X IV 2 7/28/67

SATURN V FIRST STAGE

annual progress report

FISCAL YEAR 1967

THE BOEING COMPANY • SPACE DIVISION • LAUNCH SYSTEMS BRANCH

D5-12601-4

ANNUAL PROGRESS REPORT

JULY 1, 1966 THROUGH JUNE 29, 1967
CONTRACT NAS8-5608, SCHEDULES 1 AND 1A
JULY 28, 1967

LAUNCH SYSTEMS BRANCH
SPACE DIVISION
THE BOEING COMPANY

PREPARED BY J. P. Delaloye

SUPERVISED BY D. H. Valentine

APPROVED BY C. L. McIntire

APPROVED BY F. E. Coenen

DISTRIBUTION

L. D. Alford	5-8300	FA-26
J. F. Allan	5-1830	LN-70
W. R. Allen	5-3100	LA-35
H. G. Anderson	5-1710	LP-58
W. C. Applegate	5-1840	LF-50
R. S. Benson	5-1800	LA-02
L. B. Bignold	5-9140	JD-35
L. E. Buchart	5-1950	LT-53
C. C. Caldwell	5-1100	LT-90
J. T. Cavanaugh	5-3600	LC-51
W. W. Clarke	1-1800	LA-11
L. G. Cochran	5-1500	LR-60
F. L. Coenen	5-1900	LD-42
S. R. Colson	5-1730	LE-39
E. K. Cooper	5-1910	LD-42
R. A. Cox	5-9020	JA-31
D. H. Creim	5-1200	LA-19
R. T. Crowley	5-7300	LS-72
W. W. Davis	5-7900	LS-55
E. Dean	5-9100	JD-51
L. R. Driggers	5-4000	AH-13
H. R. Frost	5-1700	LA-23
G. B. Goff	5-5400	LU-24
H. D. Gunning	5-1070	LA-42
D. O. Haas	5-1854	LN-54
C. W. Harris	5-3000	LA-10
W. C. Holmes	5-5000	LA-42
K. S. Ingram	5-1910	LD-33
J. Irico	5-1300	LT-43
I. A. Johnson	5-1630	LR-17
S. P. Johnson	5-3000	LP-36
A. M. Johnston	5-8000	FA-24
M. Kabinoff	5-7100	LS-10
M. P. Keith	5-1600	LR-65
S. D. Krull	5-5700	TA-01
L. E. Lea	5-1100	LT-90
C. E. Maddox	5-1400	LN-98
D. E. Marchus	5-1100	LT-90
T. R. Marley	5-3200	LA-03
A. D. Martin	5-1750	LE-20
C. L. McIntire	5-1240	LD-03
E. J. Merkel	5-1230	LT-92
J. D. Monroe	5-1440	LF-27
R. H. Nelson	5-1000	LA-42
J. L. O'Neil	5-3600	LA-18
B. L. Osborne	5-1100	LT-90
F. V. Paradise	5-7150	LS-30
J. E. Parazynski	5-1430	LN-87
A. H. Phillips	5-1010	LA-42
C. E. Pollom	5-1100	LT-90
W. H. Quarles	5-1940	AG-10
J. J. Reetz	5-1820	LA-29
H. C. Runkel	5-7000	LS-43
K. L. Sanborn	5-5200	LP-31
P. T. Sauber	5-5100	LP-34
T. L. Schmidt	5-1600	LR-18
D. E. Serrill	5-9200	JC-51
C. G. Smith	5-1800	FA-20
J. V. Smith	5-1020	LA-31
T. J. Smith	5-1260	LT-96
T. P. Snow	2-5937	AS-01
J. C. Sorenson	5-7600	LS-28
R. L. Stallings	5-5220	LP-29
G. H. Stoner (2)	5-1000	84-22
C. D. Stroud	5-1300	LT-43
R. A. Sundquist	5-3500	LA-36
R. F. Terry	5-1280	LA-21
D. G. Valentine (10)	5-1220	LD-59
W. J. Waugh	5-7400	LS-76
J. G. Weber	5-1020	JB-33
C. W. Wetzel	5-1100	LT-90
L. A. Wood	2-1000	14-26
L. Yanoff	5-1020	LA-41
C. H. Zobrist	5-3510	LC-08
Michoud Contracts Files	5-1100	LT-90
Facilities Central Files	5-1492	LN-95

J. Keller — 1200 Commonwealth Bldg.
1625 K. Street, N.W.
Washington, D. C. 20006

R. W. Brown	R-QUAL-J	NASA
D. H. Newby	DEP-A	NASA
C. L. Thionnet	R-AERO-P	NASA
J. R. King (5)	R-ASTR-BV	NASA
W. B. Huckaby	R-ME-R	NASA
M. E. Buchholz	I-CO-LH	NASA
H. W. Hallisey (2)	I-V-SIC	NASA
H. S. Garrett	MS-D	NASA
L. L. Jones	MS-H	NASA
T. S. Johnson	I-V-P	NASA
A. V. Clark	R-P&VE-XG	NASA
J. W. Moody	I-V-Q	NASA
C. W. Holmes	R-OM-V	NASA
F. W. Johnson	I-V-T	NASA
H. H. Quinton	I-MICH-MGR	NASA
G. N. Constan	I-MICH-MGR	NASA
M. S. Hardee	I-MICH-C	NASA
S. Smith	I-MICH-BU	NASA
R. J. Nuber	I-MICH-OB	NASA
W. B. Herrington	I-MICH-QES	NASA
H. L. Williams	I-MICH-QR	NASA
W. M. Bailey	I-MICH-F	NASA
J. B. Taylor	I-K-V	NASA

CONTENTS

ILLUSTRATIONS

FOREWORD

The Annual Progress Report has been prepared by The Boeing Company to fulfill the requirements of IN-I-V-S-IC-65-10 and IN-I-V-S-IC-66-10, "S-IC Program Deliverable Data," Line Item 4, Document Requirement Description MA-509B of Contract NAS8-5608.

This document reports progress made by The Boeing Company on the Saturn S-IC program for FY 1967 (July 1, 1966, through June 29, 1967) pertaining to Schedules I and IA of the contract.

Progress is reported by contract part in accordance with NASA/MSFC instructions. Activities that encompass more than one contract part are reported under that part considered to have the major role.

This report includes the following subjects:

- Project Management
- Contract End Items and Services
- Facilities Planning and Activation
- Logistics
- Stage System Studies
- Launch Operations
- Advanced Studies

THE BOEING COMPANY
LAUNCH SYSTEMS BRANCH. SPACE DIVISION P. O. BOX 29100, NEW ORLEANS, LA. 70129

National Aeronautics and Space Administration
George C. Marshall Space Flight Center

During the fiscal year of 1967, the Saturn V/S-IC effort was directed toward continuing, expanding, and improving the high standards that were established early in the program. Through the combined effort of all personnel, major production objectives and test schedules were successfully met.

Highlighting this period's activity is the extension of the S-IC contract. On February 3, 1967, NASA and The Boeing Company signed contract modifications for five additional boosters. As a result of this action, Boeing is now under contract to fabricate and assemble 15 S-IC stages. Negotiations are also underway for stages 16 through 25. The Boeing 16 through 25 proposal has been finalized and the package submitted to NASA June 30, 1967.

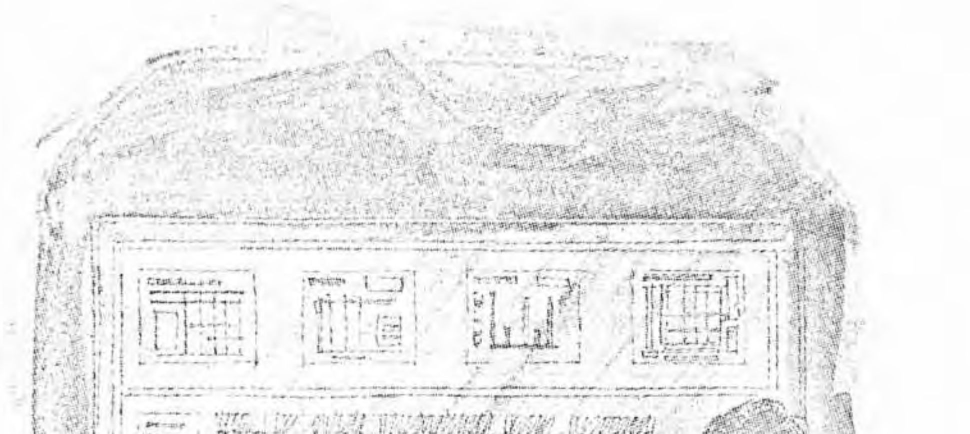
Stage activity has been extremely gratifying. The two Marshall Space Flight Center assembled flight stages, the S-IC-1 and S-IC-2, were shipped to Kennedy Space Flight Center and arrived August 26, 1966, and February 13, 1967, respectively. The S-IC-3, the first Michoud assembled flight stage, was shipped to the Marshall Space Flight Center and was installed in the test stand October 3, 1966. On November 15, 1966, the stage was successfully static fired for the contractually specified duration. The stage was returned to Michoud November 27, 1966, for refurbishment and post-static checkout. The S-IC-3 now remains in storage at Michoud after being accepted by NASA March 15, 1967.

Of significant importance to the S-IC program is the checkout and activation of the Mississippi Test Facility static test stand. On March 3 and March 17, 1967, the S-IC-T was successfully static fired in the Mississippi Test Facility stand. The stage, ground support equipment, and facility systems performed satisfactorily, thus verifying the facility for use in tests of flight stages. The S-IC-T was removed from the stand and on April 5, 1967, the S-IC-4 was successfully static fired for a 125-second duration. NASA's analysis of the results of the static firing showed it to be an apparent success.

With the two flight stages on dock at Kennedy Space Center and the extension of the Boeing S-IC contract, all members of the Saturn V/S-IC project can look forward to the coming year as one of continuing challenges and historical accomplishments.

F. L. Coenen
S-IC Program Executive
Launch Systems Branch

PROJECT MANAGEMENT 1



SUMMARY

The most significant Project Management event during FY 1967 was the execution of Schedule IA, Contract NAS8-5608. Under this contract, Boeing is authorized to fabricate, assemble, and test 5 more S-IC stages (S-IC-11 through S-IC-15).

A firm proposal for long lead item support for stages S-IC-16 and S-IC-17 was submitted on April 7, 1967; and a firm proposal for assembly and test of 10 stages (S-IC-16 through S-IC-25) was submitted at the end of June.

CONTRACT MANAGEMENT

CONTRACT NAS8-2577

As reported in the Annual Progress Report for FY 1966, the Contract Closeout Record, listing evidence of compliance with all contract tasks, was submitted to the contracting officer on November 17, 1965. A fully executed supplemental agreement, deleting the requirements for provisional overhead rates, was received on December 13, 1966.

CONTRACT NAS8-5606 (F)

This contract covers special facilities equipment for the Saturn S-IC program. The requirements for such equipment are established by program needs and submitted to the government as a fiscal year plan of forecasted requirements. The forecast is negotiated, the necessary level of funding is placed on contract, and the approved list of equipment to be acquired is listed in Schedule C of the contract. This equipment is segregated into two categories: 1) contractor acquired equipment, which is listed in Schedule A of the contract and 2) government furnished equipment, listed in Schedule B. Following acquisition of the equipment identified in Schedule C, it is added to Schedule A or Schedule B. Schedule C is updated on an annual basis to delete that equipment acquired during the previous year.

During FY 1967, funding was increased by $1,895,195 to a total current contract value of $27,093,540. The forecast of equipment requirements for FY 1968, with a proposed value in excess of $3,000,000, has been submitted to the government for review and is in negotiation as of June 29, 1967. The total expected value of the contract, including contractor acquired equipment for contract Schedules I and I-A and government furnished equipment for contract Schedule I-A, is set forth in Article XI, Schedule I-A of Contract NAS8-5608 (CPIF) in the amount of $37,540,633.

CONTRACT NAS8-5608

Schedule I-A to Contract NAS8-5608, which calls for the fabrication, assembly, and test of five S-IC stages, S-IC-11 through S-IC-15, at a target cost of $112 million and a target fee of $8,137,500, was approved by NASA headquarters on February 1, 1967, and received by Boeing on February 17, 1967. This contract embodies an incentive structure which differs substantially from that of Schedule I. It includes a flight performance incentive which provides substantial penalties in the event of flight failure, a schedule incentive provision calling for penalty only in the event of late delivery, and a cost incentive provision wherein Boeing shares in any underrun on the basis of 35 percent, and in any overrun on the basis of 20 percent, to a minimum fee of 1.45 percent of target cost and a maximum fee of 14.53 percent of target cost.

During this reporting period, the following schedule and performance incentive milestones were accomplished under Schedule I of the contract:

September 22, 1966	Post-manufacturing static firing readiness test completion of S-IC-3
November 15, 1966	Acceptance static firing of S-IC-3
December 5, 1966	Post-manufacturing static firing readiness test completion of S-IC-4
March 7, 1967	Post-manufacturing static firing readiness test completion of S-IC-5
March 15, 1967	End item delivery of the S-IC-3
May 16, 1967	Acceptance static firing of S-IC-4

A total of 3,452.6 out of a possible 4,678.4 incentive points were earned.

The late availability of the position I of the government furnished S-IC test stand at Mississippi Test Facility (MTF) forced Boeing to increase its efforts to minimize the delivery schedule impact. These efforts included further tasks under Contracts NAS8-17218 and NAS8-19528 (described below) and additional tasks assigned to Boeing under Schedule I. During this period it was agreed that acceptance static firing requirements would be changed from two firings per stage to one. As a result, Supplemental Agreement MICH-491 was reached May 15, 1967. This modification recognized additional costs incurred by Boeing, a 55-day extension of the S-IC-4 delivery date, and a seven-day advance in the incentive acceptance dates for the S-IC-6 through S-IC-10.

Boeing's activation task at MTF has been completed. A Certificate of Completion (COC) has not yet been supplied by the contracting officer.

Following conversion to the CPIF contract, Supplemental Agreement MICH-210 was made on September 19, 1966. By this action Boeing assumed design responsibility for additional hardware.

Contract changes have been received for storage of the S-IC-F and S-IC-D stages and for the evaluation of the S-IC-D for subsequent use. While stored at Michoud, the S-IC-F stage is undergoing inspection for evaluation and supply of additional reliability information on stage hardware.

Approximately 210 Budget Change Proposals were submitted to the customer for approval during the reporting period. The majority of these proposals were approved by the customer with the disapproval rate being less than five percent.

A supplemental agreement was executed on March 9, 1967, to cover the manufacturing and installation effort associated with in-scope changes to the Part I CEI Specification for the S-IC-1 and S-IC-2 stages through launch, provided both stages are launched within CY 1967.

Major revisions to Documents IN-I-V-S-IC-65-7, "Saturn S-IC Minimum Configuration Management Requirements Plan" and IN-I-V-S-IC-65-8, "Saturn V/S-IC Engineering Change Proposal Requirements", were negotiated during the reporting period. These revisions incorporate provisions for Part II CEI Specification change control but retain flexibility for changes.

Contract direction was received March 31, 1967, to store the S-IC-3 flight vehicle until August 23, and to incorporate as many of the retrofit changes which were originally scheduled for incorporation at the Kennedy Space Center (KSC).

FOLLOW-ON

In response to NASA RFP I-MICH-CB-67-80, dated March 7, 1967, Boeing submitted a firm proposal for long lead support for S-IC stages S-IC-16 and S-IC-17 on April 7, 1967. Negotiation of this proposal was concluded on May 12, 1967; on May 25, Boeing executed the resulting Contract NAS8-19544. As of June 29, 1967, Boeing had not received a fully executed contract.

In response to NASA RFP I-MICH-CB-67-83, dated April 4, 1967, a firm proposal for assembly and test of ten flight stages (S-IC-16 thru S-IC-25) was submitted at the end of June. At NASA's request, this proposal will price two separate methods of procurement, i.e., a full ten-stage buy and a two-stage buy with an option for eight additional stages. The target date for a fully executed contract is December 31, 1967.

CONTRACT NAS8-17218

On April 15, 1966, Contract NAS8-17218 was negotiated. This CPFF contract covers support of the activation of MTF and is segregated into two categories: 1) Michoud support, which was completed on March 31, 1967, and 2) On-site activation support, which was completed on February 19, 1967. The contract is presently being closed out.

CONTRACT NAS8-19528

Contract NAS8-19528 was entered into on December 9, 1966. This CPFF contract covers equipment interface modifications at MTF and additions to the MTF S-IC test complex and was completed on April 15, 1967. Closeout of this contract is presently being accomplished.

CONTRACT NAS10-4141

Notice of award of the fixed-price Contract NAS10-4141 was received by Boeing on September 15, 1966. It covers procurement, manufacture, assembly, inspection, test, and delivery of 59 items of ground support equipment to be used at KSC in support of the Saturn V launch vehicle. The period of performance was from September 15, 1966, through April 7, 1967. It is anticipated that final billing under this contract will be made by July 31, 1967.

CONTRACTING ACTIVITY FY 1967

Contract modifications received July 1, 1966, through

June 29, 1967, are indicated in Appendix A.

Proposals submitted to NASA from July 1, 1966, through June 29, 1967, are indicated in Appendix B.

Negotiations completed during the period of July 1, 1966, through June 29, 1967, are indicated in Appendix C.

Deliverable data submitted to NASA during the period July 1, 1966, through June 29, 1967, are indicated in Appendix D.

PROGRAM PLANS, SCHEDULES, AND REPORTS

PROGRAM SCHEDULES

Document D5-11040-4, "Launch Systems Branch S-IC Project Schedules," provided the contractor with internal guidelines for stage assembly and testing, and GSE activation and utilization. Six revisions, which provided current schedule direction, were made to this document during the reporting period. Publication of D5-11040-4 has been discontinued because timely internal working schedule information could not be dispersed as rapidly as necessary. Real-time internal working schedule data is now published in the form of Program Letters. These letters are issued by the S-IC Program Executive Office to establish program parameters.

Document D5-12535, "S-IC Reporting Milestones," identified and scheduled the S-IC Program Milestones to be used by the contractor in reporting the progress of Contract NAS8-5608, Schedules I and IA, to NASA/MSFC. The milestones set forth in this document were established through mutual agreement between the contractor and NASA/MSFC for the purpose of establishing a common reporting baseline by which program progress could be measured. Revision "J" to D5-12535, released on August 2, 1966, incorporated a proposed contract schedule for Stages S-IC-11 through S-IC-15. Revision "K", released September 7, 1966: 1) set forth the requirement for joint contractor-NASA/MSFC coordination and approval prior to release of document revisions; 2) deleted completed milestones and outlined current PERT event numbers; and 3) revised logistic program reporting milestones to reflect current planning. Revision "L", is presently being prepared for NASA approval. This revision, which will be completed in the first quarter of FY 1968, will add Schedule IA contractual reporting milestones to D5-12535 and will implement certain changes to the reporting format and frequency.

Document D5-13595, "S-IC Turn-Around Equipment Schedules," served as an instrument of agreement between NASA/MSFC and Boeing on the requirements for and utilization of turn-around equipment at the Michoud Assembly Facility, Mississippi Test Facility, Marshall Space Flight Center, and Kennedy Space Center. Turn-around equipment is defined as those major items of equipment, regardless of complexity, that are reused in the assembly, handling, testing, and transporting of S-IC stages. Revision "A" to D5-13595, released on July 25, 1966: 1) included changes in the transporter utilization due to additional requirements with the S-IC-F; and 2) revised the transportation summary to reflect the use of Shuttle Barge #2 to support the S-IC-3. Revision "B", released on December 15, 1966, was a complete revision to reflect the project planning that was current at that time.

