicate the defect, and the switch was accepted for use.
A196197 8-25-66	The 70 kHz VCO in FM/FM/PAM No. 2 was nonlinear in the middle range of its output.	The oscillator was reworked, retested, and accepted.
A196198 8-25-66	Transducer, P/N 1B40240-507, S/N 507-5, was out of tolerance on both high and low RACS outputs.	Acceptable to Engineering after retest failed to reproduce defects.

TABLE I, Section 2 (Continued)

FARR NO.	DESCRIPTION OF DEFECTS	DISPOSITION
A196200 8-26-66	The forward right-hand mounting stud for transducer, P/N 1A68708-1, was loose and turned with the nut.	The transducer was removed, the stud was secured, and the transducer was reinstalled. The rework was acceptable.
A216751 8-30-66	On oscillator assembly, P/N 1B33187-555, S/N 00001, adjusting the gain on wideband amplifier caused the output voltage to vary.	The unit was retested, reworked to a 1B33187-555 configuration, then reworked to a 1B52717-1, and accepted.
A216752 8-31-66	There was a broken wire at pin 11, plug P-26, on wire harness, P/N 1B58317, S/N 00001.	The pin was removed and replaced per B/P, and was accepted.
A216753 9-1-66	A coaxial connection was damaged at amplifier, P/N 1A68707-7.	Transducer kit, P/N 1A68707-601, S/N 1508, was returned to the vendor for rework to specs.
A216756 9-10-66	Coax cable 411MI675, located at panel, P/N 1A68707-577, S/N 513, had a loose connector causing intermittent operation.	The connection ends were tightened per Engineering instructions, and were accepted for use.
A216757 9-10-66	Coax cable 411MI705, P/N 1A68708-507, S/N 356, had a loose connector, causing voltage output to be about half of the required minimum.	The connections were tightened per Engineering instructions, and retested acceptably.
A216759 9-13-66	Output from transducer, P/N 1A88599-1, S/N MA-04 was 0.6 vrms. It should have been 1.4 vrms per H&CO 1B59060.	Acceptable to Engineering following retest per B/P A659-1A88599-1-PDS1.
A216760 9-13-66	The high output from DC amplifier, P/N 1A82395-1, S/N 2135, was 2.989 vdc, rather than 4.000 vdc per B/P.	The amplifier was returned to the vendor for replacement per specs.
A216761 9-14-66	Wire harness 404W15J1, P/N 1B50233-1, S/N 00004, was damaged at the keyway.	The damaged area was deburred and finished per MIL-C-5541. The rework was acceptable.

TABLE I

Section 3. Assembly and Systems Installation

FARR NO.	DESCRIPTION OF DEFECTS	DISPOSITION
A196134 8-6-66	There was a 0.019 in. gap between transducer, P/N 1B31356-507, S/N 183-6, and the accumulator mating surface. Maximum allowable gap was 0.015 in.	The transducer was returned to the vendor for rework to alleviate the condition.
A203675 7-13-66	On the aft dome, 8 in. forward of thrust structure stringer 5, support, P/N 1B27099-3, was cracked parallel to the support leg.	The cracked support was removed per DPS 32330 and replaced per B/P.
A203754 7-15-66	500 vdc was inadvertently applied to amplifier, P/N 1A68708-1, S/N 315, when 411W297-P32 was connected. P32 should have been disconnected.	The amplifier was removed and replaced. The rework was acceptable.
A203769 7-21-66	At thrust structure stringer 5, top channel, P/N 1B40617-503, was mislocated 1/4 in. outboard per B/P 1B37207.	Acceptable to Engineering for use.
A209826 4-18-66	On panel, P/N 1B39221-41, one shurlok was squeezed excessively. The attachment should have been located flush, but was recessed 1/16 in.	A washer was installed around the hole per Engineering instructions. The attachment was then installed per B/P. The rework was acceptable.
A216705 9-22-66	a. Coax cables 410MT600 and 403MT751 had damaged insulation, exposing the shield.	a. The damaged areas were wrapped with teflon tape per DPS 1.357-15.
	b. There were thirteen dings on the exterior of the engine thrust chamber, on the coolant tubes.	b. Acceptable to Engineering for use.
A216706 9-23-66	Coax cables 425MT601 and 403MT708 had damaged insulation, exposing the shield.	The damaged areas were wrapped with teflon tape per DPS 1.357-15. The rework was acceptable.