Document D5-12226, "S-IC Stage Reorder Leadtime Requirements," outlined the schedule flowtime requirements necessary to support follow-on stage production (standard leadtime requirements for any block of stages). Revision "A" to D5-12226, released June 22, 1966, incorporated leadtime information which was not previously available. Revision "B", released August 18, 1966, depicted a Reorder Baseline Schedule Chart outlining S-IC stage reorder leadtime requirements based upon idealistic planning factors such as the ready availability of raw materials and machine tool capacity to support fabrication efforts. Revision "C", released March 21, 1967, completely revised the document in order to reflect current long lead item flowtime requirements and resultant S-IC reorder leadtime requirements. Due to the rapidly changing program variables associated with follow-on procurement and production, D5-12226 no longer will be maintained. All future leadtime data will be developed on a case by case basis.

PROJECT PLAN

Document D5-11960, "S-IC Stage Project Management Plan," presents a summary view of the organization, planning, and methods used by the Boeing Launch Systems Branch to provide the most effective means of completing the S-IC project within the schedule and cost goals established by Contract NAS8-5608, Schedule I.

The contractually required semi-annual updating of D5-11960 was completed with the release of Revision "C" on September 30, 1966. Revision "D", also a semi-annual update, is being prepared for final distribution at the end of the reporting period. This revision will expand the scope of the project plan to include the additional production of stages S-IC-11 through S-IC-15, authorized by Contract NAS8-5608, Schedule IA.

PROGRAM ASSESSMENT AND PERT SYSTEM

The Saturn V/S-IC Launch Systems Branch Program Assessment Report, issued bi-weekly, presents milestone status measured against the currently approved plan. Critical path analysis and schedule outlook trend charts comprise the major portion of the report. Pacing items are identified by the PERT system. Reports D5-12749-52 through -73 were issued during FY 1967.

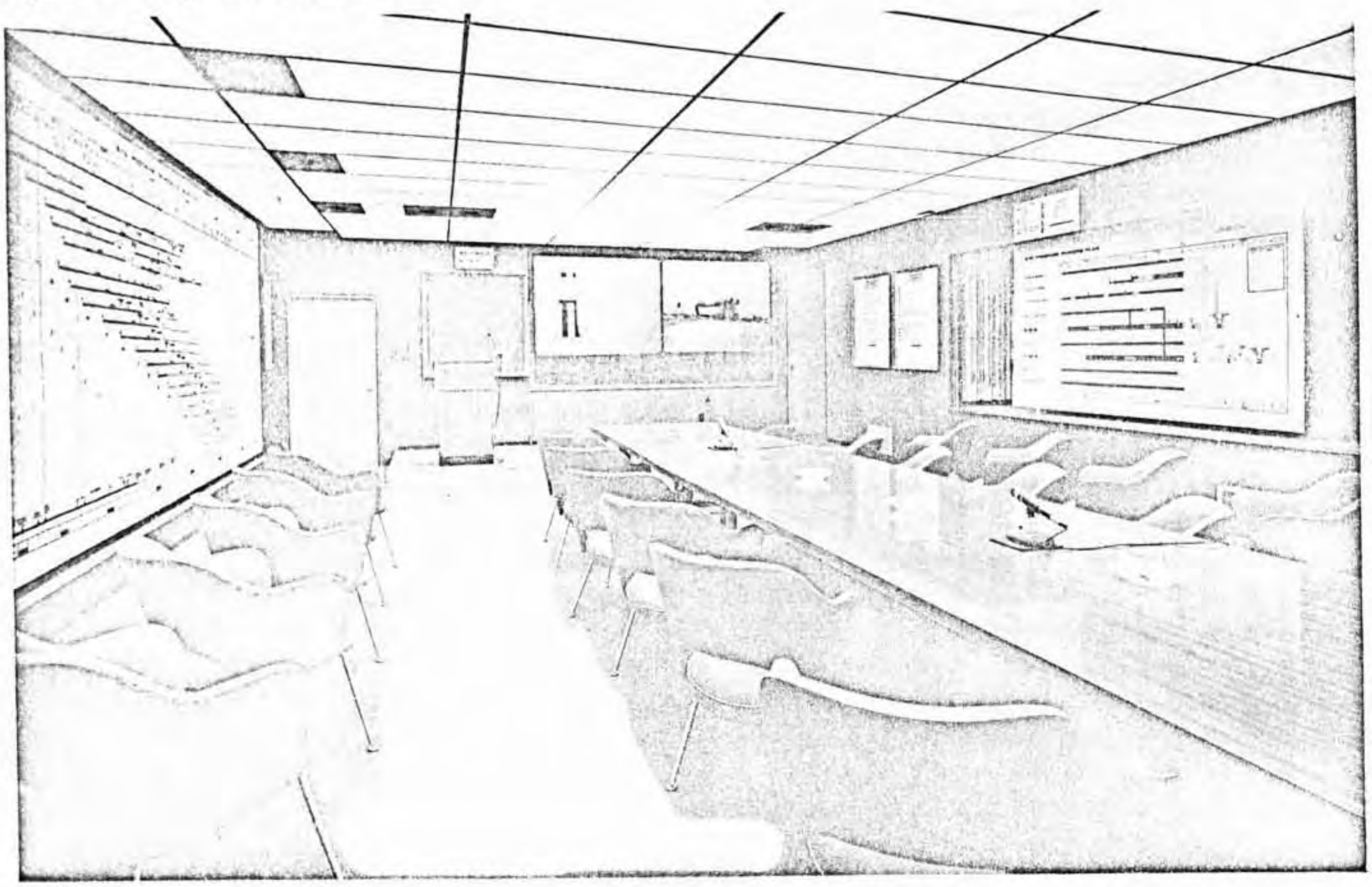
During the past year, the system for controlling and reporting change management action has been successfully functioning within the S-IC PERT system. The PERT system now covers Schedule I and IA.

MANAGEMENT CONTROL CENTERS

The Boeing Program Control Center (PCC), located at the Michoud Assembly Facility, is designed to aid the management decision-making process by providing current visibility on all aspects of the S-IC program. See Figure 1-1. During FY 1967, the PCC underwent a variety of modifications designed to place increased emphasis on technical data, schedule visibility, improved display techniques, and detailed technical problem analysis.

The Boeing Management Information Center was established at Michoud during the past year. Its purpose is to aid Boeing/Michoud management in the identification, evaluation, and analysis of organizational and resource utilization problems. Detailed information aids management decisions relative to the organizational structure and manpower required to accomplish the S-IC program in an efficient and effective manner.

Figure 1-1 Program Control Center



MANAGEMENT REVIEWS

A revision of customer requirements has reduced the number of S-IC quarterly reviews from four per year to three. Further, as the S-IC program evolves from design and development to production and delivery, and, as launch dates approach, the customer has requested that the reviews be held not only at Michoud, but also at KSC, MSFC, and MTF. The 17th S-IC Technical Progress and Program Review was held at the Kennedy Space Center.

The three FY 1967 S-IC management reviews covered Boeing's progress and performance on Contract NAS8-5608, Schedule I, with NASA, Rocketdyne, and Boeing represented. The 15th S-IC Technical Progress and Program Review was conducted at Michoud on July 27, 1966, and reviewed the status of S-IC stages and related activities including the Michoud Test Data Center and specific S-IC technical problems involving qualification testing and structural testing.

The 16th Technical Progress and Program Review was held at Michoud on November 15, 1966, and concentrated on design assurance, production and test assurance, and evaluation of S-IC stages. Technical problem reviews covered the qualification test program, interface control documentation status and CEI specifications vs. design drawings.

The 17th Technical Progress and Program Review, held at KSC on March 16, 1967, concentrated on a critical evaluation of the S-IC-1 stage; including configuration status, test programs, product performance assurance, and a detailed review of technical problems and their proposed solutions. Also discussed was a brief summary of the status of S-IC-2 through S-IC-15 stages.

CONFIGURATION MANAGEMENT

During FY 1967, configuration management activities were highlighted by the following actions:

a) To comply with the intent of NPC-500-1, Boeing and NASA updated and revised IN-I-V-S-IC-65-8 to cover the Class II type changes affecting Part II CEI Specification for stages S-IC-1 through S-IC-10;

b) The requirement to implement a retrofit procedure to support changes to delivered CEI's was undertaken and completed in time to support the S-IC-1 stage delivery to KSC;

c) Stages S-IC-11 through -15 were placed on contract resulting in the issuance of IN-I-V-S-IC-66-7 and 66-8 on September 15, 1966, to cover the change procedures and configuration control for these stages; and

d) As directed by MICH-448, The Boeing Company incorporated certain retrofit changes into the S-IC-3 stage during storage at Michoud. As a result, these changes were recommitted to install at Michoud prior to delivery of the stage to KSC.

Major configuration management activities and milestones which were accomplished during the fiscal year are:

REVISIONS TO IN-I-V-S-IC-65-8

The Part II CEI Specification was placed on contract resulting in one major revision to IN-I-V-S-IC-65-8. This revision provided for utilization of the Miscellaneous Engineering Change Proposal (MECP) to transmit to the procuring agency all Class II type PRR's affecting the PART II CEI Specification.

REVISIONS TO IN-I-V-S-IC-65-7

The modification instructions used with each retrofit kit were revised to include the estimated total manhours required to install all the retrofit kits of that change against any one CEI for stages and any one total GSE effectivity, i.e., LUT 1, etc. The Incorporation Notice Card (INC) section was revised to require the technician installing the retrofit kit to enter the estimated time he required to install the change.

IMPLEMENTATION OF IN-I-V-S-IC-66-7 AND 66-8

These procedures were implemented prior to the actual receipt of the contract for stages S-IC-11 through S-IC-15 to provide timely configuration management for these stages. Stages S-IC-11 through S-IC-15 are covered by a single CEI Specification but are singularly identified by their CEI number. No problems were encountered in implementing these procedures but certain revisions will be required prior to implementation of retrofit procedures which may be similar to those accomplished in IN-I-V-S-IC-65-7.

IMPLEMENTATION OF RETROFIT KIT PROCEDURES

The retrofit kit procedures are defined in IN-I-V-S-IC-65-7 and 65-8 for stages up to and including

S-IC-10 as well as the associated deliverable GSE. These procedures are explicitly defined for implementation Branch-wise by D5-12980-1, "S-IC Change Processing System Manual". The Accounting and Statistical records are defined in D5-12980-3, "S-IC Configuration and Change Accounting System". The reports defined in D5-12980-3 are contractual and are identified as CM-501, "S-IC Configuration Report" and CM-502, "S-IC ECP Status Report." These reports cover the entire configuration management field from the inception of the ECP to the final installation of retrofit by the agency responsible for installation. Every effort is made at the time of commitment to minimize the impact of these changes on KSC-BATC in order to protect the scheduled roll-out dates of these vehicles. No serious problems were encountered in implementing these procedures. To insure the acceptability of retrofit kit dates to BATC, a BATC configuration management representative is always present at the S-IC Change Board to coordinate the commitments at BATC.

STATUS OF FACI

The First Article Configuration Inspection (FACI) was accomplished February 22, 1967, on S-IC-3 per the requirements set forth in IN-I-V-S-IC-65-7. (See page 58.)

Since the implementation of the retrofit procedures, the following numbers of retrofit kits have been installed at KSC, MSFC, and MAF (as of June 29, 1967):

29 — Changes have been installed on S-IC-1
19 — Changes have been installed on LUT 1
6 — Changes have been installed on S-IC-2
9 — Changes have been installed on LUT 2
10 — Changes have been installed on S-IC-3

EQUIPMENT MANAGEMENT

During FY 1966, the Equipment Management Organization (EMO) was consolidated and realigned. This realignment resulted in the following detailed studies and audits being performed on EMO functions and responsibilities:

a) A review of NAS8-5608, GFP, GFP stores, and GFP status documentation was conducted. To resolve deficiencies that the audit revealed, the following corrective action was taken. EMO made a complete review of Document D5-11044-1, "Government Furnished Property and Services," and this document was updated and revisions released May 9, 1967;

b) To insure close coordination between EMO and Production Control Area (PCA) stores 532, form 1910-M-20, "GFP Parts Request," was initiated. This form is utilized in the control of rejected, replaced, and relocated government equipment; and

c) To eliminate contradiction between D5-11044-1 and IN-I-V-S-IC-66-1 "NASA GFP Document," a review was made by the Equipment Control Board. A decision was made to cancel D5-11044-1 and make IN-I-V-S-IC-66-1 an all-inclusive GFP document. The contract document will contain all firm, preliminary, and loan (NAS8-5608) government equipment and will be sectionalized and color-coded so that categories of equipment can easily be identified.

   To insure inclusion of pertinent information, review pages will be released as status changes. The release of the all-inclusive GFP document is anticipated in early July of 1967.

A review of Document D5-12888, "Master Equipment List," and its associated documents was conducted. The purpose of this study was to determine document need, use, and distribution requirements. As a result of this study, the publication of the Master Equipment List and Addition, Deletion, and Revision (ADR) report was reduced to monthly; and distribution was reduced by 20 percent.

The Make or Buy committee released three plans during FY 1966. Document D5-13627, the Make or Buy Plan for stages S-IC-11 through S-IC-15 was released by the Make or Buy committee June 6, 1966. NASA concurrence with this plan was obtained on September 23, 1966.

COST IMPROVEMENT

Emphasis was placed on cost effectiveness by all levels of management during this reporting period. Each major organization employed part or full time cost improvement coordinators as required. During the first half of this period, a total savings of $20,580,000 was logged; this represented 552 cost improvement reports. For the second half, a total of $11,849,000 has been saved and recorded on 490 reports.

ZERO DEFECTS PROGRAM

A change of emphasis from group to individual recognition was made during this reporting period. Each organization was directed to implement a zero defects program tailored to fit the individual characteristics of that organization. This was accomplished throughout Michoud. Awards in the form of lapel pins, pen and pencil sets, and slide rules have been used with very satisfactory results. The objectives are to create a zero defects attitude and to reduce costs by giving recognition to those employees who have performed in an outstanding manner.

INDUSTRIAL MANAGEMENT

HEALTH AND SAFETY

EXECUTIVE SAFETY COUNCIL

The S-IC Executive Safety Council continued to coordinate safety management efforts and provide uniform guidance of safety programs at Michoud and MTF. Significant accomplishments during the fiscal year included:

a) Perfecting of the concept of a test conductor being responsible for all safety aspects of a test operation;

b) Improvement of the "flash" accident reporting system by extending it to all locations and covering hardware damage accidents as well as personnel injuries;

c) A survey of all material handling operations to identify critical operations and require certain inspection, proof load and safety monitoring functions;

d) An evaluation of emergency procedures for facility utility outages of all types;

e) Participation in a systems safety survey covering manufacturing and test functions and critical S-IC stage components; and

f) Initiation of a pilot program to improve hardware and property damage reporting systems so that a more extensive damage prevention program can be instituted.

MICHOUD SAFETY COUNCIL

The Michoud Safety Council coordinated the operating details of the safety programs for the manufacturing, test, and support organizations at the Michoud Assembly Facility. The active participation of all line organizations, during a period when manufacturing and test activities were at their highest level since the program began, has kept accidents at a minimum.

The Michoud Safety Council approved changes in the 1967 Monthly Safety Contest rules to increase emphasis on personal injury and safety training. Much interest and competition has developed in the contest. The council is supporting a training program for safety monitors and supervisors. The four-hour course, given on the average of once each month, has been well received.

LINE CONTROL SAFETY PROGRAM SUPPORT

Health and Safety began an extensive safety training program known as the Line Control Program. A safety monitor/supervisor training course was implemented. The safety advisor concentrated efforts on safety crew meetings and assisted the supervisors in establishing frequent sessions with their crews. Future exposure to training plans calls for a series of safety instructions for all types of industrial hazards as well as company policy and command media.

The Supervisor's Safety Guide is being revised to include additional information such as that found in "Saturn Safety Data Sheets" that should be readily available to the first line supervisor. Over all, the Line Control Program is functioning well. Checklists are being completed, area inspections are being made by supervision, crew meetings are held frequently, and the councils are active.

SAFETY ENGINEERING

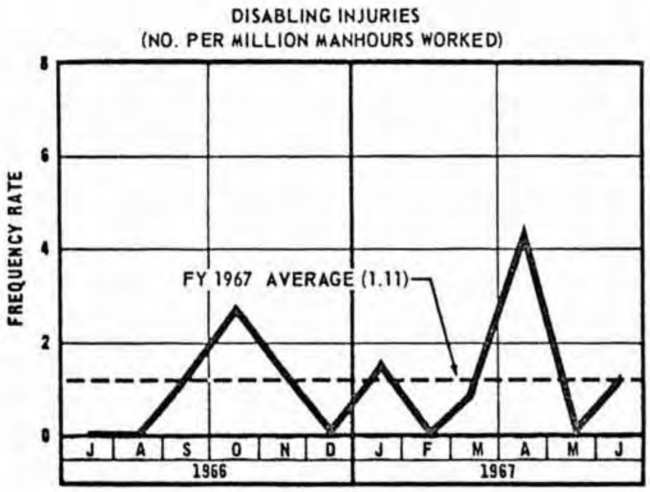
The in-depth safety audit program originated in FY 66 has continued into FY 67 and has proven to be an excellent means of providing and improving support to the shop safety organizations. The present schedule of one audit per month will be changed to two audits per month during FY 68 to further improve support to the shop safety organizations.

Additional emphasis has been placed on broader application and use of safety engineering data developed in accident and property damage investigations. Formal loss prevention programs include: handling fixture maintenance and control; in-plant mobile equipment inspection, maintenance, and operator certification; employee safety instruction and applicable certification training; and manufacturing or test procedure preparation and review.

Safety engineering hazard analysis and design reviews have been maintained for changes in manufacturing processes, machine tool acquisitions, and facility modifications. Newly acquired heavy machine tools requiring special attention in the design and provision of safeguards were the Y-ring boring mill, skin mill, and numerical control mill.

SAFETY ADMINISTRATION

There were 1,625 reported injuries in FY 1967 compared to 2,384 reported injuries in 1966. Health and Safety processed 127 workmen's compensation claims in FY 1967, 10 of which were disabling injuries. This compares to 150 workmen's compensation claims processed in FY 1966, six of which were disabling injuries. The monthly rates of injuries per million man-hours worked are presented in Figure 1-2.



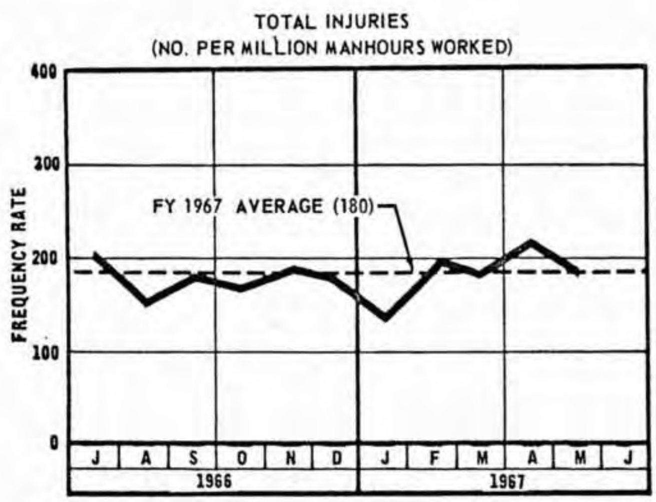


Figure 1-2 Reported Injuries in FY 1967

The statistical injury indices for fiscal 1967 may be compared to the previous years' results in the following table:

	FY 1967	FY 1966
Reported total injury frequency rate*	180	206
Disabling injury frequency rate	1.11	0.62
Disabling injury severity rate	18.2	11.1
Workmen's Compensation claim rate	14.0	14.0

*All rates are per million manhours worked.

It can be noted that the frequency rate of total injuries declined for FY 1967 below the rate of FY 1966. However, the opposite occurred in the case of the disabling accident frequency rate which experienced an increase over FY 1966. While the FY 1967 disabling injury rate of 1.11 is well below the Aerospace Industry average of 2.0, concentrated effort will be made to lower this rate to or below the level that was reached in FY 1966. The rate of injuries which resulted in workmen's compensation claims remained constant over the previous two fiscal years.

INDUSTRIAL HYGIENE AND RADIATION SAFETY

A summary of radiation exposure levels for FY 67 for several groups of radiation workers is given below:

Number of radiation workers on program	50
Average exposure to all radiation workers (mrem)	14
Average exposure to all Quality radiographers (mrem)	19
Average of Health and Safety monitors (mrem)	50

The maximum allowable dose of radiation as stated in the Atomic Energy Act, Code of Federal Regulations, Title 10, Part 20, is 5,000 millirem per year. The employees on the radiation control program are engaged in x-raying of welds, electron beam welding, laboratory work radiation monitoring, and instrument calibration.

An in-depth industrial hygiene survey was made on the Y-ring welding operation. The results of the survey showed that the exhaust ventilation system originally installed at this location is inadequate in keeping the concentration of toxic welding gases below the safe working level. The use of supplied air respirators was prescribed as a temporary corrective measure. The shielding of the welding torch was recommended as a permanent correction to the problem. The use of a shield will not only reduce the amount of ozone generated by the welding process, but also will improve the ventilation flow pattern of the present exhaust system.

MICHOUD CENTRAL SAFETY BOARD

This board plans and coordinates phases of the safety program in conjunction with NASA and the prime contractors at the MAF. A Mission Safety 70 campaign for July 1966 was organized by the board to extend to all contractors at MAF. Boeing participated by purchasing 5,000 employee pass-out booklets entitled "The Road to Safety". Boeing also purchased the Mission Safety 70 poster sets and posted these on our safety bulletin boards monthly throughout the year. Boeing again will participate in the 1967 July campaign.

The board surveyed each prime contractor's traffic safety program in an effort to promote better plant-wide traffic safety. As a result, Boeing is in the process of writing new command media covering plant traffic regulations. The company also is taking steps to improve our licensing procedures for our material handling people, in regard to both testing methods and record keeping.

PARTICIPATION IN LOCAL INDUSTRIAL HYGIENE AND SAFETY EFFORTS

Promotion of industrial hygiene training in the local area has been actively pursued. In August, a one-week course, "Orientation in Occupational Health", was presented in New Orleans jointly by the Louisiana State Board of Health and the United States Public Health Service. The Boeing manufacturing area was chosen for the course "field trip" through a manufacturing operation. Several presentations by Boeing personnel were made to the group.

Assistance has been given to Tulane University and Delgado College in their efforts to bring industrial hygiene course work into their curriculums. Tulane University presently offers a graduate level course in industrial hygiene through the Department of Civil Engineering. Health and Safety staff members gave several lectures to the group, and a survey of the Boeing manufacturing area was used as a field trip for the students in the course.

Two members of the Health and Safety staff serve as president and secretary-treasurer of the local section of the American Industrial Hygiene Association. One member serves as a director of the local section of the American Health Physics Association. Two members serve as secretary and program chairman in the New Orleans Chapter of the American Society of Safety Engineers.

MISSISSIPPI TEST FACILITY HEALTH AND SAFETY

In an effort to maintain a high degree of safety in the S-IC test complex, the Corps of Engineers, NASA, General Electric, and Boeing safety personnel conducted periodic safety meetings for all employees during activation of the complex. Coordination for such activities is maintained through the MTF Site Safety Council.

During the reporting period, Boeing/MTF worked a total of 974,619 manhours without a lost-time injury. During the fiscal year, there were only 12 workmen's compensation claims and 63 minor injuries.

Safety engineering completed a hazard analysis of the high pressure gas systems and several analyses of the expected conditions during an S-IC stage catastrophic event. The results of the studies have been used as the basis for access control procedures. Similar analyses are being conducted on the propellant, crane, and derrick systems.

Twenty-five of the 33 systems and facility activation tests were monitored and supported. The other eight tests presented no hazards. Surveillance and support were provided for the S-IC-T and S-IC-4 stage installation and removal, propellant load, and static firing tests. Safety criteria for personnel exposure was provided and implemented into test procedures.

The Boeing/MTF Line Safety Program (see Line Control Safety Program Support, Page 7) was fully implemented. The training program for area safety supervisors and area safety monitors was updated. The Boeing/MTF Safety Council met monthly to assure compliance with the Systems Test-MTF Safety Plan. Arrangements were made with the support contractor fire department to provide emergency and fire brigade training. To date 23 safety monitors and other key personnel have been trained.

SECURITY

Proper security of all classified data, material, and hardware was maintained during FY 1967. Security inspections of the Boeing portions of the Michoud Assembly Facility were conducted in August and December of 1966 and April 1967, by NASA/MSFC representatives. A security inspection of the Boeing portion of MTF was conducted in December 1966 and April 1967. Each of these inspections indicated that Boeing security procedures and Industrial Security Manual compliance are satisfactory. Continuing security surveillance revealed no security violations during the fiscal year.

Measures were taken in January 1967 to improve the control of access to the Vertical Assembly Building during the critical lifts of the S-IC stage into the vertical position. Special badges are provided only to those personnel who have specific operations to perform during the operation. Support Services security guards monitor the area during the operation to ensure that only those employees wearing the special badges are present.

Methods of ensuring S-IC stage security at MTF were developed during FY 1967. While a stage is at MTF, access to it is controlled by Boeing personnel or Support Services security guards at all times.

A security education program was given to the 174 employees who have access to classified material. Security clearances were granted to 933 employees during the fiscal year.

Personnel in critical areas received training in fire fighting and fire prevention during January 1967. Fire inspections are routinely conducted to reduce the probability of a fire to a minimum.

Boeing/Michoud was nominated for the Cogswell Industrial Security Award by the Dallas Defense Contract Administration Services Region, Dallas, Texas. This award was established in May 1966, to encourage the achievement of a superior degree of excellence of industrial security posture by United States contractors participating in the Defense Industrial Security Program.

PERSONNEL

MANPOWER

Launch Systems Branch manpower was reduced by 1,826 employees during FY 1967. Of this total, Michoud employment decreased by 974 employees. Following is a payroll comparison:

Payroll	Total LSB		
	6-30-66	6-29-67	Net Change
Hourly	1,820	1,737	- 83
General Office	4,508	3,572	-936
Prof/Tech	2,533	2,046	-487
Supervisory	1,179	875	-304
Office Exempt	177	161	- 16
Total	10,217	8,391	-1,826

Payroll	Total Michoud		
	6-30-66	6-29-67	Net Change
Hourly	1,628	1,607	- 21
General Office	2,513	2,023	-490
Prof/Tech	1,146	850	-296
Supervisory	677	508	-169
Office Exempt	97	99	+ 2
Total	6,061	5,087	-974

Of the LSB total of 8,391 as of June 29, 1967, 6,537 employees were new hires and 1,859 were transfers from within The Boeing Company. At the same time, 3,982 of the Michoud total were new hires and 1,105 were transfers.

TRAINING

Paid-time training increased during FY 1967. In FY 1966, 5,135 employees completed 629 paid-time training classes, and in FY 1967 8,560 employees completed 1,182 classes.

Of the 8,560 employees who received paid-time training during FY 1967, 1,698 completed 334 classes of certification training, 817 completed 326 re-certification classes and 6,045 completed 522 skills, systems, and management courses.

A machinists' training program was activated for machine operators. Of the 48 employees completing the program, 23 were instructed in lathe operation, 21 in mill operation, and four in drill press operation.

A soldering re-certification program to comply with the requirements of NPC 200-4 and 60B32063, Quality Requirements for Hand Soldering of Electrical Connections, was initiated September 1, 1966, and completed December 31, 1967. There were 151 employees re-certified from MSFC-PROC-158M to NPC 200-4.

MTF training requirements have been supported on a continuing basis. Major emphasis has been placed on certification and re-certification training programs in support of critical operations for S-IC stage testing.

A steadily declining work force caused a reduction in number of employees participating in off-hour training programs. During the fiscal year, 883 employees completed 82 courses.

Attendance at technical sessions, seminars, and symposiums increased during the fiscal year. In FY 1967 341 employees attended technical sessions, seminars and symposiums. During FY 1966, 236 attended similar sessions.

MANAGEMENT DEVELOPMENT PROGRAM

Five off-hour management courses were conducted for Boeing employees by the Boeing/Michoud training organization. One hundred and twenty-four employees attended these courses. Three Boeing/Michoud managers attended the company-sponsored Fundamentals of Management Course offered in Seattle; two attended the Louisiana State University-Baton Rouge Mid-South Executive Development Program; one attended the Spring Hill University Executive Development Program; and 144 attended a one-day program on motivation presented in New Orleans by Professor Hertzberg, Western Reserve University. (The one-day program was presented twice, with 104 attending the November 1966 session and 40 attending the April 1967 session.)

GRADUATE STUDY PROGRAM

As a result of the Boeing Graduate Study Program, 26 employees will receive their Masters degrees at the end of the summer term in 1967. In addition, 94 employees took 496 credit hours during the fall semester of 1966, and 78 employees enrolled in 421 credit hours for the spring semester of 1967.

UNDERGRADUATE STUDY PROGRAM

In September 1966, a Boeing Undergraduate Study Program was initiated. This program is designed to encourage employees who do not have college degrees to pursue studies which will enhance their value to the S-IC program. This program resulted in 51 employees enrolling in 293 credit hours for the fall semester of 1966, and 56 employees who enrolled in 324 credit hours for the spring semester of 1967.

PLANS FOR PROGRESS AND EQUAL EMPLOYMENT OPPORTUNITY PROGRAMS

The Contracts Compliance Office of the Department of Defense Equal Employment Opportunity Office conducted an audit of the Boeing Michoud Assembly Facility and Mississippi Test Facility Equal Employment Opportunity Program in August, 1966. All areas of personnel administration were covered, including employment, training, hourly payroll administration and recruiting. A follow-up audit of the Michoud Assembly Facility and the Mississippi Test Facility was conducted in October, 1966. The Boeing Equal Employment Opportunity Program was approved by this audit.

Administrative Procedure 580, entitled "Administration of Discipline," has been revised and published. The procedure is designed to ensure the consistent administration of discipline.

A Standard Operating Instruction, "Employee Complaints", has been developed and is being used to provide uniform methods of documenting and handling employee complaints.

A comprehensive briefing program initiated to ensure each supervisor's familiarity with The Boeing Company's Plan for Progress was completed. The one-and-a-half hour briefing was given to 543 supervisors during 40 classroom sessions.

A summer orientation program for high school counselors was sponsored by the New Orleans Voluntary Equal Employment Opportunity Council. The Boeing Company participated as a member of the Aerospace Electronic Panel.

An unusual training opportunity became available for a number of Negro employees in August 1966. A basic machine operator training course was established to train lathe, mill, and drill press operators. These positions are typically filled by the non-Negro labor force in the deep south. Twenty non-Negro and twelve Negroes successfully completed the program.

A college orientation team visited eight minority colleges in Mississippi during December 1966 to acquaint students and faculty with Boeing employment and advancement opportunities in the Southeastern area. In February 1967, 30 data processing students from the Sullivan Vocational Technical Institute were given a tour of the Michoud Assembly Facility including the data processing and computer areas. And, in April 1967 a tour of Michoud was given to 12 senior girls from the secretarial class of Southeastern Louisiana College.

During the reporting period, a member of Boeing Management served as President of the New Orleans Voluntary Equal Employment Opportunity Council. Boeing management was also represented on the boards of the following organizations: (1) New Orleans Social Welfare Planning Council - the planning arm of the United Fund; (2) The Community Relations Council - a biracial group affiliated with State and National Community Relations Council Organizations; (3) The City Department of Public Welfare; (4) The Citizens Advisory Committee to the Southwest Educational Development Laboratory - a committee organized to resolve problems on intercultural education related to Negro and South American minorities; and, (5) The Urban League of New Orleans.

INFORMATION MANAGEMENT

During the past year the former Engineering Applied Mathematics organization, which provided computer support to engineering, was transferred to the Management Services organization which, in turn, was re-designated Information Management. This organizational realignment was established in order to provide a common administration of computing requirements and a more effective utilization of the systems and data processing resources existing in the two organizations, and, to provide a single point of interface with NASA relative to Boeing computing requirements.

BUSINESS INFORMATION AND SUPPORT SERVICES

COMMUNICATIONS

During FY 1967, cost and equipment reductions were made in telephone communications as follows:

a) Commercial toll calls - There was a 63 percent decrease in toll calls at a cost reduction of $35,000 during the first three quarters.

b) Main lines and instruments - During the first 11 months of the fiscal year, 178 main lines were dropped and instruments were reduced by 389, a decrease of 10 percent and 14 percent, respectively.

c) Speakerphones - Speakerphone installations were reduced 16 percent.

A Boeing point-to-point teletype system was installed in the Logistics Engineering organization for an interim period until the third generation computer system is completed. This teletype system connects Boeing/Michoud directly with the Boeing Atlantic Test Center and Boeing offices at the MTF.

The total cost of communications allocated to The Boeing Company through May 1967 was $793,653.

RECORDS MANAGEMENT

The 27th shipment of vital records was sent to Seattle on April 20, 1967, for underground storage in event of a disaster.

The Engineering Library Classified Control Station and the Records Management Classified Control Station were combined during the reporting period. This consolidation eliminated much duplication of paperwork and provided more timely service with no increase in manpower. This change was made as the result of an employee suggestion received by the Boeing/Michoud Suggestion System.

During FY 1967, a total of 2,275 cubic feet of records was received in the Records Storage Center. This consisted of 1,750 cartons of material. Based on a cost standard prepared on March 1, 1967, by the Seattle Records and Release Group, cost of storing records in an office area is $2.62 per cubit foot while it costs only $.27 per cubic foot to store them in the Records Storage Center. At a savings of $2.35 per cubic foot, the records submitted to the storage center during FY 1967 produced a net savings of $5,346.25.

As of March 1967, vellum copies of documentation were eliminated to further help cut costs of the support services contractor.

Zero Defects awards were recently presented to the Classified Control Station employees for over two years of work in the station without a security violation. NASA and Air Force security officials have highly complimented these employees for their excellent records.

DOCUMENT CONTROL

The Launch Systems Branch Document Control System continued its cost effective operations during this reporting period and generated significant cost savings. Certain identified savings derived from documents cancelled during preparation were determined valid by both Boeing and NASA/MSFC. These have not been determined as yet by NASA headquarters to be cost savings.

In order to attain a fundamental objective of having complete accountability of branch generated documents, a major effort has been directed toward standardizing the configuration and identification of all documents to conform to the system defined in Administrative Procedure 101, "Document Control Program". Particular attention is being given to those documents which are contract requirements.

In keeping with economy features of document production, a form plate was obtained for insertion in the SC4020 computer printer. This plate permits the one-step printout of Boeing document format reproducible masters directly from the computer together with test data grid plots. Several documents are now prepared by this means. Clerical cost savings and improved efficiency in making data transmittals to NASA were also obtained through the development of Boeing form "Data Transmittal and Document Information Record" which also includes features of the MSFC Document Information Record.

Emphasis has been placed on limiting document distribution since the inception of the document control system. The results of a recent survey shows that average document distribution has been reduced by more than 45 percent. This reduction is compatible with NASA goals related to reproduction effort by the support services contractor.

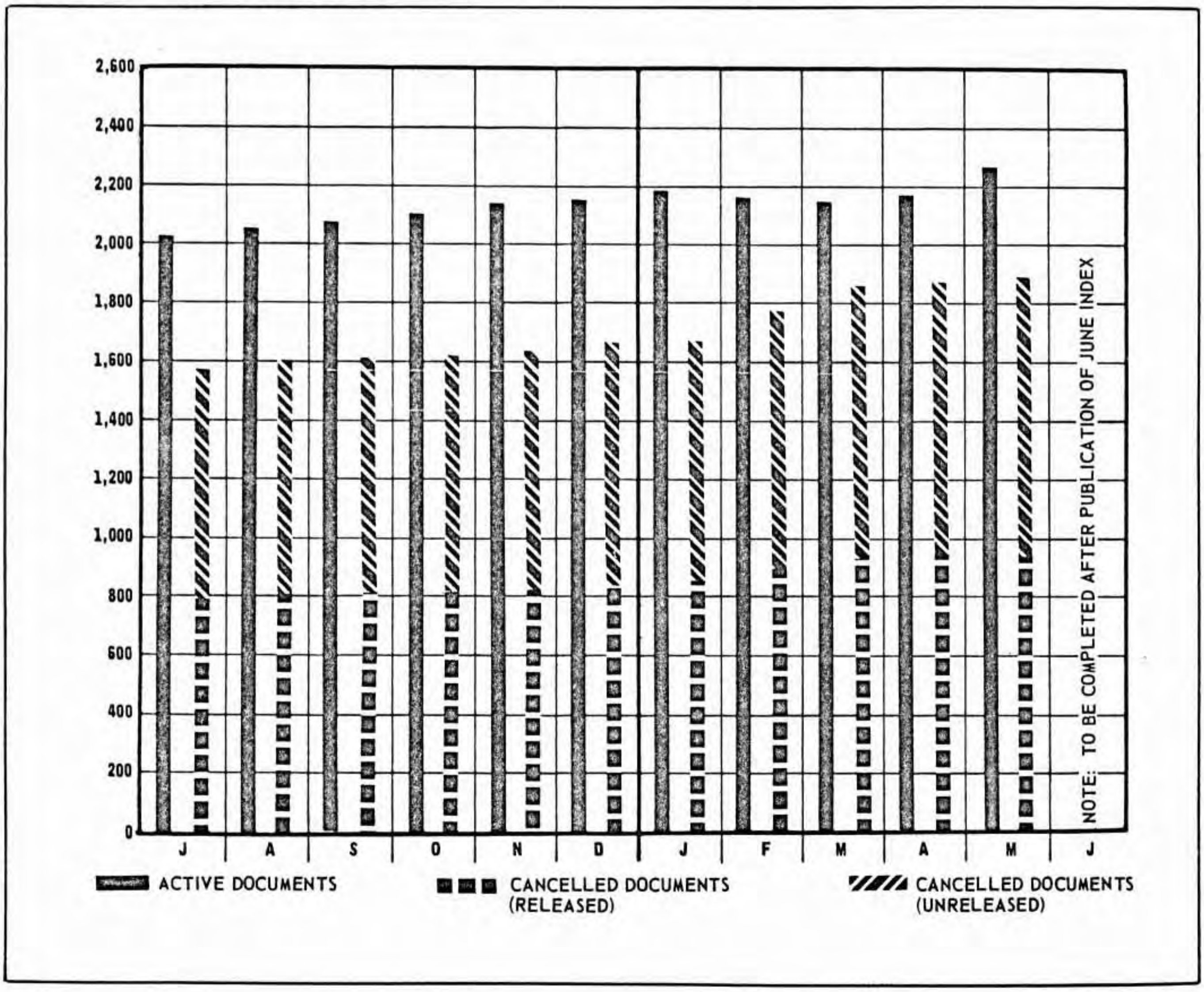
A review of document activity during the reporting period, as reflected in Figure 1-3, indicates that, through constant management, active documents have increased approximately 10 percent and cancellation has kept pace with program requirements.