TABLE I, Section 3 (Continued)

FARR NO.	DESCRIPTION OF DEFECTS	DISPOSITION
A216707 9-28-66	The following defects were found in the aft skirt: a. At stringer 8, the forward end of the stringer was trimmed back 3/8 in. to clear a crack. b. At stringer 56, cap, P/N 1B42355-1, was trimmed to clear an aft skirt joining bolt. c. At stringer 57, the same cap rode the joining bolt. d. Between stringers 133 and 134, an excess 1/2 in. hole was drilled 3 ft. forward of the aft end.	a. The corner of cap, P/N 1B42355-1, was scarved. b. The open end of the cap was sealed with DPM 2531. c. Acceptable to Engineering for use. d. A new doubler was fabricated and installed, using existing attachments. All rework was acceptable.

TABLE II. FAILURE AND REJECTION REPORTS, STRUCTURAL ASSEMBLIES

Section 1. Propellant Tank Assembly, P/N 1A39303-515

FARR NO.	DESCRIPTION OF DEFECTS	DISPOSITION
A184350 2-4-66	Inside the forward dome, on weld seam pads 1 through 5 and 9, there were sharp shallow cuts, ranging from 0.001 in. to 0.002 in. in depth and 2 in. to 8 in. in length, parallel to and 1 in. away from each seam.	The scratches were removed using No. 400 aluminum oxide cloth. The rework was acceptable.
A184558 1-22-66	X-ray of the aft dome to ring weld revealed closely grouped porosities at ten locations.	After machining, small porosities were scattered at the same locations. This condition was accepted for use.
A188329 2-5-66	During rework of the forward dome door jamb doubler per B/P 1B59281, during the first cure cycle, no records were kept of the relative humidity.	Following a review of coupon tensile test results, Engineering accepted the condition for use.
A188482 2-10-66	There were voids in the adhesive fillets on all spacers, P/N 1B59281-23.	All voids were filled with DPM 3396 per DPS 32330. The rework was acceptable.
A188495 2-24-66	During hydrostatic testing per acceptance test procedure A659-1B38414-1PDS7, the aft dome was cracked from 20 3/4 in. left of seam 4, to 8 1/4 in. past seam 5, when pressurized to 50 psi.	The 1007A tank assembly was installed in place of the 1007. The latter was installed on test vehicle, S/N 9005, following rework per SEO 1B39303-014.

TABLE II, Section 1 (Continued)

FARR NO.	DESCRIPTION OF DEFECTS	DISPOSITION
A197779 4-19-66	a. Dye check inspection of the aft dome to ring weld revealed greater than No. 3 porosity in all segments. b. Dye check also showed intermittent indications between seams 5 and 6, and 6 and 7.	a. The indications were ground out and accepted. b. The defects were scraped, and accepted.
A197905 4-27-66	Dye check of the forward dome to ring weld showed: a. Greater than No. 3 porosity in numerous locations. b. A 1/8 in. linear indication between seams 6 and 7.	a. The porosities were ground out, blended, and accepted. b. The linear indications were blended and accepted.
A197924 5-15-66	Dye check of the aft dome fittings showed: a. Three cracks in the LOX fill line fitting to segment 3 weld. b. Greater than No. 3 porosity in the same weld.	a and b. The defects were ground out and accepted.
A197990 5-14-66	Dye check per QEC 1697 revealed a crack in the inside fitting, P/N 1B44178-1, to forward dome weld.	The indication was ground out, polished, etched, re-dye checked, and accepted for use.

TABLE II, Section 1 (Continued)

FARR NO.	DESCRIPTION OF DEFECTS	DISPOSITION
A197991 5-14-66	Dye check of forward dome external flange fitting, P/N 1B33284-501, to segment 2 weld revealed connected linear porosity and two small transverse cracks.	The connected linear porosity and indicated cracks were ground out, etched, redye checked, blended, and accepted.
A197996 5-17-66	Dye check revealed two longitudinal cracks in the LOX fill line fitting, P/N 1A39153-1, to aft dome segment 3 fillet weld.	After being twice ground out, the condition was reworked per salvage SEO 1A39303-015. The rework was acceptable.
A203376 6-27-66	T-peel coupons representing supports, P/N's 1B27099-3, -5, -7, and -8, and 1B37888-529, did not meet the requirements of DPS 32330.	After reviewing lap shear test values, Engineering accepted the condition for use.
A203430 6-27-66	Defects discovered in the LH_2 tank deflector and baffle installation included an insufficient gap at the tape fastener, segment 9; and numerous voids and a loose edge at the bond line.	The gap was accepted as is. The voids were filled and the loose edge was repaired with 1P20025 adhesive per DPS 32340.
A209539 3-31-66	An indentation measuring 0.125 in. x 0.059 in. was found in the mating surface face of door, P/N 1A59710-501, S/N 22, midway between two 0.435/0.444 in. bolt attachment holes.	The edge of the indentation was radiused out 1/32 in. The area was cleaned per MSFC spec 164 and re-finished with alodine per DPS 9.45.