At the close of the year, progress was being made toward strengthening the document control system by re-emphasizing fundamental concepts and more clearly establishing authority and responsibility.

FORMS MANAGEMENT

The Launch Systems Branch business forms management system, which was implemented in April 1966 and reported upon in the last annual report, was operational throughout the past year. Through organizational realignment in September 1966, the Forms Store was consolidated with other forms management functions and all activity is now the responsibility of one organization. By the centralized control of forms, problem areas at Michoud have been significantly reduced during the past year.

Figure 1-3 Document Activity During FY 1967



Also, by close inventory and issue control, stocks held in the Forms Store have been reduced by approximately 50 percent and better judgment is now exercised over the frequency of re-orders.

These activities have led to a reduction of the support services contractor reproduction burden which, in turn, has contributed to substantial cost savings. Internally, the Forms Store has operated on a Zero Defects basis in that, under the present organizational control, there has been no out-of-stock item during the last nine months and no emergency order was necessary to support requirements.

GOVERNMENT FURNISHED SUPPORT SERVICES

A major effort was made during the past year by the government and the prime contractors to reduce the cost of support services. A Support Services Committee was established and is currently meeting once a month. Actions have been taken by the Support Services Contractor to reduce headcount and modernize equipment in an effort to reduce overall support costs.

The FY 1967 budget for support services (less computer operations) for The Boeing Company is \$8,350,000 as compared to \$9,050,000 for FY 1966. Actual expenditures, if extended through June 1967 at the present rate, will approximate \$7,850,000, a cost reduction of \$1,200,000 or approximately 13 percent.

DATA PROCESSING

During FY 1967, Boeing upgraded the equipment devoted to unit record processing efforts. This action resulted in the installation of advanced equipment that increased capabilities while reducing equipment rental expenditures.

Several major advanced mechanized systems achievements were accomplished during FY 1967. Among these is a mechanized Data Collection System which permits the instantaneous collection and reporting of Payroll and Labor Distribution information and will make possible total Material Management and Manufacturing Production Status Systems. This equipment will eventually tie into the centralized computing facility at the Michoud Computer Operations Office providing on line real-time capabilities for existing and future efforts.

Mechanized Optical Scanning equipment was installed in June 1967. This equipment permits photo-electric reading and editing of source documents and produces machine readable media. As a result of this effort, several steps in data flow are eliminated, accuracy and timeliness of reporting is greatly improved, and the cost of operation is reduced. This is a further realization of the total Information Management Plan.

AS-BUILT SYSTEMS

Development of a Mechanized Configuration Control System was begun in August 1966. This system will portray the as-built configuration of any vehicle. This will provide Quality and Reliability Assurance with overall configuration management in support of deliveries, as well as data for prelaunch readiness reviews.

COST MANAGEMENT SYSTEM

The Mechanized Financial Management System has been implemented. This system provides a graphic display of the correlation between our actual financial performance and our planned financial performance. The system has been highly successful in providing management with accurate, timely reports on our financial position thus permitting remedial action to be initiated at the earliest indication of deviation from plan.

SYSTEMS ADVANCEMENT

The payroll system was modified to generate hourly and salary paychecks on common check forms during the same process. This process has resulted in considerable machine and manhour savings in preparing and distributing payroll data. The labor distribution system was modified during this fiscal year to perform a computerized redistribution of direct distributable work orders.

THIRD GENERATION CONVERSION

The initial conversion to third generation computer equipment began in August 1966. The first application was the S-IC Engineering Release Documentation System. Prior to receiving a Univac 1108 Mod I, locally, all conversion activity was conducted at Houston and Goddard Space Flight Center. Conversion activities commenced on-site in November 1966.

The following systems are now being processed on the Univac 1108: S-IC engineering release documentation, Saturn personnel accounting reporting, plant services maintenance reporting, and parts requirements.

The government furnished third-generation equipment conversion was originally scheduled to be completed in June 1967. This date has been extended to February 1968 to enable many applications to be redesigned for initial processing on third generation computer equipment.

AUTOMATED SYSTEMS DEVELOPMENT

AUTOMATED BOEING CALIBRATION DATA (ABCD)

During this fiscal year, all 25 ABCD computer program documents were released and the system, comprised of 35,000 Fortran IV statements and 15,000 Macro Assembly Program (MAP) instructions, was turned over to computer operations personnel for production processing. In addition, over 75 separate revisions were made to this programming system to provide more computer verification of input data, to reduce both computer and flow time, to handle standardized calibration data input to produce additional reports for feedback of design and configuration data, and to produce the Apollo/Saturn Calibration Tape (A/SCT) for delivery to MTF and KSC.

FLIGHT EVALUATION - COMPUTER SUPPORT SYSTEM

A major system of computer programs was developed, primarily during FY 1967, to support S-IC flight evaluation. A portion of this system supports S-IC static test evaluation. The system, designed for flexibility and speed of operation, includes the capabilities to provide:

a) Plots and lists of calibrated S-IC telemetry measurements;

b) Plots and lists of calibrated telemetry data from other Saturn V stages and other flight related data from KSC;

c) Telemetry data in MSFC standard telemetry data format for delivery to MSFC and other Saturn contractors;

d) Aperture cards for the Boeing Test Data Center;

e) Data conditioning by selection from a variety of data smoothing and filtering techniques; and

f) Graphical and tabular display of computed or reformatted S-IC stage data from measured conditioned data input automatically and/or from data input manually.

THIRD GENERATION COMPUTER UTILIZATION DEVELOPMENT

The advent of third generation computing equipment has prompted development in two new areas: teletype remote terminal communications and a Launch Systems Branch common data base. An IBM terminal, connected to the direct coupled IBM 7040/7094 computer in Slidell, was installed at MAF during October 1966 to permit Boeing programmers to gain experience on such equipment as a prelude to third generation computing. The capability to query files of PERT/COST and personnel data in a near real-time fashion has been demonstrated.

Data base work has as its objective the most efficient use of the mass random storage, multi-processing and multi-programming capabilities provided by third generation equipment. Data content and structure studies have resulted in a design for the first two phases of the data base system to be completed in the fourth quarter of CY 1967.

NUMERICAL CONTROL

A numerical control (NC) manufacturing environment is currently being initiated with the installation of the necessary computer software required to control the Sundstrand NC/3 tooling machine. This numeric control system provides the ability to generate the controls for machine tools by computer techniques.

The major elements within the numerical control environment are: the part programmer which translates the part designer's drawing into machine tooling instructions; the automatic program tooling and postprocessor computer software, which translates the programmer's instructions into a paper tape containing the necessary commands for controlling the NC tooling machine; and the NC tooling machine which manufactures precision parts with little operator intervention.

The NC effort should expand substantially with the arrival of additional NC machines during FY 1968.

PERT

Major improvements to the Launch Systems Branch

PERT reporting system were implemented during this past year. These included:

a) The Boeing direct couple system (DCS) edit process which replaces the previous standardized IBM 1401 NASA PERT "C" edit process. The upgraded editing process edits incoming PERT transactions, corrects many of the noted errors, and automatically deletes previously completed activities from the PERT master file. An annual operational savings of $50,000 is anticipated by Boeing through the use of this system.

b) "A PERT bar chart program" which produces 8 by 24 inch Gant type bar graphs depicting the workflow and milestone status of PERT activities. The bar graphing technique, developed within this program, has considerably increased overall PERT reporting visibility.

c) "A physical completion model" which locates the current schedule position and graphically represents a schedule pattern for various program control levels including project, organization, department, and product milestones. This model proved advantageous in negotiating the S-IC incentive contract.

COMMAND MEDIA

The LSB-Michoud Command Media System provides formal establishment and documentation of management policies and controls, authority delegations, and practices.

During FY 1967, in addition to the continuing refinement and documentation of customer and contractor originated business systems (e.g., Cost Improvement, New Technology, "ALERT,"), The Boeing Company placed special emphasis on improving controls via command media in three areas:

a) Equal Employment Opportunity - to ensure governmental requirements and corporate policies were enforced.

b) Product Reliability - to impose more stringent controls to meet customer/contractor goals.

c) Safety - to ensure personnel safety in all facets of vehicle assembly test and transportation.

SATURN PERFORMANCE AND LAUNCH READINESS BOARDS

Two Boeing Launch Systems Branch executive boards met periodically during the fiscal year for the purpose of assuring proper performance of Boeing's Saturn contractual obligations. These two boards are: 1) The Saturn Performance Board, and 2) The Saturn Launch Readiness Board.

The Saturn Performance Board membership during the reporting period consisted of the Boeing Launch Systems Branch Manager (and his technical assistant), and the Boeing/Michoud, Boeing/Huntsville, and Boeing/Atlantic Test Center Managers. The prime purpose of this board is to assure that the engineering, manufacturing, and documentation of test requirements for all facets of the Saturn program for which Boeing has contractual responsibility are performed in a manner which will support the planned Saturn V mission.

The Saturn Launch Readiness Board membership during the fiscal year consisted of the Director of the Boeing Atlantic Test Center, the BATC Saturn Program Manager, and the S-IC Program Executive. The purpose of this board is to assure that The Boeing Company's activities in preparing for each Saturn V mission are complete and on schedule with respect to hardware, documentation of test and launch requirements, and the flight readiness assessment of test and checkout results.

During the year, the performance board met four times and the Launch Readiness Board met two times. The boards also met jointly twice during the fiscal year. The purpose of these joint meetings is to bring together all the key Boeing/Saturn line and program managers with the purpose of resolving problems which affect both boards.

MICHOUD ORGANIZATION REALIGNMENTS

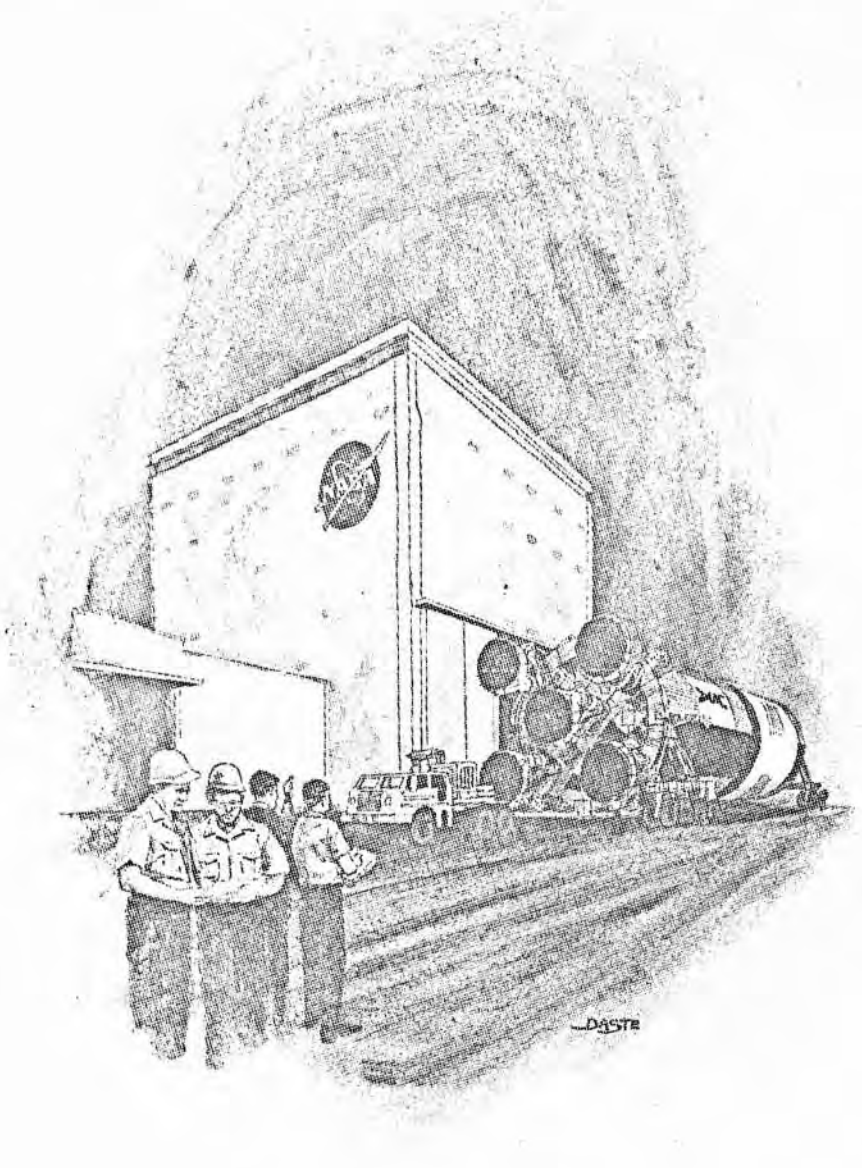
During FY 1967, several significant changes were made to the Boeing Michoud Organization structure.

During the first quarter, the new Information Management Organization (IMO) was established. The old Management Services Organization and Engineering's Applied Mathematics Section were merged to form IMO. This organization was formed in order to provide a single focal point for information and computing services and to assure maximum benefit in the application of these resources.

Quality and Reliability Assurance (Q&RA) was made a separate organization reporting directly to the Boeing Michoud Manager. This change occurred during the third quarter of the reporting period: Q&RA had previously been a portion of the Operations Organization. This realignment was made so that Q&RA could better accomplish its primary function, which is to provide the Michoud Manager with vigilance to detect and correct problems before they reach critical proportions.

CONTRACT END ITEMS & SERVICES

2



SUMMARY

Delivery of Boeing's first Michoud assembled flight stage, the S-IC-3, was accomplished on March 15, 1967. Other stages which were nearing completion at the end of the year were: the S-IC-4, which was undergoing refurbishment and post-static checkout following its successful static firing at MTF; the S-IC-5, which is at MTF awaiting static firing; and, the S-IC-6 which was undergoing post-manufacturing checkout at the end of the year. The S-IC-7 was in horizontal assembly at year-end, and major structures assemblies were in work for stages S-IC-8 through S-IC-12.

The structural testing program was completed during FY 1967. These tests were performed to confirm the adequacy of the S-IC structure. Other major testing programs maintained during the year were qualification, reliability, and development testing.

Boeing Quality Assurance activities during the year included 39 visits to subcontractors supplying critical hardware items. These visits were made by teams consisting of management personnel from Quality, Materiel, and Engineering. During these trips, quality motivation presentations were made to each supplier.

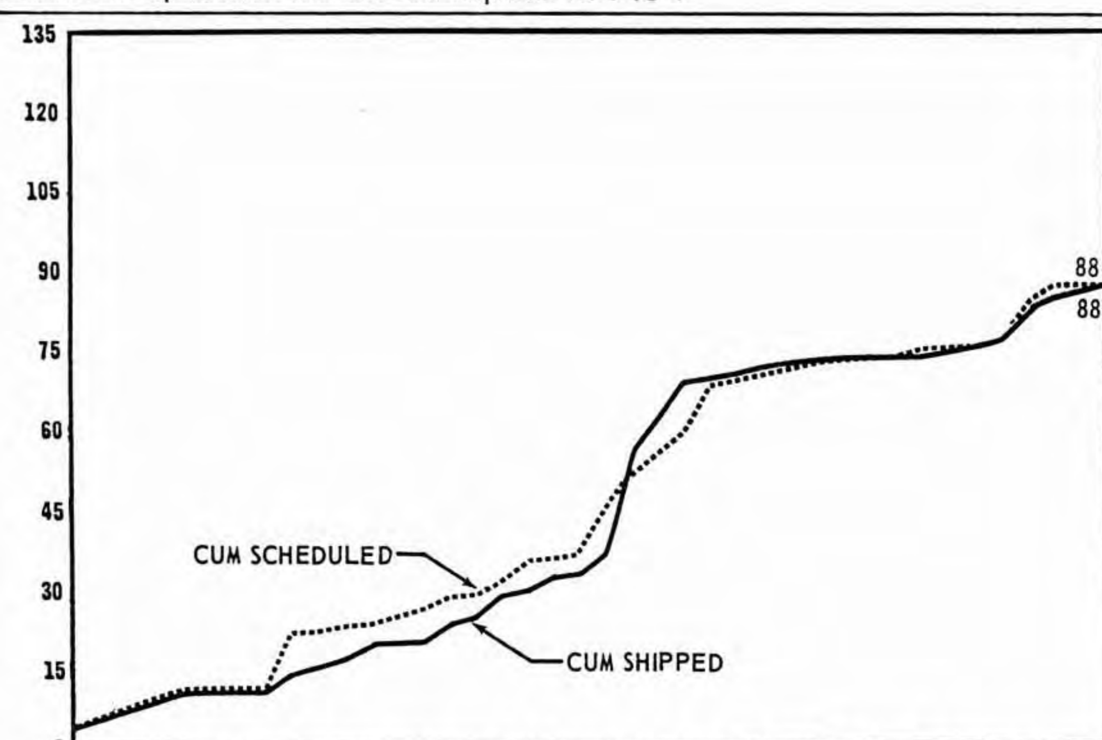
DELIVERABLE HARDWARE

S-IC STAGES - NASA/MSFC ASSEMBLED

S-IC-1 AND S-IC-2

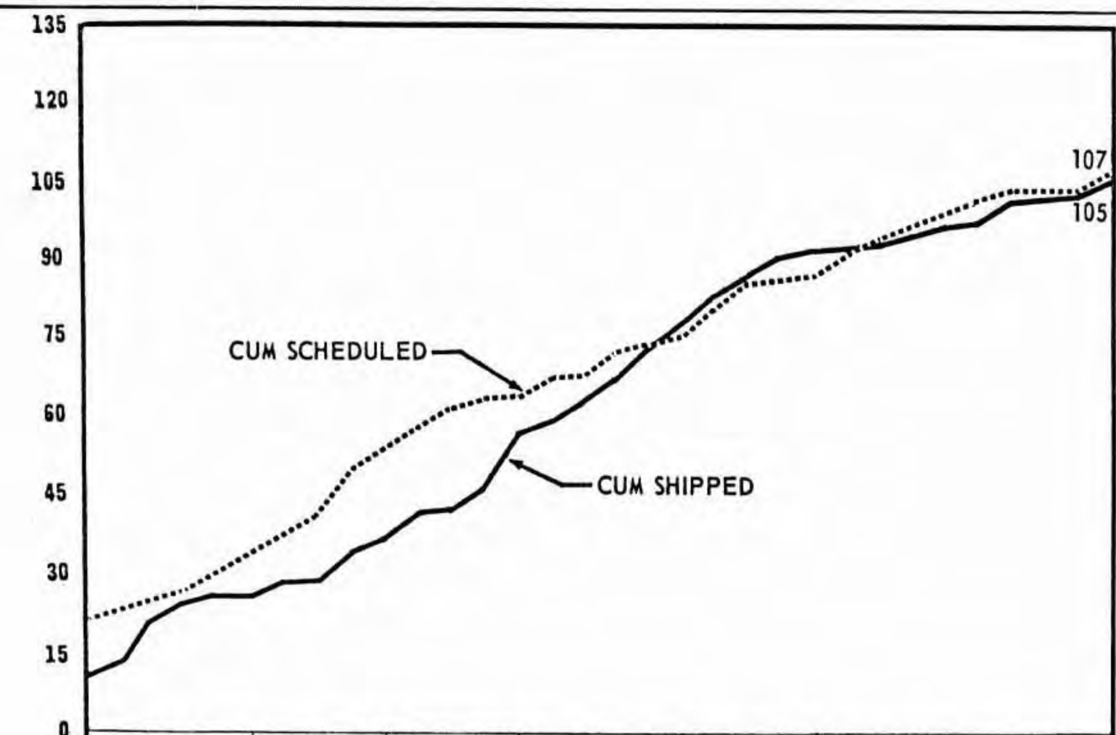
During the fiscal year, S-IC Systems Test teams supported the post-manufacturing static firing readiness testing (PMC) and post-static checkout (PSC) of the S-IC-1 and S-IC-2 at MSFC. These teams worked under participation task assignments which were directed by NASA/MSFC. Retrofit kit shipments (versus scheduled shipments) for the S-IC-1 and S-IC-2 are shown in Figures 2-1 and 2-2.