TABLE II, Section 1, (Continued)

FARR NO.	DESCRIPTION OF DEFECTS	DISPOSITION
A209706 4-11-66	a. Between aft dome seams 2 and 3, the anodized surface was scratched off the common bulkhead skin intermittently over a 12 in. length. b. Between seams 4 and 5, at station 286.147, two 0.001 to 0.004 in. gouges were noted.	a. The scratches were polished out to a 10:1 ratio, cleaned, alodined, and accepted. b. Acceptable to Engineering for use.
A209704 4-12-66	Proper cylinder overlap per B/P 1A39303 did not exist at aft dome seam 2. The overlap was 1 51/64 in.	Acceptable to Engineering for use.
A209705 4-15-66	Dye check of the aft dome to cylinder weld revealed: a. No. 3 porosity near the dome, between seams 1 and 2. b. Linear indications throughout the weld.	a. The porosity areas were smoothed, etched, and accepted. b. Acceptable to Engineering for use.
A209711 4-22-66	At weld joint center segment 2, 21 in. counter-clockwise from cylindrical seam 2, there was a melted area in the forward dome skin measuring 3/8 in. x 1 3/8 in.	The area was cleaned and ground to remove impurities, and was patched per Engineering instructions. The rework was acceptable.

TABLE II, Section 1 (Continued)

FARR NO.	DESCRIPTION OF DEFECTS	DISPOSITION
A209712 4-27-66	X-ray of the forward dome to ring weld revealed: a. Scattered porosities between seams 5 and 6, 6 and 7, 7 and 8, and 8 and 9. b. Linear indications in seams 3, 4, and 5.	a. Acceptable to Engineering after re-X-ray failed to show defects. b. The condition was accepted for use.

TABLE II, (Continued)

Section 2. Forward Dome, P/N 1A39304-509

FARR NO.	DESCRIPTION OF DEFECTS	DISPOSITION
A177846 12-20-65	There was a can condition on forward dome segment 2, just aft of the AC-AC flange.	The can was reworked acceptably per Engineering instructions.
A177867 12-28-65	There was an etched hole in the concave surface of segment 6, measuring 9/32 in. x 1/8 in. x 0.028 in.	Trim lines were adjusted to remove the hole. The rework was acceptable.
A177870 12-29-65	There were pasa-jell spots on the exterior surface of segment 1.	The areas were touched up with alodine per DPS 9.45. The rework was acceptable.
A177880 1-3-66	Numerous porosities, voids, and clusters were noted throughout all meridian seams.	Numerous reworks, including grindouts and twelve rewelds, resolved all problems satisfactorily.
A182620 1-14-66	At the equatorial plane, the pi tape diameter was 259.617 in. at 68°F. The diameter should have been 259.702 ± 0.060 in. per B/P 1A39304.	Acceptable to Engineering for use.
A182623 1-16-66	a. There were intermittent scratches and scraper marks in parent material adjacent to weld seams 2, 3, 4, 6, and 7. b. There was an underfill area in seam 6. c. The inner weld bead was flush in seam 6, two locations.	a. Sharp edges were broken and reworked areas were touched up with alodine. b. The underfill was smoothed and blended, dye checked and accepted. c. Acceptable to Engineering for use.

TABLE II, Section 2 (Continued)

FARR NO.	DESCRIPTION OF DEFECTS	DISPOSITION
A182636 1-19-66	There was an underfill area in the flange to dome weld, midway between seams 3 and 4.	After blending, dye check revealed No. 3 porosity which was ground out and accepted.
A182646 1-23-66	a. There were out-of-contour conditions at 60° latitude and 180° longitude, and at 82° latitude and 60°, 80°, 100°, 120°, 140°, 160°, 180°, 200°, and 220° longitude. b. The side of bracket, P/N 1B41942-1, was not parallel to the face of the check tool.	a and b. Acceptable to Engineering for use.

TABLE II, (Continued)

Section 3. Cylindrical Tank Assembly, P/N 1A39306-511

FARR NO.	DESCRIPTION OF DEFECTS	DISPOSITION
A177899 1-11-66	Dye check and X-ray 66-B4 of the inside helium bottle support fittings to cylindrical tank weld showed: a. Less dense inclusions in 1V1 and 2V4. b. Lack of complete penetration in 4V2. c. Scattered No. 3 porosity around each fitting.	a and b. Acceptable to Engineering for use. c. All porosities were ground out, and fitting 4 was accepted for use. All other fittings were rewelded twice and accepted.
A182634 1-18-66	There were nicks on the inside edges of the sealing surfaces of flanges on helium bottle fittings 1 through 5.	The nicks were deburred and sharp edges were broken. The metal was touched up with alodine, and the rework was accepted.
A182655 1-17-66	Dye check of the helium bottle support fittings to cylindrical tank welds revealed: a. Lack of fusion in view 3, and No. 3 porosity in view 1, fitting 1. b. No. 3 porosity in view 1, fitting 2. c. No. 3 porosities in views 1 and 4, fitting 3. d. Lack of fusion in view 3, and scattered No. 3 porosity, fitting 4. e. Scattered No. 3 porosity in fitting 5.	The No. 3 porosities and lack of fusion indications were scraped and ground, then rewelded and accepted for use.

TABLE II, Section 3 (Continued)

FARR NO.	DESCRIPTION OF DEFECTS	DISPOSITION
A182661 1-25-66	X-ray 66-B12 before machining showed a lack of fusion in aft ring seam 3, and voids in seam 3, view A. Dye check revealed cracks in seams 1, 2, and 4, and No. 3 porosity in seam 3.	The lack of fusion and voids were ground out, rewelded, and accepted. The dye check indications were ground out, and all but seam 3 were accepted. Seam 3 was rewelded and accepted for use.
A182671 2-2-66	a. X-ray 66-B19, before machining, of the forward ring seams revealed cracks in seams 1 and 2, scattered porosity and lack of fusion in seam 3, voids and a cluster of porosity in seam 4. b. Dye check showed cracks in seams 1, 2, and 3, and porosity in seam 4.	a. The scattered porosity was accepted for use. The other defects were ground out and accepted after two rewelds. b. All cracks and porosity were ground, out and accepted.
A188522 3-1-66	X-ray 66-51 of longitudinal seam 6 revealed a void 27 3/4 in. from the forward end.	Acceptable to Engineering for use.
A188745 3-4-66	There was an out-of-tolerance grindout in the aft ring to cylinder weld.	The area was blended to a 10:1 ratio and polished. The rework was acceptable.

TABLE II, (Continued)

Section 4. Liquid Oxygen Tank Assembly, P/N 1A39307-513

FARR NO.	DESCRIPTION OF DEFECTS	DISPOSITION
A189350 2-24-66	There were underfill areas in the aft dome to common bulkhead weld, between aft dome seams 3 and 4.	The areas were cleaned and automatically rewelded. The rework was acceptable.
A189358 3-1-66	There were scratches and bare areas in all segments of the aft dome in the bulkhead weld area.	Sharp edges were broken and the scratched areas were smoothed up. All locations were touched up with primer per spec F-289.
A189362 3-3-66	There was pasajell splatter and black and brown discoloration on all aft dome segments.	The splattered spots were touched up with alodine. The brown discoloration was accepted for use, and the black discoloration was removed with toluene. The rework was acceptable.

TABLE II, (Continued)

Section 5. Common Bulkhead Assembly, P/N 1A39309-501

FARR NO.	DESCRIPTION OF DEFECTS	DISPOSITION
A171505 10-12-65	Dye check of the forward ring welds showed cracks in seam 1 at the edges of the standing and base legs.	The defect areas were ground out, rewelded, re-X-rayed, re-dye checked, and accepted.
A171515 10-23-65	X-ray 65-B125 and dye check revealed cracks in the forward base leg, aft ring, seams 1, 2, and 3, and in the forward standing leg in seams 1 and 2.	Defects were ground out, rewelded, re-X-rayed, and accepted.
A171524 10-30-65	X-ray of the aft face meridian welds revealed: a. Void in seam 1. b. Inclusion and linear porosity in seam 5.	a. The void was ground out, etched, blended, dye checked, and accepted. b. The inclusion and porosity were ground out, blended, etched, dye checked, and accepted.
A171526 10-31-65	Dye check showed a crack in the No. 1 hoist fitting.	The crack was ground out, rewelded, re-dye checked, and accepted.
A171998 11-5-65	The following defects were noted in the aft face meridian welds: a. Underfill in seam 2 outside. b. Underfill in seam 6 outside. c. Scratch adjacent to seam 2 inside.	a and b. Underfill areas were smoothed. Area in seam 2 was ground out and accepted. Seam 6 was acceptable for use. c. The scratch was ground out, blended, etched, and accepted.