Figure 2-1 Retrofit Kit Shipments Versus Scheduled Shipments for S-IC-1



	OCT				NOV				DEC					JAN			
WK ENDING	7	14	21	28	4	11	18	25	2	9	16	23	30	6	13	20	27
SCHEDULED				8				11		2		1	2	2		3	
CUM SCHED				11				22		24		25	27	29		32	
CUM SHIPPED				10	10	10	10	14	16	17	20	20	20	24	25	29	29

	FEB				MAR					APR				MAY				JUN				
WK ENDING	3	10	17	24	3	10	17	24	31	7	14	21	28	5	12	19	26	2	9	16	23	30
SCHEDULED	4	1	11	5	4	2	10		1	1	1	1			2			2	7	4	1	
CUM SCHED	36	37	48	53	57	59	69		70	71	72	73			75			77	84	87	88	88
CUM SHIPPED	30	33	36	57	62	70	71	71	72	72	72	73	73	73	73	75	75	77	83	83	86	88



	DEC					JAN				FEB			
WK ENDING	2	9	16	23	30	6	13	20	27	3	10	17	24
SCHEDULED			11	4	3	3	3	10	4	3	3	3	1
CUM SCHED			26	30	33	36	39	49	53	56	59	62	63
CUM SHIPPED	13	20	25	26	26	28	28	34	37	40	41	46	57

	MAR					APR				MAY				JUN				
WK ENDING	3	10	17	24	31	7	14	21	28	5	12	19	26	2	9	16	23	30
SCHEDULED	3		6	2	1	4	6	1	1	4	2	2	2	2	4			4
CUM SCHED	66		72	74	75	79	85	86	87	91	93	95	97	99	103			107
CUM SHIPPED	59	63	69	73	78	82	85	90	92	93	93	95	96	96	102	103	104	105

Figure 2-2 Retrofit Kit Shipments Versus Scheduled Shipments for S-IC-2

S-IC STAGES - BOEING ASSEMBLED

S-IC-D

The S-IC-D arrived at MTF for storage on April 15, 1967. The stage will remain in the Booster Storage Building at MTF for an undetermined period of time.

A refurbishment study of the S-IC-D (authorized by CCP 9208) was completed on June 16, 1967. The formal presentation of this study is to be made to NASA early in FY 1968.

S-IC-F

The S-IC-F was returned to Michoud from KSC on December 11, 1966. Upon arrival at Michoud, the stage was placed in storage.

A detailed reinspection of the vehicle was conducted during February and March of 1967. All discrepancies discovered during this inspection were noted on UER's, and those discrepancies for which NASA authorized repair were corrected during the reinspection. A formal report of this reinspection was submitted to the NASA S-IC stage project manager on April 12, 1967. (See Page 41.)

At the end of the reporting period, the stage was being used for crew training in preparation for S-IC-3 helium bottle changeout (ECP 0215). After this training, the stage will be placed in storage to await shipment back to KSC on September 10, 1967.

S-IC-3

Post-manufacturing static firing readiness testing (PMC) of the S-IC-3 was completed on September 22, 1966. The maximum number of incentive points available to Boeing for achieving the milestone (399 points) were earned. Figure 2-3 shows the stage during PMC, and Figure 2-4 shows the Stage Test Control Room.

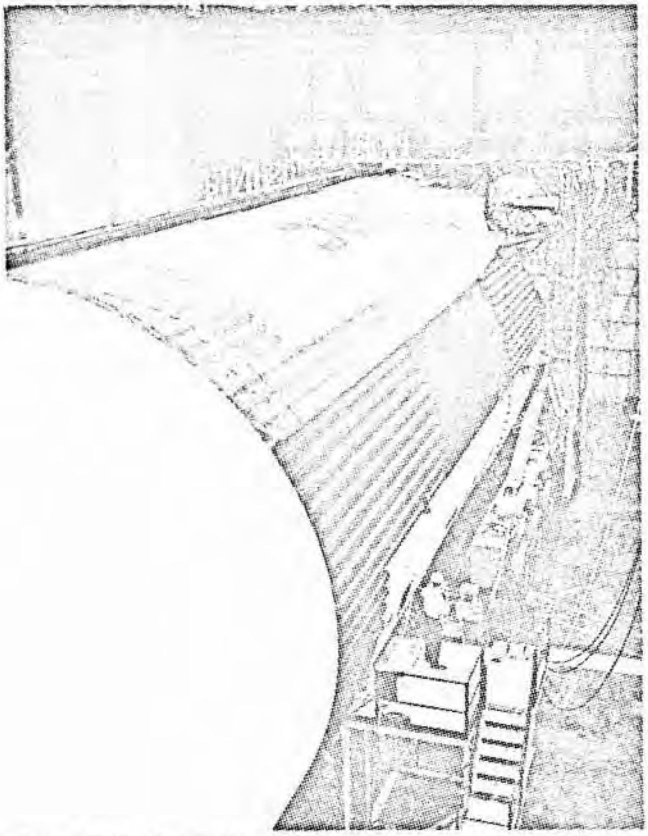


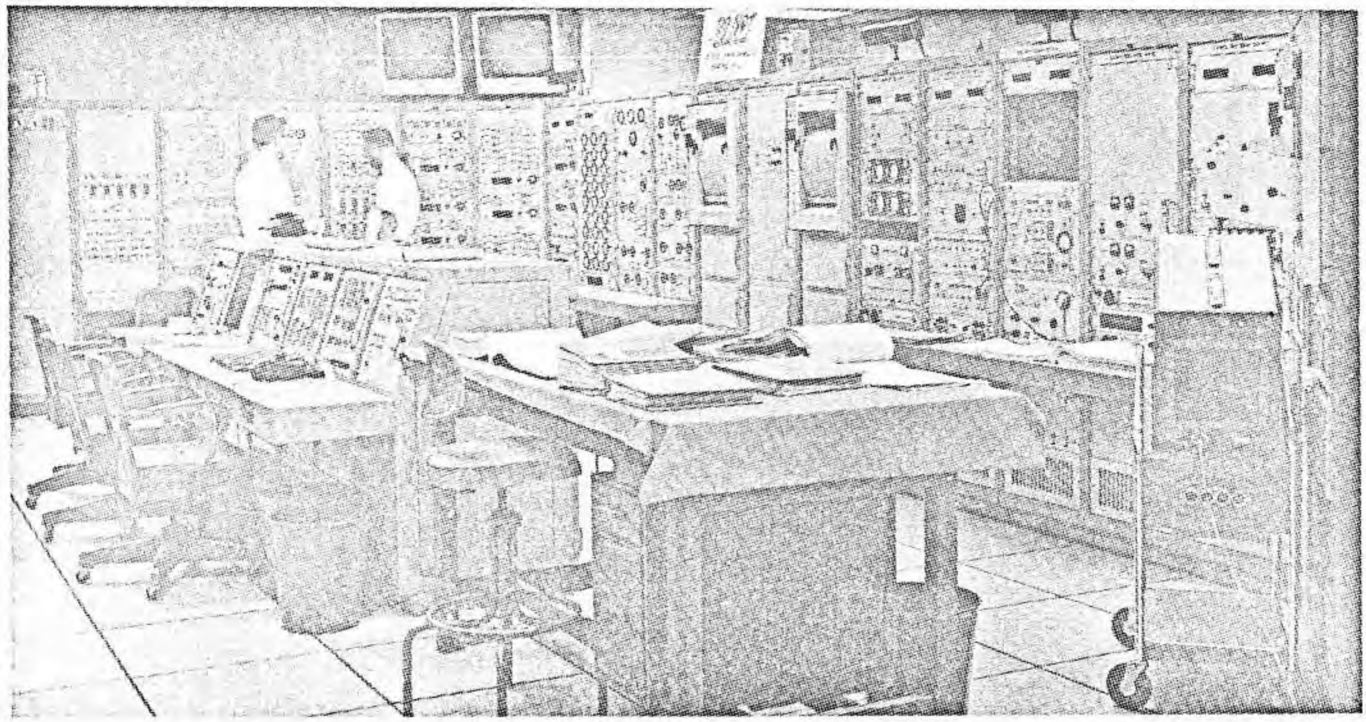
Figure 2-3 S-IC-3 Stage in PMC

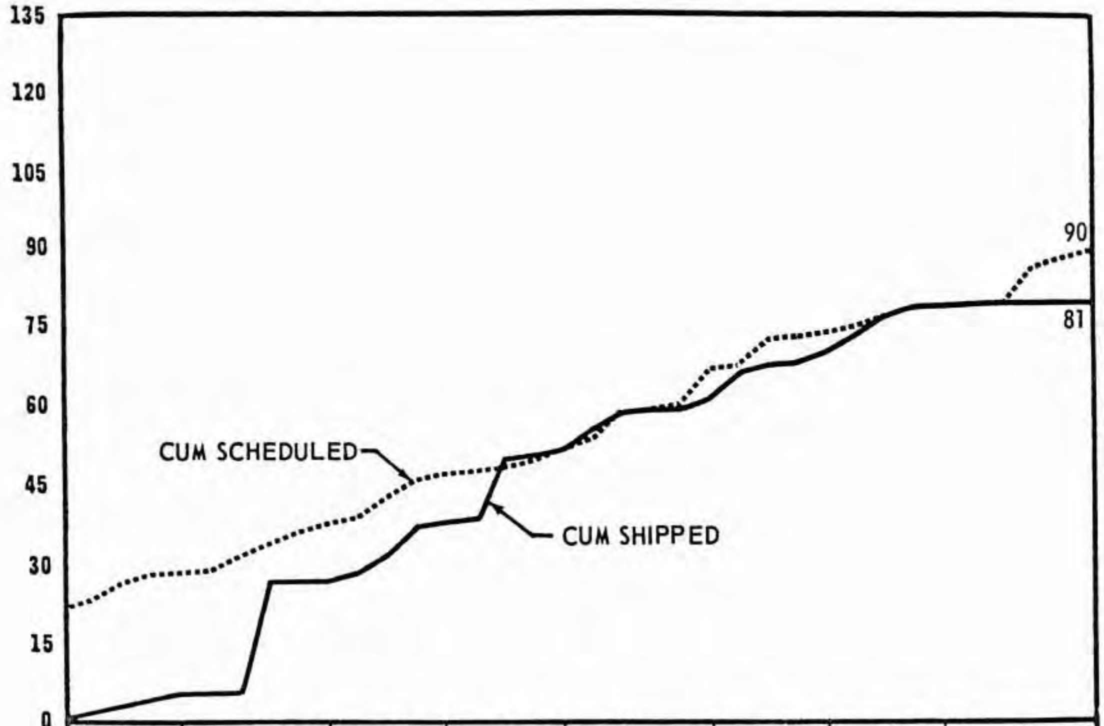
Because the government furnished S-IC test stand at MTF was not operational at this time, the stage was shipped to MSFC for static firing. The S-IC-3 left Michoud on September 23, 1966, and arrived at MSFC on October 1. It was loaded into the Huntsville static test stand on October 3.

A propellant load test was successfully completed on October 26, 1966. During this test and subsequent leak tests, a fuel leak was discovered at the connection of the fuel pump balance cavity supply line to the pump housing of the engine in position Number 5. Investigation revealed that the O-ring had broken, and one-third of it could not be located. After a series of unsuccessful attempts to find the partial O-ring, a replacement engine was shipped to MSFC and installed on November 7, 1966. Because of this delay, static firing was rescheduled for November 15. (Original schedule date was November 3.)

A successful static firing of 127.3 seconds occurred on November 15. This firing earned Boeing 274.1 incentive points out of a possible 280 points. The vehicle was then removed from the stand on November 21 and shipped to Michoud on November 22. The stage arrived at Michoud on November 27, and refurbishment and PSC was begun immediately. Integrated PSC was completed on February 10, 1967.

Figure 2-4 Stage Test Control Room





	NOV				DEC					JAN			
WK ENDING	4	11	18	25	2	9	16	23	30	6	13	20	27
SCHEDULED	24	3	1		1	3	2	3	1	1	4	3	1
CUM SCHED	24	27	28		29	32	34	37	38	39	43	46	47
CUM SHIPPED				5	5	5	27	27	27	29	32	38	39

	FEB				MAR					APR			
WK ENDING	3	10	17	24	3	10	17	24	31	7	14	21	28
SCHEDULED		2	1	3	1	5		3	6	1	4	1	1
CUM SCHED		49	50	53	54	59		62	68	69	73	74	75
CUM SHIPPED	39	51	51	52	57	59	59	59	62	63	69	69	71

	MAY				JUN				
WK ENDING	5	12	19	26	2	9	16	23	30
SCHEDULED	1	1	2			1	6	2	1
CUM SCHED	76	78	80			81	87	89	90
CUM SHIPPED	74	78	80	80	80	81	81	81	81

Figure 2-5 Retrofit Kit Shipments Versus Scheduled Shipments for S-IC-3

After PSC, the vehicle was erected in the Michoud Vertical Assembly Building (VAB) for thrust structure splice angle changes (ECP 0156). After modification, the vehicle was weighed and returned to the Stage Test Building for retest and final preparation for shipment (including ECP 0193, Electrical Distributor Changeout).

The S-IC-3 was accepted by NASA (Michoud on-dock incentive milestone) on March 15, 1967. Maximum incentive points available for this milestone were 2,800 of which Boeing earned 1,580.1). Of the total S-IC-3 incentive points available (3,479), Boeing earned 2,253.2. Since final delivery to NASA, the S-IC-3 has been at Michoud, either in storage or undergoing certain changes which were originally scheduled to be done at KSC. Retrofit kit shipments (versus scheduled shipments) for S-IC-3 are shown in Figure 2-5.

S-IC-4

At the start of the reporting period, the S-IC-4 was in horizontal assembly. This assembly was completed on August 5, 1966, at which time the stage was transferred to the Stage Test Building for post-manufacturing static firing readiness testing (PMC). This testing was completed on December 5, 1966. The maximum number of incentive points available for this milestone (499.8 points) were earned by Boeing.

After PMC, the vehicle was returned to the factory for storage and incorporation of ECP 0156 (thrust structure splice angle change). (See Figure 2-6.) ECP 0156 was accomplished in the VAB between January 12 and February 16, 1967. The stage was then returned to storage (Figure 2-7) where some prefiring modifications were accomplished until it was shipped to MTF on April 4.

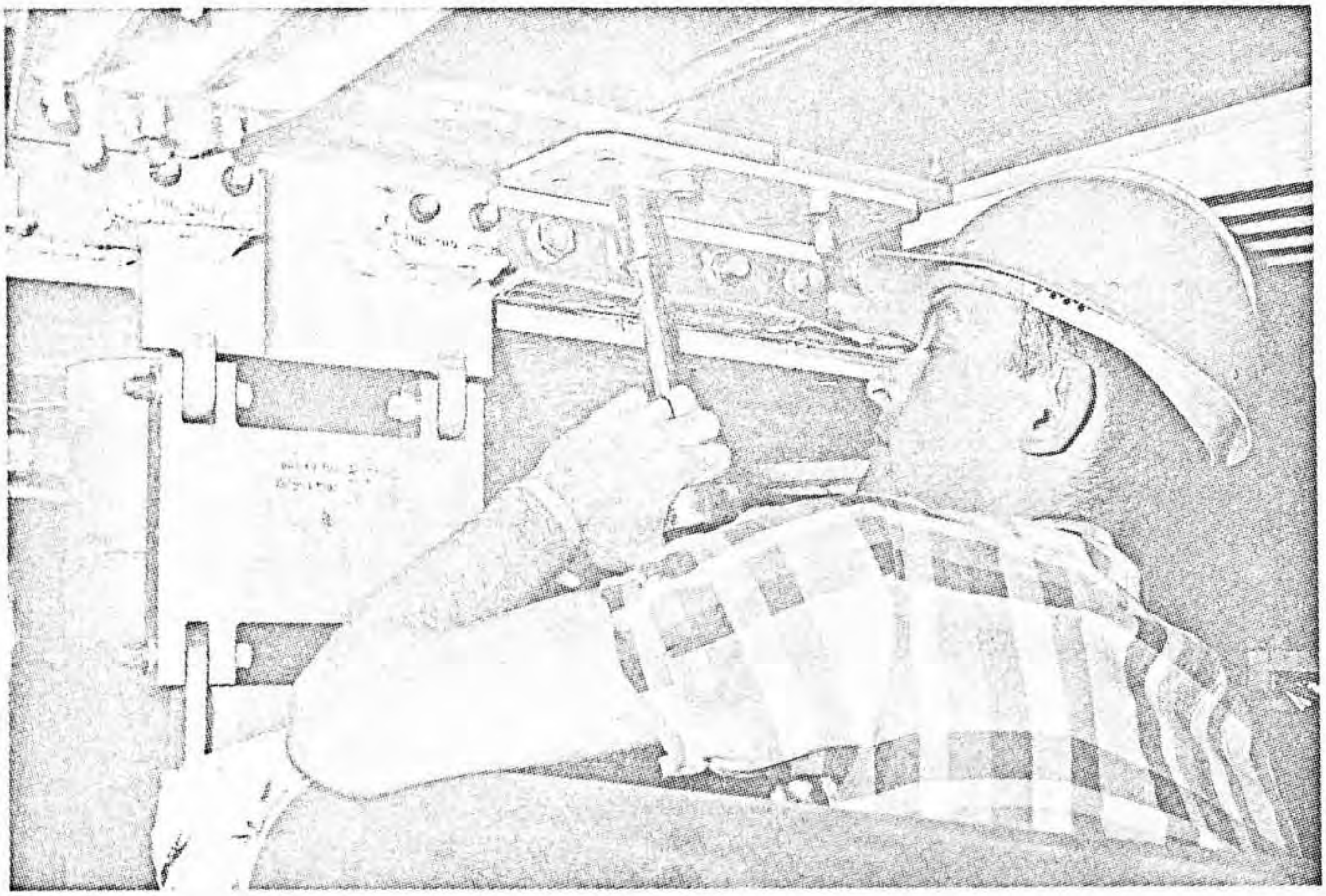
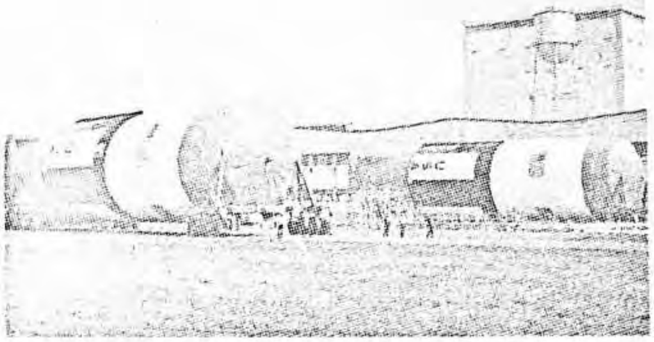


Figure 2-6 Splice Plate Installation

Figure 2-7 S-IC-3 and S-IC-4 Stages Transferred



The S-IC-4 was hoisted into the MTF test stand on April 5. During the LOX system leak check, it was discovered that the LOX pump inlet seal on engine Number 5 leaked. This seal was replaced prior to propellant load testing, and no further leaks were discovered.