TABLE II, Section 5 (Continued)

FARR NO.	DESCRIPTION OF DEFECTS	DISPOSITION
A172017 10-26-65	The recorder malfunctioned during welding of aft face seams 1, 2, and 3.	The welds were X-rayed, dye checked, and accepted for use.
A177609 12-2-65	There was an area on the concave side of the aft face where too much anodic coating had been removed for the installation of the aft ring.	Acceptable to Engineering for use.
A177811 12-6-65	There were excessive grindouts in all seams of the aft face, and No. 3 porosity in seam 3.	Grindouts in seams 8-9 and 9-1 were blended and accepted. All others were acceptable. The No. 3 porosity was smoothed and blended out satisfactorily.
A177879 1-3-66	X-ray 65-B157 of the forward face to ring weld showed connected porosity in the grindout 83 in. from seam 4 toward seam 5.	The porosity was ground out, rewelded, re-dye checked, and accepted.
A178460 1-3-66	Thermocouple 7 was inoperative throughout the cure cycle of the core to aft face adhesive bond. The test coupon results were per DPS 31150-1.	Acceptable to Engineering for use.
A182606 1-6-66	There were out-of-contour conditions on the forward face at 82° latitude and 10° to 360° longitude.	Acceptable to Engineering for use.

TABLE II, Section 5 (Continued)

FARR NO.	DESCRIPTION OF DEFECTS	DISPOSITION
A182679 2-11-66	Dye check and X-ray of the common bulkhead welds revealed: a. No. 2 and 3 porosity in seam 2. b. No. 3 porosity in seam 3. c. No. 1 and 3 porosity in seam 6. d. No. 3 porosity in seam 8. e. No. 3 and clusters of porosity in seam 9.	All defects were ground out. One reweld was required. All rework was acceptable.
A187013 1-27-66	The common bulkhead seal weld had an excess 5/32 fillet weld.	Acceptable to Engineering for use.
A187020 1-30-66	Per QEC 657B, the inside contour of the bulkhead was out of tolerance at 82° latitude and 80° longitude.	Acceptable to Engineering for use.

TABLE II, (Continued)

Section 6. Aft Dome Assembly, P/N 1A39308-513

FARR NO.	DESCRIPTION OF DEFECTS	DISPOSITION
A177897 1-10-66	X-ray 66-B3 of the outside H-H flange fitting to aft dome weld showed lack of fusion in view 2.	Acceptable to Engineering for use.
A182637 1-20-66	There was a 8 in. x 10 in. x 0.375 in. can condition in the B-B fitting adjacent to segment 3.	The condition was reworked to an acceptable level per Engineering instructions.
A182642 1-20-66	There were flat areas around the B-B fitting to segment 3 weld.	Acceptable to Engineering for use.
A182643 1-21-66	There was excessive ovality at the B-B fitting sealing surface.	Acceptable to Engineering for use.
A182648 1-22-66	There were areas of excessive grindouts and lack of penetration in meridian seams 5, 6, and 7.	Seams 5, 6, and 7 were rewelded, and the grindouts were blended acceptably. All rework was satisfactory.
A182651 1-12-66	X-ray 66-B3 of the inside G-G fitting to segment 9 weld revealed less dense inclusion in view 3, and linear porosity at the root.	The linear porosity was acceptable as is. The inclusion was ground out, rewelded, and accepted for use.
A182698 2-9-66	X-ray 66-B3 of the AR-AR elbow to aft dome weld showed dense foreign material in view 1.	Acceptable to Engineering for use.

TABLE II, Section 6 (Continued)

FARR NO.	DESCRIPTION OF DEFECTS	DISPOSITION
A182699 2-9-66	X-ray 66-B3 of the G-G elbow to aft dome weld showed: a. Linear and scattered porosity, and a void with a tail in view 1. b. Clusters of porosity in view 2. c. Clusters, scattered porosity, and a void with a tail in view 3. d. Clusters and a void with a tail in view 4.	Voids with tails were ground out and rewelded. The other defects were acceptable for use.
A182700 2-9-66	X-ray 65-B3 of the F-F elbow to aft dome weld showed dense foreign material in views 1 and 4, and lack of fusion and connected porosity in view 2.	The foreign material was accepted for use. The defects in view 2 were ground out, rewelded twice, and accepted.
A187046 2-4-66	The percussion weld on one PU probe stud on segment 6 failed torque tests.	The area was spotfaced and a new stud was welded in place per B/P. The rework was acceptable.
A187059 2-15-66	X-ray 66-B3 of the inside AP-AP elbow to dome weld showed: a. Lack of penetration in views 1, 2, 3, and 4. b. More dense inclusion in view 2.	a and b. Acceptable to Engineering for use.

TABLE II, Section 6 (Continued)

FARR NO.	DESCRIPTION OF DEFECTS	DISPOSITION
A187060 2-15-66	X-ray 66-B3 of the AR-AR flange to elbow weld showed: a. Lack of penetration in views 3 and 4. b. Crack in view 3. c. Cold lap in view 2.	a and b. Defects were ground out and rewelded. View 3 was rewelded twice. The rework was acceptable. c. Acceptable to Engineering for use.
A187061 2-15-66	X-ray 66-B3 of the AT-AT flange to elbow weld showed more dense inclusion in view 4.	Acceptable to Engineering for use.
A187062 2-15-66	X-ray 66-B3 of the AU-AU flange to elbow weld revealed lack of penetration in views 1, 3, and 4.	Acceptable to Engineering for use.
A189318 2-11-66	The ovality of the G-G fitting weld was 0.088 in. on the inside and 0.020 in. on the outside. Maximum allowable was 0.015 in. per B/P 1A39308.	The high spots were flattened per Engineering instructions and touched up with alodine. The rework was acceptable.
A189337 2-17-66	a. Per QEC 564A, out of contour conditions were found at fifteen locations. b. Per QEC's 564C through 564G, fitting dimensions were out of tolerance on four fittings.	a and b. Acceptable to Engineering for use.

TABLE II, (Continued)

Section 7. Forward Skirt Assembly, P/N 1A39264-509

FARR NO.	DESCRIPTION OF DEFECTS	DISPOSITION
A192964 3-14-66	There were two gouges and seven rivet set marks between stringers 8, 9, and 10, 19 3/8 in. forward of the aft interface.	The gouges were smoothed up and ground out, and a doubler was fabricated per Engineering instructions and installed. The rivet marks were smoothed up and ground out, and extra rivets were installed. All rework was acceptable.
A192968 3-17-66	a. At stringer 101, station 610, four 5/32 in. holes through stringer, skin, and doubler interfered with the installation of casting, P/N 1B54215-2. b. At stringer 102, station 610, three 5/32 in. holes through stringer, skin, and doubler interfered with the installation of fitting, P/N 1B54215-2. c. At stringer 10, forward interface, a double hole was drilled through frame segment, P/N 1A58328-1, and angle segment, P/N 1A58609-1.	a and b. Rivets, P/N NAS1097AD5, were installed in the interfering holes. The fitting was installed per B/P. c. The hole was plugged double flush with AD5 rivet material. A doubler was fabricated and installed per Engineering instructions. All rework was acceptable.
A192973 3-22-66	At stringer 19, station 663, four instead of five BJ5 rivets were installed through fitting, P/N 1B44623-1, intercostal, P/N 1A39264-283, cap, P/N 1A39264-285, and angle, P/N 1A39264-63.	Acceptable to Engineering for use.

TABLE II, Section 7 (Continued)

FARR NO.	DESCRIPTION OF DEFECTS	DISPOSITION
A209545 4-4-66	a. At stringer 49, station 620, one 5/32 in. BJ-5 rivet hole was drilled 1/4 in. through doubler, P/N 1A39264-721, only, and 3/16 in. through skin and stringer.	a. A rivet, P/N MS20470ADL was installed through the 3/16 in. hole. Otherwise, the condition was accepted for use.
	b. At stringer 101, station 624, there was a canned condition in skin and doubler, P/N 1A39264-723, surrounding a 5/32 in. BJ-5 rivet hole.	b and c. Acceptable to Engineering for use.
	c. At stringer 41, station 605, there were three 1/2 in. circular dings in the skin.	

TABLE II, (Continued)

Section 8. Aft Skirt Assembly, P/N 1A39295-505

FARR NO.	DESCRIPTION OF DEFECTS	DISPOSITION
A188453 2-8-66	Between stringers 116A and 117A, station 220, there were twelve excess No. 40 pilot holes drilled through cap, P/N 1A87929-69.	All but two holes were plugged with rivets, P/N MS20426AD3. The remaining two were pulled to align with holes in bracket, P/N 1A93015-1. The rework was acceptable.
A188506 2-23-66	At stringer 126A, station 207, two 0.1855/0.1885 in. holes were elongated to 0.240 in. through stringer only.	Hi-loks, P/N HL20-8, were installed per DPS 3.67-39. The rework was acceptable.
A188514 2-25-66	Between stringers 61 and 96, holes were drilled out of perpendicular to the stringer surfaces at ring frames 220, 240, and 256.	Tapered washers were installed under lockbolt heads per Engineering instructions. The rework was acceptable.
A188516 2-26-66	Visual inspection of longitudinal seam 1 revealed a gouge 4 1/2 in. from the aft end, and lack of complete penetration.	The gouge was blended out to a 5:1 ratio, correcting the condition.