A successful static firing (125 seconds) was held on May 16. Maximum incentive points (400) were earned by Boeing for this firing. The stage was removed from the stand on June 6 and returned to Michoud on June 7. Refurbishment and post-static checkout began upon return to Michoud and are now in process. Post-static checkout is now scheduled for completion on August 23 with final delivery to NASA scheduled for August 30. To date Boeing has earned 899.8 incentive points out of a possible 899.8 available for the S-IC-4 incentive milestones achieved.

S-IC-5

All major structural assemblies of the stage were completed. Vertical Assembly of the S-IC-5 was

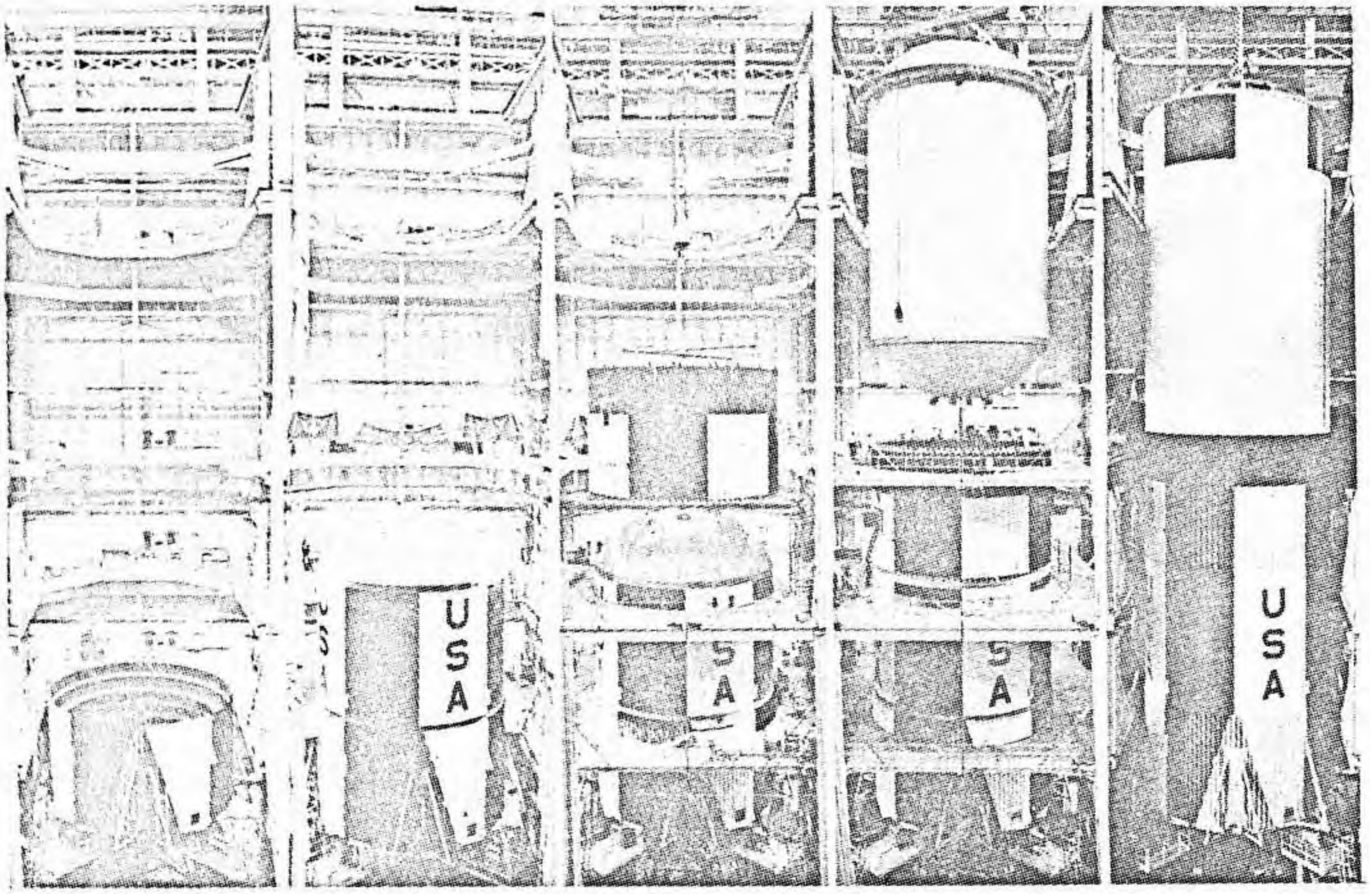


Figure 2-8 S-IC Vertical Assembly

then completed on September 12, 1966 (See Figure 2-8), and the stage was transferred to horizontal assembly on September 13. This assembly was completed on December 16 at which time the stage was transported to the Stage Test Building for post-manufacturing static firing readiness testing (PMC). This testing was completed on March 7, 1967, (299.6 incentive points were possible for this milestone; 299.6 were earned by Boeing). Stage electrical distributors were then changed out on March 8, 1967 (ECP 0193). The incorporation of this change demanded a partial retest of the stage which was conducted during April. CCP 9217 dictated the changeout of two S-IC-5 engines (positions 3 and 5) for the inspection of the oxidizer pump primary oxidizer seals. These Rocketdyne engines were removed, inspected, and reinstalled in the stage. Because of this change a 12-day slide in the Michoud incentive on-dock delivery date has been negotiated.

The vehicle was shipped to MTF on June 21, stored in the Booster Storage Building, then loaded into the MTF test stand on June 29. The stage is scheduled to undergo certain changes while it is in the test stand. Static firing is currently planned for August 9, 1967.

S-IC-6

All major structure assemblies of the S-IC-6 were completed during FY 1967. Vertical assembly of the stage commenced on November 29, 1966, and was completed on January 5, 1967. The stage then underwent horizontal assembly which was completed on May 8, 1967.

The vehicle is currently undergoing post-manufacturing static firing readiness testing (PMC). At the end of FY 1967, this testing was 66 percent complete and scheduled to be completed on July 26.

Two engines were removed from the vehicle and replaced on May 26, 1967, (CCP 9217). Because of this change, a 10-day slide in the Michoud incentive on-dock delivery date has been negotiated.

S-IC-7

All major structure assemblies were completed during the fiscal year. The thrust structure, fuel tank, and forward skirt were completed in March; and the intertank and LOX tank were completed in April. Figure 2-9 shows the S-IC-7 thrust structure being placed on pylons in the VAB. The stage completed vertical assembly on April 20, 1967, and was in horizontal assembly at the end of the reporting period. Horizontal assembly is scheduled for completion on August 14, 1967. Because of engine changeouts on S-IC-5 and S-IC-6 (CCP 9217), a slide of seven days in the completion date of the incentive milestone, post-manufacturing static firing readiness testing, has been negotiated.

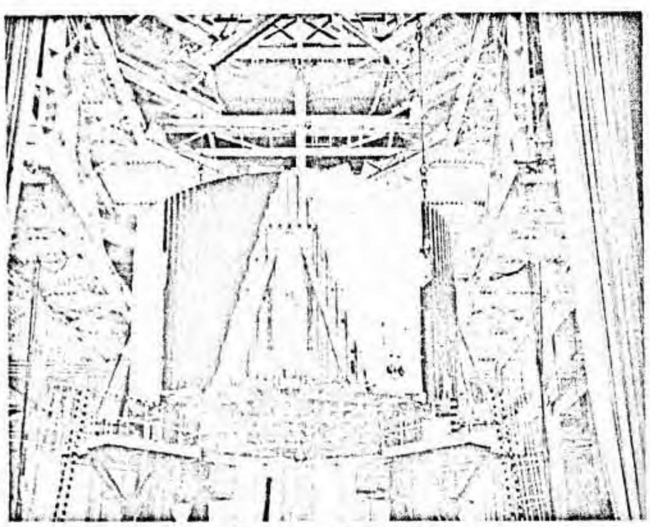
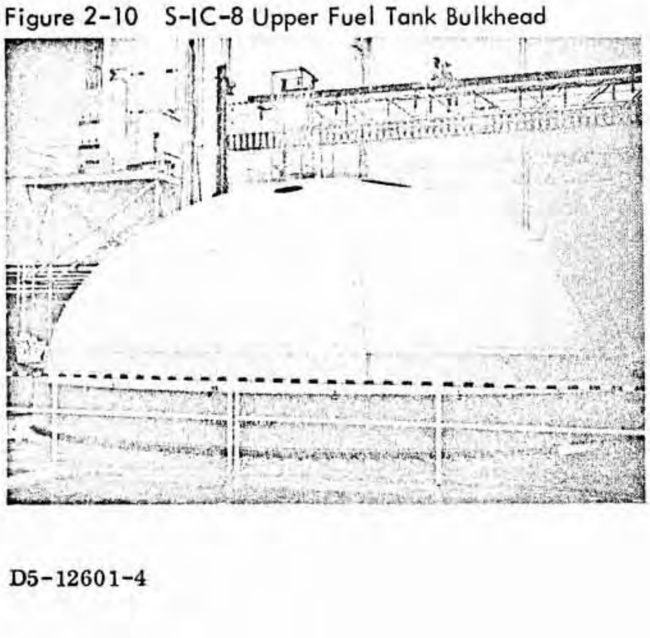


Figure 2-9 Thrust Structure Being Lowered on VAB Pylons

Figure 2-10 S-IC-8 Upper Fuel Tank Bulkhead



S-IC-8

The S-IC-8 intertank and forward skirt had been completed at the end of the fiscal year, while the thrust structure was 95 percent complete, the fuel tank was 90 per cent complete, and the LOX tank was 90 percent complete. Figure 2-10 shows the S-IC-8 upper fuel tank bulkhead.

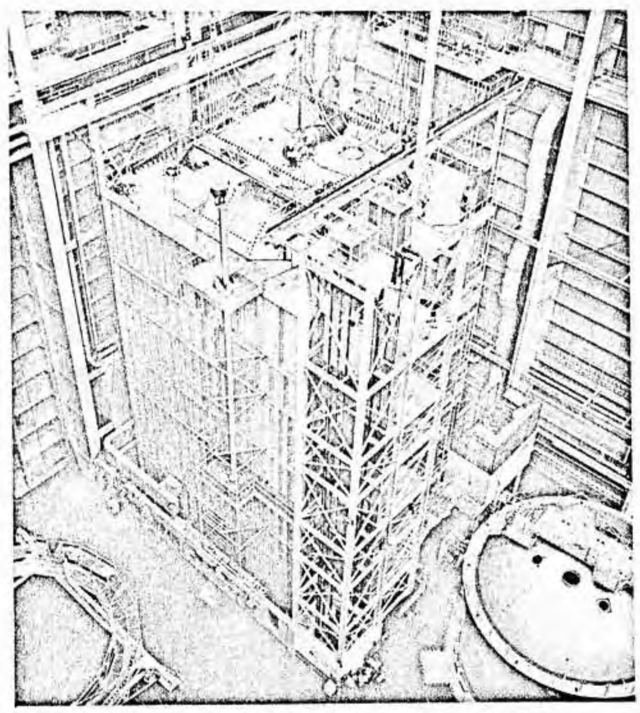


Figure 2-11 S-IC Fuel Tank In Hydrostatic Test

An inspection of the S-IC-8 fuel tank, after hydrostatic testing, revealed eight indications of cracks in the weld repair areas. Boeing's position was that the tank could be used in its then current condition; however, NASA wanted further assurance and directed that additional hydrostatic tests be performed to determine if these crack indications would propagate. The tank completed a proof-cycle test on June 21. It was then processed through an additional series of two tests consisting of five operating cycles each. No leaks or new rejectable penetration indications occurred, and no discernible propagation of the crack indications was detectable during any of the additional tests. A report to NASA is now being prepared which presents all test results and restates Boeing's original position that the tank should be used in its current condition. Figure 2-11 shows an S-IC fuel tank undergoing hydrostatic testing.

S-IC-9 THROUGH S-IC-12

All activities on these stages are progressing on schedule. The percentage of completion of all major structure assemblies in work (at the end of FY 1967) for stages S-IC-9 through S-IC-12 is shown in Figure 2-12. Figure 2-13 shows the lower LOX tank bulkhead of the S-IC-9.

MAJOR STRUCTURE ASSEMBLIES	STAGE -9	STAGE -10	STAGE -11	STAGE -12
THRUST STRUCTURE	78%	51%	14%	0
FUEL TANK	60%	75%	46%	11%
INTERTANK	81%	55%	10%	0
LOX TANK	73%	50%	38%	1%
FORWARD SKIRT	83%	44%	0	0

Figure 2-12 Major Structure Assemblies Complete As of June 29, 1966

GROUND SUPPORT EQUIPMENT

TEST AND CHECKOUT SETS

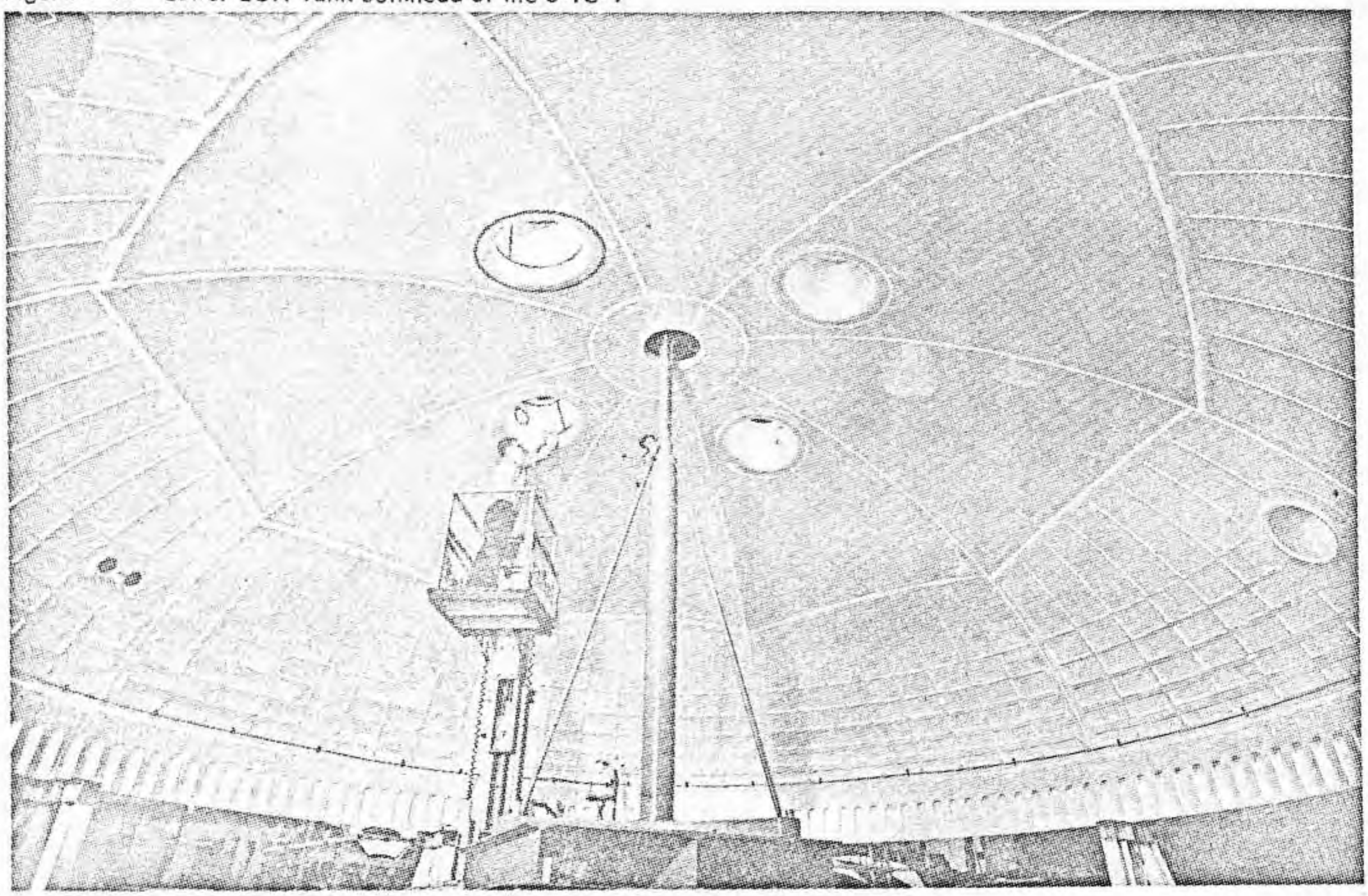
R-Test - Delivery of all basic and change-generated end items was accomplished by the second fiscal-year quarter. The final change kit shipment was made to the station in the third fiscal-year quarter. R-Test satisfactorily supported the static firing of the S-IC-3 vehicle in November 1966.

R-Qual - Delivery of all basic and change-generated end items was also accomplished at R-Qual in the second quarter FY 1967. The final change kit shipment was made in the third fiscal-year quarter. The station was used for PSC of the S-IC-2. Following completion of PSC of the S-IC-2, the station was transferred to the government per CCP 9133.

KSC EQUIPMENT

Seventy-four end items, required by MICH-112, CCP 9001, were delivered during the past fiscal year. Twenty-eight end items remain to be delivered.

Figure 2-13 Lower LOX Tank Bulkhead of the S-IC-9



Five units of Mod. 123/185 umbilical units were delivered in the fiscal year, including two refurbishment units for R-P&VE. Three units remain to be delivered, including one refurbishment unit for R-P&VE.

Three units of Mod. 122/174 pneumatic equipment were delivered by the end of FY 1967. Two of the three remaining items (the helium and nitrogen sections of the pneumatic console) were retained at Michoud after completion in order that engineering laboratories might run a life cycle test. Following completion of the test, the units will undergo a complete refurbishment prior to delivery to KSC, which is expected in the third quarter of FY 1968. The third remaining unit is expected to be delivered to KSC in the first quarter of FY 1968.

RETROFIT KITS

Figure 2-14 shows total GSE retrofit kit shipments versus scheduled shipments.