TABLE II, (Continued)

Section 9. Thrust Structure, P/N 1A39316-509

FARR NO.	DESCRIPTION OF DEFECTS	DISPOSITION
A188730 3-3-66	Doubler, P/N 1A39316-55, was mislocated at stringers 16 and 17 instead of stringers 15 and 16.	Four mislocated holes were plugged. A new doubler was fabricated and installed using B/P attachments. The rework was acceptable.
A192956 3-11-66	Between stringers 10A and 11, 68 in. forward of the aft gimbal face, two 1/8 in. holes through fitting, P/N 1B27631-1, were misaligned with existing holes through frame segment, 1B52893-7, and angle, P/N 1B52893-9.	The mislocated holes were double flush plugged through frame and angle. B/P attachments were installed, drilled from the fitting. The rework was acceptable.
A209528 3-23-66	Between stringers 1 and 2, at ring plane 2, four No. 21 holes for the installation of support, P/N 1B34894-5, fell in the radius of skin, P/N 1A68549-1.	The radius of the skin was spotfaced where the rivets would fall. The spotfaced area was alodined and primed per B/P. The rework was acceptable.
A209536 3-30-66	On the thrust structure assembly, there was a deep rivet set mark around one BJ4 attachment hole on the outer surface of beam, P/N 1B56214-5.	The set mark was smoothed out, dye checked, alodined per spec F289, and accepted.
A209878 4-11-66	Between stringers 24 and 1, on frame assembly, P/N 1B52893-501, circular cracked set marks were found in panels, P/N 1B52893-15.	No. 50 stop holes were drilled at the ends of the cracks. A triangular doubler was fabricated and installed, picking up existing attachments. The rework was acceptable.

TABLE II, Section 9 (Continued)

FARR NO.	DESCRIPTION OF DEFECTS	DISPOSITION
A209882 4-14-66	At stringer 8A, at the first and second ring frames, aft attach ring: a. Bracket, P/N 1B37207-31, could not be installed per B/P because the stringer attachment layout was mislocated. Bracket, P/N 1B37207-23, when installed, had a 1/8 in. edge distance on one AD6 rivet. Minimum allowable edge distance was 3/8 in.	Both brackets were refabricated, to conform to the stringer rivet pattern, following Engineering instructions. The rework was acceptable.

APPENDIX 4

GLOSSARY

GLOSSARY OF TERMS

ABCL	As Built Configuration List. A listing of the part number, change letter, and manufacturing position index number. Compiled by the Reliability Assurance Department from the manufacturing paper applicable to the stage.
ACS	Automatic Checkout System (Complete Complex).
AFQA	Air Force Quality Assurance
AGC	Automatic Gain Control
AO	Assembly Outline. Document controlling the assignment of work to assembly areas, and provides a record of conformance. Planned and released by Manufacturing Planning and verified through Reliability Assurance (Quality Control) procedures.
APS	Auxiliary Propulsion System
CCO	Contract Change Order
COAL	A computer routine for changing data in memory.
Countdown	Tasks carried on during the backward counting (in minutes and seconds) from initiation to conclusion of a propellant loading, or static firing exercise.
Critical Components	Those functional components essential to stage performance.
CLT	Cargo Lift Trailer
DDAS	Digital Data Acquisition System
DDT	Data Description Tape
DPS	Douglas Process Standard
Dye Check	Dye Penetrant Inspection. Visual identification of surface weld defects, such as porosity and cracks, with a colored dye.
EBW	Exploding Bridge Wire System
ECL	Engineering Configuration List. A tabulated listing of the Douglas/vendor part numbers, Douglas/government/industry standard part numbers, specification and source control drawing numbers, processes and material specification numbers, test requirement drawing numbers, bulk material identification numbers, serialized engineering order and drawing change request engineering order numbers, plus the part number and drawing change letters defining the engineering released design intent applicable to this end item.
ECP	Engineering Change Proposal

GLOSSARY OF TERMS (Continued)