MECHANICAL AUTOMATION BREADBOARD

The S-IC hydraulic load simulator was successfully demonstrated to NASA November 30, 1966. Four items were recorded on unplanned event records. These items were listed on the delivery summary as shortages and were as follows:

a) Install and check out a temperature transducer;

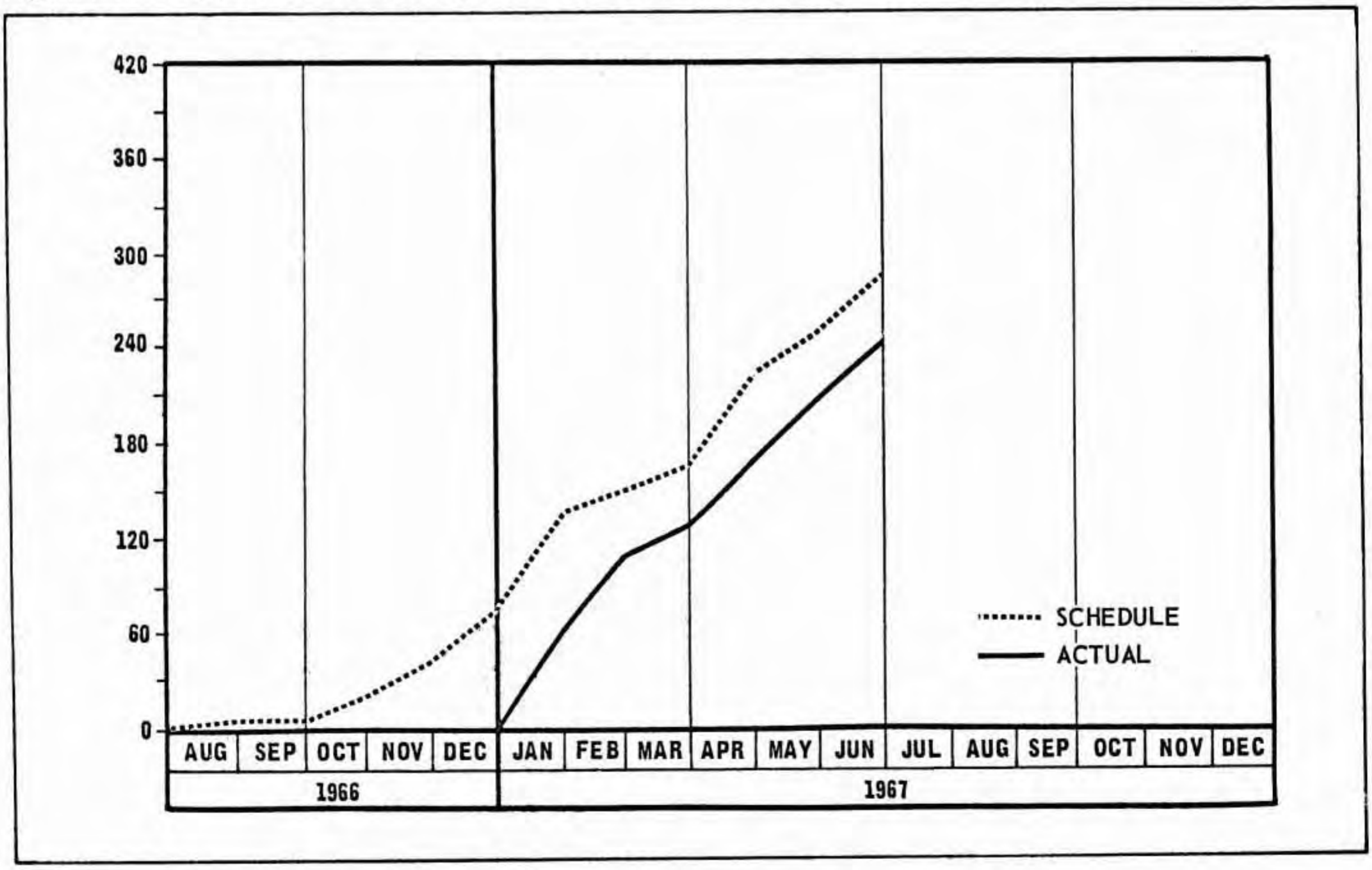
b) Install and check out a pressure transducer;

c) Rework actuator simulating gas generator ball valve; and

d) Clear up several minor installation type discrepancies.

Form 71 was prepared for sell-off and was subsequently signed on January 13, 1967. The four open items have been cleared, and there are no existing shortages. This completes basic delivery of the mechanical automation breadboard and the hydraulic load simulator.

Figure 2-14 Total GSE Retrofit Kit Shipments Versus Scheduled Shipments



DESIGN AND ENGINEERING

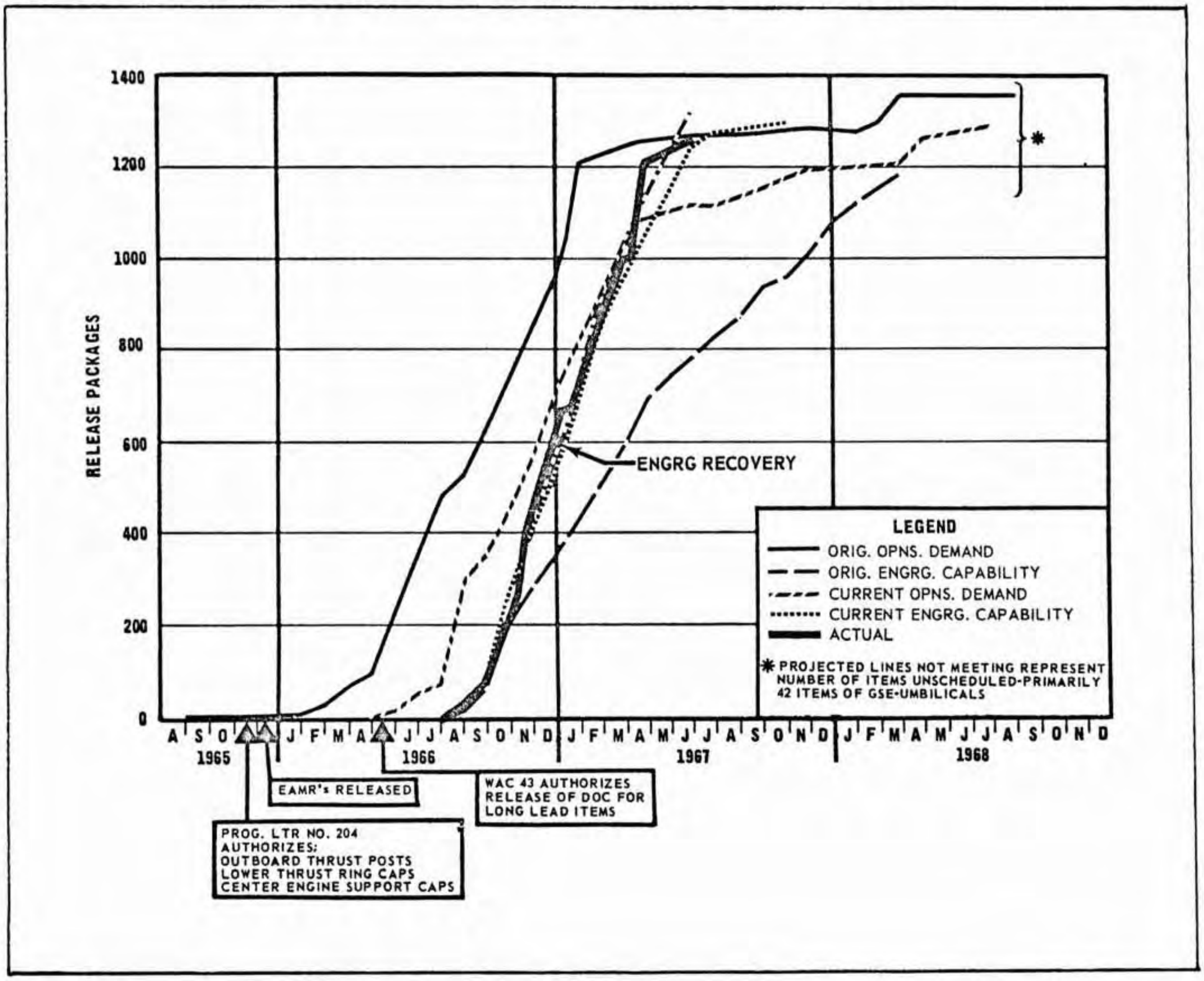
S-IC ENGINEERING DOCUMENTATION

Documentation release for the fiscal year consisted primarily of S-IC-11 through S-IC-15 basic releases and change action. The basic release activity was predicated on demand dates supplied by Operations. Beginning in July of 1966, an accelerated effort was made to match Engineering's release capability with Operations' requirements. Releases closely paralleled Operations' demand beginning in November 1966 and actually exceeded the requirement by April 1967. This effort resulted in the early delivery of approximately 500 release packages. No further accelerated work schedules are expected to be required to complete this program. As required by the contract, releases have been made for S-IC-11 through S-IC-15 incorporating the intent of outstanding engineering orders (EO's). The cumulative number of packages released at the end of the fiscal year was 1,207. Sixty-five packages remain to be released. (See Figure 2-15.)

Documentation release associated with change action consisted of the completion of documentation for 156 changes which are listed in Appendix E. During the same period, changes initiated included 174 ECP's, 68 PRR's, and 21 CCP's for a total of 263 changes which are listed in Appendix F.

The "Saturn Program Engineering Drafting Annex" and document D5-11979, "Required Engineering Re-

Figure 2-15 Documentation Packages Released During FY 1967



lease Documentation," were revised during the fiscal year to incorporate requirements to control retrofit documentation. As part of these requirements, a unique configuration code, "K," was established to identify retrofit documentation within the automatic release system.

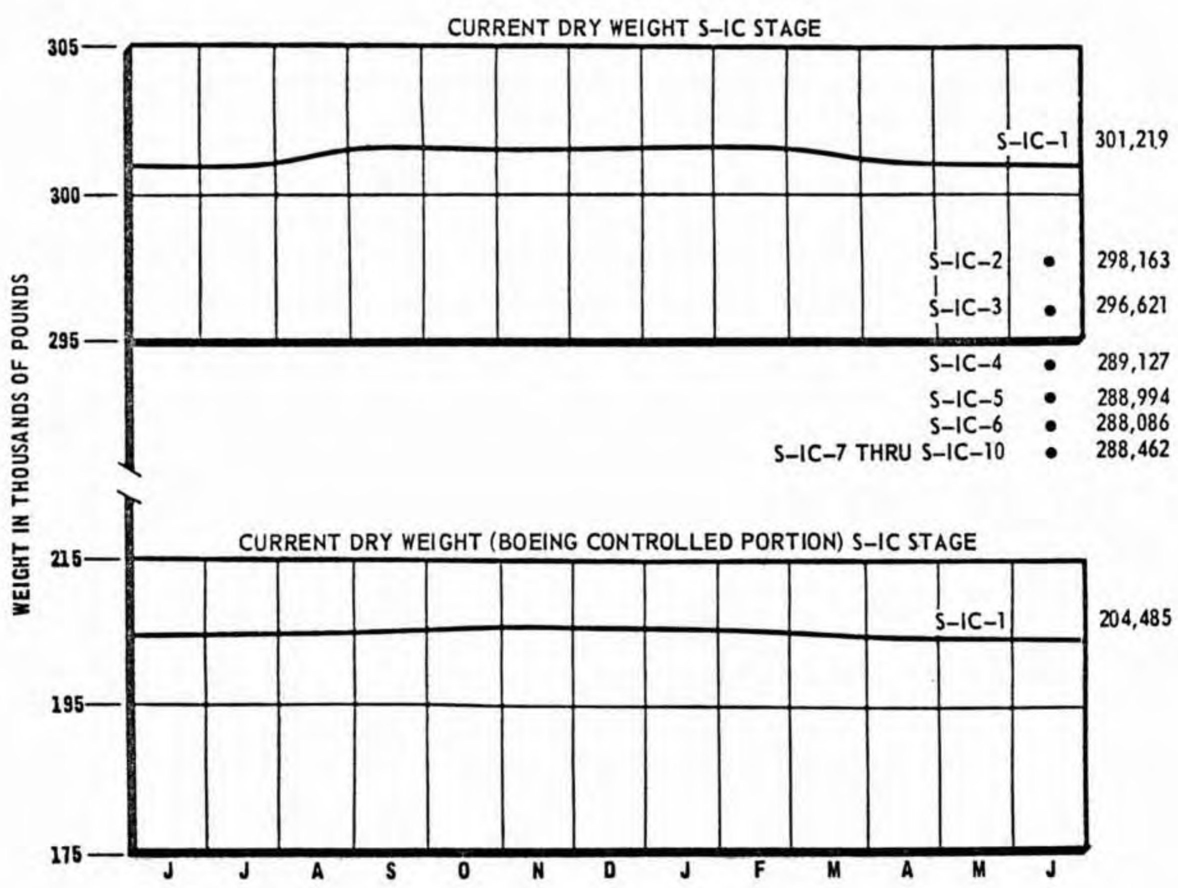
S-IC STAGE WEIGHT STATUS

The calculated dry weight of the S-IC-1 stage, including F-1 engines, increased 947 pounds during FY 1967. That portion of the stage for which Boeing has responsibility (F-1 engines are excluded) decreased 114 pounds.

The Boeing CEI specification weight decreased by 37 pounds. Variations in S-IC-1 dry weight are shown in Figure 2-16. Weights of the other flight stages at year-end are shown for comparison. These weights do not include research and development (R&D) instrumentation which varies with each vehicle (S-IC-1 through S-IC-5) and will be deleted entirely after S-IC-5.

Figure 2-17 represents the current dry stage weight, CEI specification weight, CEI specification weight (less engines), Boeing current weight (R&D, less engines), and dry stage weight (R&D). Weights are given in pounds.

Figure 2-16 S-IC Stage Dry Weight Status



VEHICLE	CEI SPEC. WEIGHT	CEI SPEC. WEIGHT (LESS ENGINES)	BOEING CURRENT WEIGHT (R&D) (LESS ENGINES)	DRY STAGE	DRY STAGE (R&D)
S-IC-1	305,296	212,796	210,037	301,219	306,771
S-IC-2	305,489	212,989	212,518	298,163	306,010
S-IC-3	304,627	212,127	210,969	296,621	304,428
S-IC-4	297,028	204,528	201,610	289,127	294,545
S-IC-5	297,034	204,534	201,223	288,994	294,191
S-IC-6	291,000	198,500	195,684	288,086	288,086
S-IC-7	298,075	198,575	195,572	288,462	288,462
S-IC-8	291,075	198,575	195,572	288,462	288,462
S-IC-9	291,075	198,575	195,572	288,462	288,462
S-IC-10	291,075	198,575	195,572	288,462	288,462

S-IC-1 WEIGHT STATUS (CHANGES DURING FY 1967).

	6/30/67	6/30/67	NET CHANGE
DRY (LESS R&D)	300,272	301,219	+ 947
BOEING OPERATIONAL WEIGHT (LESS ROCKETDYNE)	204,599	204,485	- 114
BOEING CEI SPECIFICATION WEIGHT (INC. R&D)	212,833	212,796	- 37
BOEING WEIGHT (INCLUDING R&D)	210,270	210,037	- 233
CEI SPECIFICATION WEIGHT	305,333	305,296	- 37

RESEARCH AND DEVELOPMENT WEIGHTS (R&D) (CURRENT)

S-IC-1	5552 LB.	S-IC-4	5418 LB.
S-IC-2	7847 LB.	S-IC-5	5196 LB.
S-IC-3	7807 LB.		

Figure 2-17 Breakdown of S-IC Stage Weights

S-IC STAGE DESIGN

ELECTRICAL DISTRIBUTORS

Foam expansion - Altitude and temperature tests on a Saturn V instrument unit distributor revealed that the foam potting material, BMS 8-38 Stafoam, had expanded since the initial cure cycle. Subsequently, numerous S-IC stage distributors which use this material were examined to determine if similar expansions had occurred. Some foam irregularities were noted, particularly in the S-IC-1 and S-IC-2 distributors (made by MSFC); however, extensive laboratory tests showed that the functional operation of the distributors was not affected. These tests, and earlier qualification tests, have verified the adequacy of BMS 8-38 Stafoam for use in S-IC electrical distributors.

Union Switch and Signal relays - During reliability testing of the S-IC electrical distributors, abnormal closings of open relay contacts were detected. These closings occurred during a sine vibration sweep designed to simulate an engine shutdown condition and were detected in the MBR 37496-7 and -8 relays manufactured by Union Switch and Signal Company (US&S). An extensive failure analysis program showed the cause of the closings to be the presence of contamination in the relays. Further investigation showed that this condition was probable in all four-pole and six-pole relays manufactured by US&S. Because these relays are used in critical applications, a decision was made to replace all of the relays with parts manufactured in a clean environment under Boeing Quality Control surveillance. A joint Boeing/vendor effort resulted in an improvement in the manufacturing environment and inspection techniques. All relays are presently being inspected prior to sealing and are inspected on a sampling basis after delivery. The relays are part-marked with a new part number MBR 37496-9 and -10, and are identified with a green dot on the header. The MBR 37496-7 and -8 relays were replaced on all vehicles under ECP 0193.

As a result of the close surveillance exercised by Boeing during the manufacture and testing of the MBR 37496-9 and -10 relays, irregularities were uncovered in the US&S testing techniques. Proper testing revealed that when the relays are subjected to temperature extremes, a carbonaceous deposit forms on the contact area, resulting in an out-of-tolerance contact resistance on the six-pole (MBR 37496-10) relay. A review of electrical circuitry using this relay showed that no circuit function would be compromised by this phenomenon; however, every effort was made to isolate and eliminate the source. This effort included chemical analyses of component parts, back-fill gas, plant-filtered air, and relay-contained gas; investigation and study of cleaning processes, baking techniques, and assembly methods; and electrical testing of various configurations (including the MBR 37496-8 configuration). The results indicated that the MBR 37496-8 relays were similarly affected by temperature extremes and that a new extraction and cleaning process will be necessary to alleviate this phenomenon. This extraction process is now standard practice in the manufacture of the MBR 37496-10 relay.

Terminal boards - Problems were encountered during the fabrication and qualification testing of new silicon terminal boards utilizing new solder coated terminals as directed by PRR 1038. The terminal boards failed to pass qualification testing due to dielectric strength failures. Since the exact cause of the failures could not be determined in time to support production schedules, PRR 1038 was revised to delete the new silicon terminal board and return to the previously specified epoxy resin material. The new solder coated terminals will be retained.

VISUAL INSTRUMENTATION

The film camera system operated satisfactorily during the S-IC-3 static firing. Strobe light skipping, experienced during the S-IC-2 static firing, was found to have been caused by poor regulation in the ground power supply. This problem was eliminated by using stage batteries during S-IC-3 firing. A random flashing of the strobe lights during the programmed "dark time" was discovered to have been caused by transients on the timer reset cable. This discovery was verified during the S-IC-3 static firing and later corrected by grounding the reset cable (ECP 0201). One of the two TV cameras was inoperative on S-IC-3 static firing due to the failure of a coaxial connector. A reinspection and rework program was conducted during refurbishment of S-IC-3 in order to improve reliability of all coaxial connectors. A 70 KC interference ripple, which appeared on the video signal and the monitors during pre-static checkout, was corrected by ECP 0197 which added additional filtering to the regulated power supply of the 60B74600-1 TV transmitter.

ENGINE SYSTEMS

The tubing material for the stage-mounted LOX dome, LOX seal, engine cocoon purge, and prefill systems has been changed from Hastelloy "C" to aluminum in order to reduce manufacturing costs. This change was accomplished under PRR 1135 and is effective for vehicle S-IC-7 and on.

The LOX seal purge regulator has been revised to delete the shutoff valve feature. The regulator is a flight critical item and, under normal operating conditions, the shutoff valve could have caused diaphragm reversal and subsequent failure. ECP 0141, which deletes the shutoff valve, is effective for vehicles S-IC-1 and on.

ENVIRONMENTAL CONTROL

The forward skirt environmental control system was redesigned per ECP 0076 to optimize canister orifice sizes and add duct insulation. Redesign will be accomplished on vehicles S-IC-3 and on.

A hazardous gas detection system was designed for the forward skirt and thrust structures per ECP 0040, effective for S-IC-1 and on.

EXCESSIVE FORWARD SKIRT TEMPERATURES

In February 1967, revised predicted S-IC forward skirt structural temperatures, based on the SA-501 maximum heating trajectory environment, were received from NASA as additional design criteria. After review of the new thermal data, it was concluded that external thermal protection would be necessary for vehicles S-IC-1 and on. NASA was notified by letter on April 6, 1967, of Boeing's intention to submit ECP 0207 to accomplish this forward skirt insulation.

The S-IC forward skirt will be insulated with Dow Corning 93-044 white silicone rubber (to be controlled by specification 60B32559). This material is suitable for spraying when diluted with freon, cures within 24 hours at room temperature, and exhibits no slump when applied at maximum drawing thickness. A two to five-mill coating of Dow Corning 92-009 dispersion coating pigmented with Ferro Corporation's V-1747 Black Silicone Color Concentrate will be applied as required for proper color. (See Page 52.)