End Item	A customer-required system, or any principal system or subsystem elements. Also, those articles covered by major subcontracts, delivered direct to a customer, or provided as customer furnished property to a contractor.
EO	Engineering Order. Engineering document which is used to release design intent, for development and manufacture.
FARR	Failure and Rejection Report. A report used to identify or divert nonconforming material. Also used to record dispositions of such material, and the corrective action taken to prevent recurrence.
FACI	First Article Configuration Inspection
Form DD250	A material inspection and receiving report used to transfer an end item from one location or responsible agency to another.
Form DD829-1	Historical record used to document scope change verification.
FTC	Florida Test Center. Douglas Missile and Space Systems Division test center at Cape Kennedy, Florida.
Growler Inspection	A sonic inspection method for detecting internal discontinuities in Saturn stage common bulkheads.
GSE	Ground Support Equipment. Equipment whose function is to transport, protect, handle, service, test, check out, and monitor the complete Saturn S-IVB stage, separate assemblies, or components.
H&CO	Handling and checkout drawing (test procedure)
He	Helium
IIS	Inspection Item Sheet
IU	Instrument Unit
KSC	Kennedy Space Center, located in Florida
LH_2	Liquid Hydrogen
LOX	Liquid Oxygen
Log Book	A compilation of special records, packaged in book form, pertaining to a given end item.
MRB	Material Review Board. A committee which evaluates and determines the disposition of all rejected material (other than obvious scrap or incompletes) and initiates corrective action to prevent recurrence of the nonconformances leading to the rejections.

GLOSSARY OF TERMS (Continued)

NPC 200-2	NASA Quality Publication. The Quality Program Provisions for Space Systems Contractors.
OLSTOL	On Line Saturn Test Oriented Language. A method of manual (i.e. typewriter) input to correct a computer program.
PAM	Pulse Amplitude Modulated radio transmission
PCM	Pulse Code Modulated radio transmission
PCL	Planning Configuration List. Tabulated listing prepared by the planning release group containing that information listed on the engineering configuration list plus information required by the planning and manufacturing departments.
Permanent Nonconformance	A condition, signifying material is nonconforming at the time of inspection, and cannot be made to conform exactly.
Permeability	Degree to which one substance will diffuse through or penetrate another.
Porosity	Gas pockets or voids free of solid material occuring in welds.
PDM	Pulse Duration Modulation of radio transmission.
P/N	Part Number
PMR	Programmed Mixture Ratio
ppm	Parts per million
PU	Propellant Utilization system
PUEA	Propellant Utilization Electronic Assembly
psia	Pounds per square inch, absolute. Pressure measurement which includes atmospheric pressure.
psig	Pounds per square inch, gage. Pressure measurement which does not include atmospheric pressure.
QEC	Quality Engineering Chart. A chart, prepared by Quality Engineering, which provides specific inspection instructions to shop personnel, and a means of recording sequential inspection for each unit fabricated.
RACS	Remote Automatic Calibration System (telemetry checkout).
RF	Radio Frequency

GLOSSARY OF TERMS (Continued)

RMR	Reference Mixture Ratio
RPM	Revolutions per minute
RS	Range Safety
RSRS	Range Safety receiver system
SC	Scope Change. Changes, requirements, or details of all or any part of a program.
sccm	Rate of flow measurement - standard cubic centimeters per minute.
scim	Rate of flow measurement - standard cubic inches per minute.
SCO	Subcarrier Oscillator
SEO	Serial Engineering Order. Engineering orders, generally used to authorize and describe rework in conjunction with a production change. The SEO is also used to issue information or work authorization when no drawing change is involved, i.e., salvages for manufacturing errors, and authorization for variation from engineering drawing requirements or information.
SIM	Safety Item Monitor
SPCR	Saturn Program Change Request
SSB	Single Sideband, radio transmission
SSC	Space Systems Center. Douglas Missile and Space System Division Center at Huntington Beach, California.
STC	Sacramento Test Center, located at Sacramento, California
S/N	Serial Number
TACD	Test Area Control Document
TAN	Task Authorization Notice. Douglas work authority.
TCC	Test Control Center.
TCS	Thermo-Conditioning System
TD	Technical Directive
Time/Cycle Significant Item	A component or end item, the measured life of which is important enough to justify running time, cycle, or attribute data collection.

GLOSSARY OF TERMS (Continued)

T/M	Telemetry
TR	Test Request
UHF	Ultra High Frequency
Ullage Pressure	The pressure of the gases in the unfilled portion of the propellant tanks.
Ultrasonic Inspection	An inspection method employing ultrasonic waves to detect discontinuities in internal insulation bonding.
Umbilical	Stage/GSE interface point for stage servicing and monitoring from a ground source.
VCL	Vehicle Checkout Laboratory, located at SSC and STC.
VCO	Voltage Controlled Oscillator
VHF	Very High Frequency
VSWR	Voltage Standing Wave Ratio. A measure of antenna efficiency.
WRO	Work Release Order. Document providing authority for the accomplishment of work within the Douglas Missile and Space Systems Division.