FUEL DEPLETION

S-IC-T testing and preliminary analytical studies indicated that adequate fuel pump inlet net positive suction head (NPSH) could not be maintained during inflight fuel tank terminal drain. This condition, resulting from a liquid surface drop-out phenomena caused by fluid inertia and pressure drop through the fuel tank lower bulkhead outlet screens, could result in catastrophic failures of the S-IC stage F-1 engines. To evaluate the problem, a development test was conducted to study the fuel tank drain dynamics. The test results revealed that a bubble injection phenomena occurred which could cause fuel pump cavitation before the fuel level drops below the outboard (lower) discrete sensors on the fuel probe. As a result of the fuel tank drain testing, the fuel depletion cutoff system was modified so that the inboard (upper) discrete sensor would initiate the S-IC outboard engine cutoff command (ECP 0116). This change resulted in an increase of approximately 12,000 pounds of fuel residuals.

An alternate solution to meeting NPSH requirements with reduced fuel residuals was sought by further testing with modified antivortex assemblies. The results of the testing showed that a combination of a filter screen covering the tank outlets with 24-inch circular flat plates placed above the outlets could reduce the fuel residuals by approximately 3,600 pounds. This reduction of residuals is equivalent to increasing the S-IC payload capability by approximately 270 pounds. A further change in assumed fuel slosh amplitudes from 4.6 to 1.5 inches reduced the residuals an additional 3,900 pounds. This configuration change has been presented to the customer via ECP 0183, effective on S-IC-3 and on.

VALVES

LOX and fuel fill and drain valves - The LOX and fuel fill and drain valves (60B41002 and 60B43002) and the LOX interconnect valve (60B41136) were reworked in accordance with ECP 0150 which required removal of all actuators for reheat treatment to a T-7351 temperature. These parts were originally made from 7075 aluminum alloy heat treated to the T-651 condition, which has a much lower stress corrosion threshold than the T-7351 condition. This change was effective on all stages.

GOX flow control valve (GFCV) O-ring - The fluorosilicone O-rings used in the GFCV (60B51441) are not LOX compatible as required by MSFC-SPEC-106. However, based upon a completely satisfactory captive test history on all S-I, S-IB, and S-IC stages, the use of those O-rings on S-IC stage GOX flow control valves is not considered hazardous. Nevertheless, LOX compatible O-rings are being qualified for use on the S-IC stage. The program consists of valve testing at Parker Aircraft to ensure that LOX compatible viton O-rings will seal properly. These tests will then be followed by a static firing test on an S-IC flight stage to ensure that the GFCV will function properly under actual flow conditions.

LOX vent and relief valves - A joint Boeing/MSFC review of failure history revealed that LOX vent valve leakage problems were experienced on captive firing tests. Although these problems were corrected by ECP 177, which is effective on all flight stages, an extensive confidence test program has been authorized. The program, which is scheduled to be completed before the end of 1967, will subject three Whittaker LOX vent and relief valves to a significantly more severe combination of flight and static firing environments than the component qualification test program.

Check valves - Sterer check valves 60B51407 have been redesigned per PRR 1097, eliminating the chatter problem experienced during checkout. The redesigned valves are presently installed on all flight stages.

Helium fill valve - Procurement problems of the helium fill valve 60B49013 prompted system redesign, replacing the valve with the 60B51407-7 check valve. Work was accomplished per ECP 0064, effective on stages S-IC-3 and on.

INSTRUMENTATION

Gas temperature transducer - Excessive response time was exhibited by the 60B72088 temperature trans-transducer, used for measuring gas temperature in the engine area. A new transducer, 60B72106, with a time response of two seconds, has been designed and qualified. This new unit requires the use of empirically derived curves to compensate for radiation errors. The new transducers, effective with S-IC-1, were provided by ECP 0182.

LOX level sensors - Three LOX cutoff sensors failed on the S-IC-3 vehicle. These failures were caused by an open resistor, a bad solar cell, and a cracked prism. Each of these failures had a different cause; however, it was concluded that thermal shock during LOX loading was the determining factor in each. Additional thermal shock tests and improved inspection of the prisms have been incorporated into acceptance tests at the vendors' and at Michoud.

Filter manifold differential pressure transducer - Numerous failures of the filter manifold differential pressure transducer, 60B72077-5, occurred during stage checkout and static firing. A plan to return all delivered units to the supplier has been initiated. Concurrently, the transducer pressure fittings were changed from one-eighth inch to one-fourth inch (ECP 0173) to provide a more rugged installation. Retested and modified transducers, which were installed on S-IC-1, exhibited the same initial failure characteristic. Further investigation has shown that all transducers of this part number behave in a similar manner. It is felt that the problem is the result of initial stresses within the transducers since the units tend to stabilize shortly after assembly with no further significant change. Initial efforts to determine the exact cause of the shift were not successful. The specification has been changed to allow a positive bias on the transducer so that telemetry (T/M) does not saturate when the negative shifts occur. The specification change has not resulted in a change in the overall systems accuracy. The vendor is continuing testing in an effort to determine the cause of the shift.

Loading electronics drift - During post-static checkout of the S-IC-2 vehicle, it was determined that the loading electronics drifted. ECP 0127 was released to correct this problem. The drift problem was corrected, the new design was qualified, and units that were in the field have been modified to the new design.

LOX tank gas temperature measurement failure - Measurements C120-119 and C121-119 (LOX tank gas temperature) have failed repeatedly during S-IC static firings. A theoretical analysis of the installation has revealed that the vibration environment causes contact chatter in the Deutsch connector used on the sensor. A clamp which will give rigidity to the connector has been designed and is scheduled to be tested on the S-IC-5 static firing. ECP 337 has been initiated to install this clamp on S-IC-1 through S-IC-3 while PRR 0571024 was released to install it on S-IC-4 and -5.

Transducer and signal conditioner calibration analysis- Transducer and signal conditioner calibration curves have been analyzed to determine if a standard calibration by part number can be used instead of individual serialized calibrations. The analysis was based on data from parts calibrated for vehicles S-IC-1 through S-IC-10. Results of the study showed that for 90 percent of the parts, calibrations could be used. Interchangeability of parts will not necessitate calibration tape changes.

A stringent review of the Airite titanium pressure vessels was conducted as a result of the S-IVB incident. All bottles delivered from Airite were eddy current tested with satisfactory results to verify use of correct filler wire. This practice will be continued on all future bottle deliveries.

Helium bottles on S-IC-3 - The continued slide in the schedule launch date of the S-IC-3 stage caused a re-evaluation of the helium bottles' susceptibility to stress corrosion. Consequently, the 20M02008 helium bottles will be replaced with 60B49031 helium bottles on the S-IC-3 per ECP 0215. The helium bottles on the S-IC-2 have already been heat-treated again because of an original production error and therefore are not considered stress corrosion susceptible.

HI-LOK FASTENER FAILURE

Failures of titanium 1/4-inch Hi-Lok fasteners during installation gave sufficient reason to investigate the cause and possible consequences of failure of installed fasteners. An intensive investigation revealed no degradation in the load carrying capability of the preloaded fasteners. However, Engineering requested an inspection of 1/4-inch titanium fasteners installed on the S-IC-3 vehicle to substantiate the integrity of the fastener installation. This inspection consisted of a visual examination of all 1/4-inch titanium fasteners. One hundred of the fasteners which were visually examined were then removed, penetrant inspected, and tensile tested. No fastener deficiencies were detected.

INSTRUMENTATION THERMAL INSULATION REQUIREMENTS

Engineering redesign of forward skirt compartment components — as a result of the J-2 engine chilldown requirement (ECP 0076) — has been completed. Heater blankets required for the rate gyros and servo-accelerometers were successfully qualification tested. Temperature sensitive transducers were either relocated to a more suitable area of the stage or successfully requalified to the ECP 0076 environmental criteria. Associated cabling components were similarly requalified to these new criteria.

PROPELLANT DISPERSION SYSTEM COMPONENTS - 60B02741

Qualification and reliability tests were successfully completed in March 1967. During test firing of the qualification test units (previously subjected to the low-temperature vibration environment), an anomaly was found in the penetration performance of the linear shaped charge (LSC). An extensive failure analysis revealed that the anomaly was caused by faulty packaging and handling procedures for the LSC prior to final assembly. After revision of the procedures, the charges were retested and performed successfully.

During the reliability test, the first test specimens experienced structural failures under vibration. An analysis of the stage static test data revealed that the test time was excessive. The test requirement was revised and the test was completed successfully.

PREVALVE SEQUENCING

As a backup for engine cutoff, the S-IC stage prevalves were originally intended to be closed upon an abort cutoff command. During an F-1 engine firing to test this engine cutoff method, prevalves were used for engine shutdown, and the turbopump was disintegrated. As a result of this problem, ECP 0164 was prepared to incorporate the prevalve interlock control circuits to eliminate the possibility of engine thrust termination by prevalves. In order to satisfy the crew safety requirements of having a redundant and safe engine cutoff system, an additional engine stop solenoid for each engine was incorporated by a Rocketdyne ECP.

PRESSURE SWITCHES

Consolidated Controls Corporation completed qualification of the 60B49030 pressure switches on February 15, 1967. This source was established to back up the initial contractor, Southwestern Industries.

STRESS CORROSION SURVEY

In October 1966, The Boeing Company initiated a resurvey of all S-IC stage hardware because several part failures were identified as stress corrosion cracking. All S-IC stage drawings were reviewed, and a total of 1,849 representative parts were identified as potentially susceptible to stress corrosion. Of these items, 319 required detailed analysis. At the conclusion of this exercise, 63 items were recommended for corrective action by engineering change memorandum (ECM).

HEAT SHIELD

An ingredient of the M-31 ceramic insulation which is used on the heat shield is tipersul, a fibrous potassium titanate. Upon notice from the supplier that the production of this material had been discontinued, it was stockpiled to support predicted S-IC heat shield requirements. An inventory of the stockpiled supply established that an insufficient supply was available to support the flight heat shield and spares requirements.

The use of an alternate ceramic material, FTA 442A, per MSFC specification 10M01828, is being documented for use on vehicles S-IC-10 through S-IC-15. Heat shield panels with FTA 442A insulation will be requalified to current predicted flight environment.

SAFETY AND ARMING DEVICE INOPERABLE - 60B02772 (INERT)

During checkout and static firing of the S-IC-1 and S-IC-2 vehicles, numerous operating failures of the inert safe and arming device were experienced. A failure analysis was successfully conducted. As a result of this analysis, more stringent inspection and test procedures were instituted at the vendor's facility.

THRUST RING SPLICE ANGLE FAILURE

Failures of several splice angles on the upper thrust ring splice angles on the S-IC-D vehicle resulted in a discrepancy check on existing installations for vehicles S-IC-T and S-IC-1 through S-IC-8. Three additional failures were reported on the upper ring splice angles of the S-IC-T. Failure analysis of the angles disclosed that stress corrosion was the cause of these failures.

ECP 0156 was implemented to reduce the possibility of failure resulting from stresses induced during assembly of the upper and lower thrust rings. The splice angles were replaced by splice plates made from 7075 material heat treated to T73 condition. This change is incorporated on vehicles S-IC-1 through S-IC-15.

TIMER CARD - 60B62101

Failures of the electrical timers were detected during reliability tests of the timer distributor, during post-static checkout of the S-IC-1 vehicle, and during functional testing of the timer cards. This failure mode was manifested by an essentially zero time delay output from the timer. An extensive failure analysis revealed that the zero time delay was caused by capacitive coupling of the start signal to the gate of the output silicon controlled rectifier. A filter capacitor in the gating circuit corrected the deficiency. As a result, ECP 0113 was prepared to modify the timer circuits.

TIME/CYCLE CHANGEOUT PROCEDURES

An analysis of data collected from the various test phases of the S-IC equipment showed that the useful life of certain limited life items could be expended prior to flight. ECP 0208 was prepared to assure that the S-IC stage would operate as nearly as possible, with equipment that had been through all of the test phases and yet had not expended its life limit. For this purpose, it was necessary to apportion the operation of limited life items for the various test phases. This apportionment facilitates timely changeout of components which, due to an excessive accumulation of operating time cycles, would eventually require replacement prior to flight or during one of the test phases.

THRUST VECTOR CONTROL SYSTEM SERVOACTUATOR

The exterior of the aluminum portion of the 60B84500 servoactuators has been painted (per ECP 0162) to further improve stress corrosion resistance capabilities. NASA/MSFC has similarily painted the 50M35008 servoactuators installed on S-IC-1 and S-IC-2.

STAGE CABLING AND ELECTRICAL/ELECTRONIC INSTALLATIONS

Qualification of metal sheath cable assemblies used in the engine instrumentation system was completed. These cable assemblies had been redesigned per PRR's 1021S and 1010S. Testing of silicon ablative tape, for protection of forward skirt cabling from the expected S-II ullage rocket motor blast (ECP 0091), was completed. Tests indicated that the tape is adequate.

Engineering drawings, for the installation of S-IC-3 and S-IC-4 static firing instrumentation, were prepared and released during FY 1967.

COMMON ORDNANCE

Contract Modification MICH-268 converted S-IC common ordnance items from contractor-furnished equipment to government-furnished equipment for stages S-IC-1 through S-IC-10. In response to this contract change, Boeing revised Class I documentation to reflect the vendor-Boeing part numbers and coordinated the closeout and/or termination of the vendor-Boeing subcontracts. Meetings were attended with North American Aviation and Douglas Aircraft Company which will be responsible for common ordnance management. This responsibility includes design, documentation, hardware allocation, supplier control, failure analysis, change control, and status reporting.

INSULATED CONFINED DETONATING FUSE - 60B02753

The qualification and reliability tests for these items were successfully completed by September 1966. There were no problems associated with the test specimens.

TELEMETRY SYSTEM

MSFC/Astrionics and The Boeing Company jointly approved flight clearance certifications for all R&D telemetry system assemblies. Qualification of the modified power supply (60B76137) for the single sideband top-deck assembly has been completed.

RF SYSTEMS

Boeing has not been able to verify the NASA qualification of the range safety decoder (50M10698) and the

ODOP transponder (50M12181-1A) to the contract end item specification for the S-IC.

The assemblies listed below have been qualified and certification letters submitted to the customer:

a) 60B75130-1B and 60B75130-3B, telemetry multicoupler:

b) 60B74941-1 range safety antenna;

c) 60B74959-5D, range safety hybrid ring;

d) 60B74959-3C, range safety hybrid ring; and

e) 60B75160-5C, telemetry RF power divider.

ENGINEERING TEST PROGRAMS

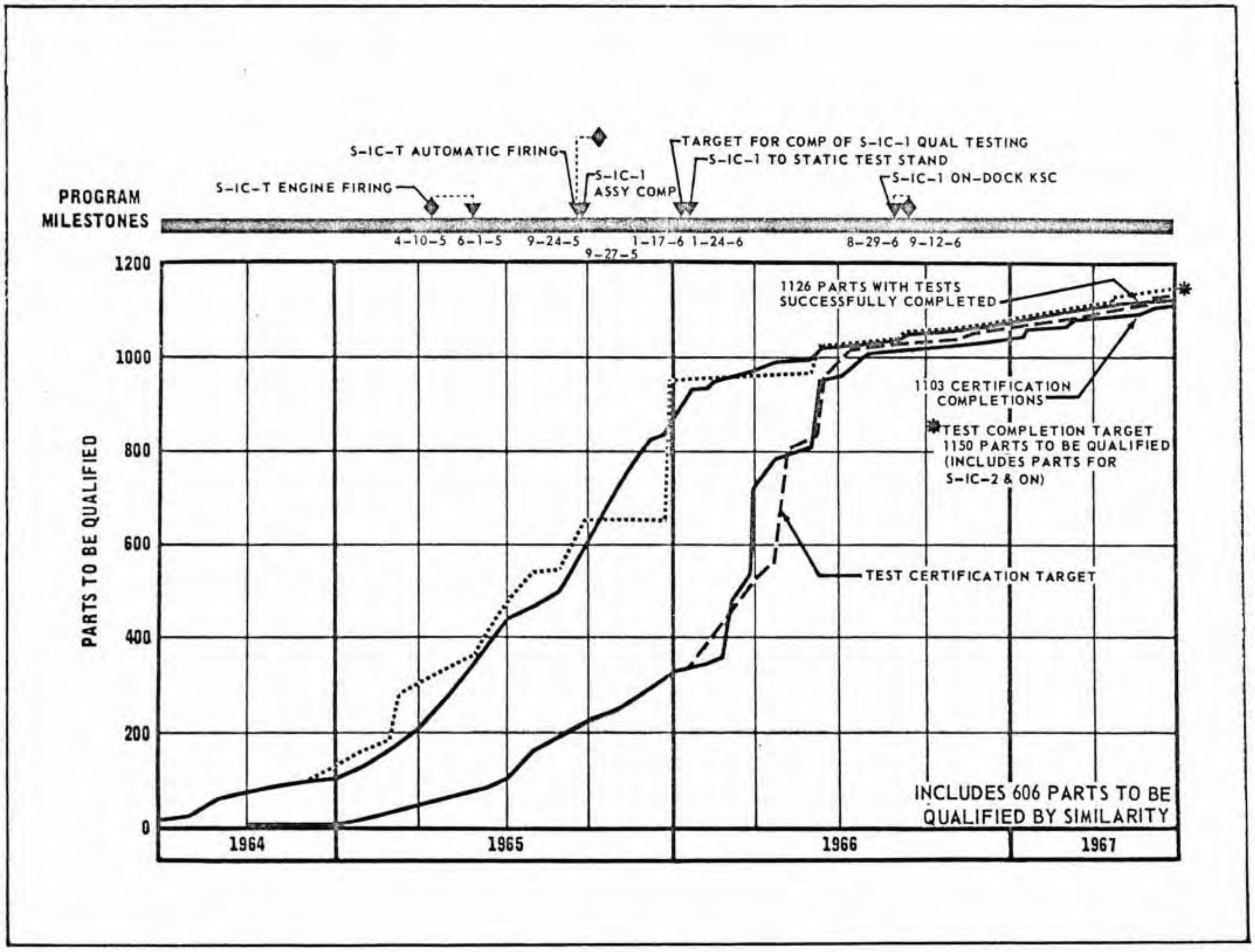
QUALIFICATION TEST PROGRAM

Boeing/MSFC designated parts - During this fiscal period, qualification testing for 75 components was successfully completed (see Figure 2-18). During this report period, the number of components certified has increased by 119 from 977 to 1,096. Sixty-two components remain to be certified; three are for the S-IC-1.

RELIABILITY TEST PROGRAM

Test program - The reliability test program started the fiscal year with 19 tests scheduled for a program

Figure 2-18 S-IC Qualification Test Summary



completion date of July 14, 1967. These tests included 12 propulsion/mechanical tests and seven electrical/electronics tests. Three tests were being conducted at the start of the fiscal year. During the reporting period, 19 tests were initiated; six propulsion/mechanical and one electrical/electronics tests were added to the schedule; three tests were cancelled; and 17 tests were completed. At the end of the fiscal year, five propulsion/mechanical tests and one electrical/electronics test remain to be completed. Completion of the program is now scheduled for November 6, 1967, instead of the original date of July 14, 1966. (See Figure 2-19.)

Factors which contributed to this change in program end date are as follows:

a) The net increase by four in the total number of tests;

b) Management's direction of giving top priority to the evaluation testing of the S-IC pneumatic console and associated GSE hardware in the High Pressure Test Facility schedules; and

c) A 2-1/2 month down period in the High Pressure Test Facility due to a high pressure line failure on March 11, 1967. (See pages 38 and 39 for details of this failure.)

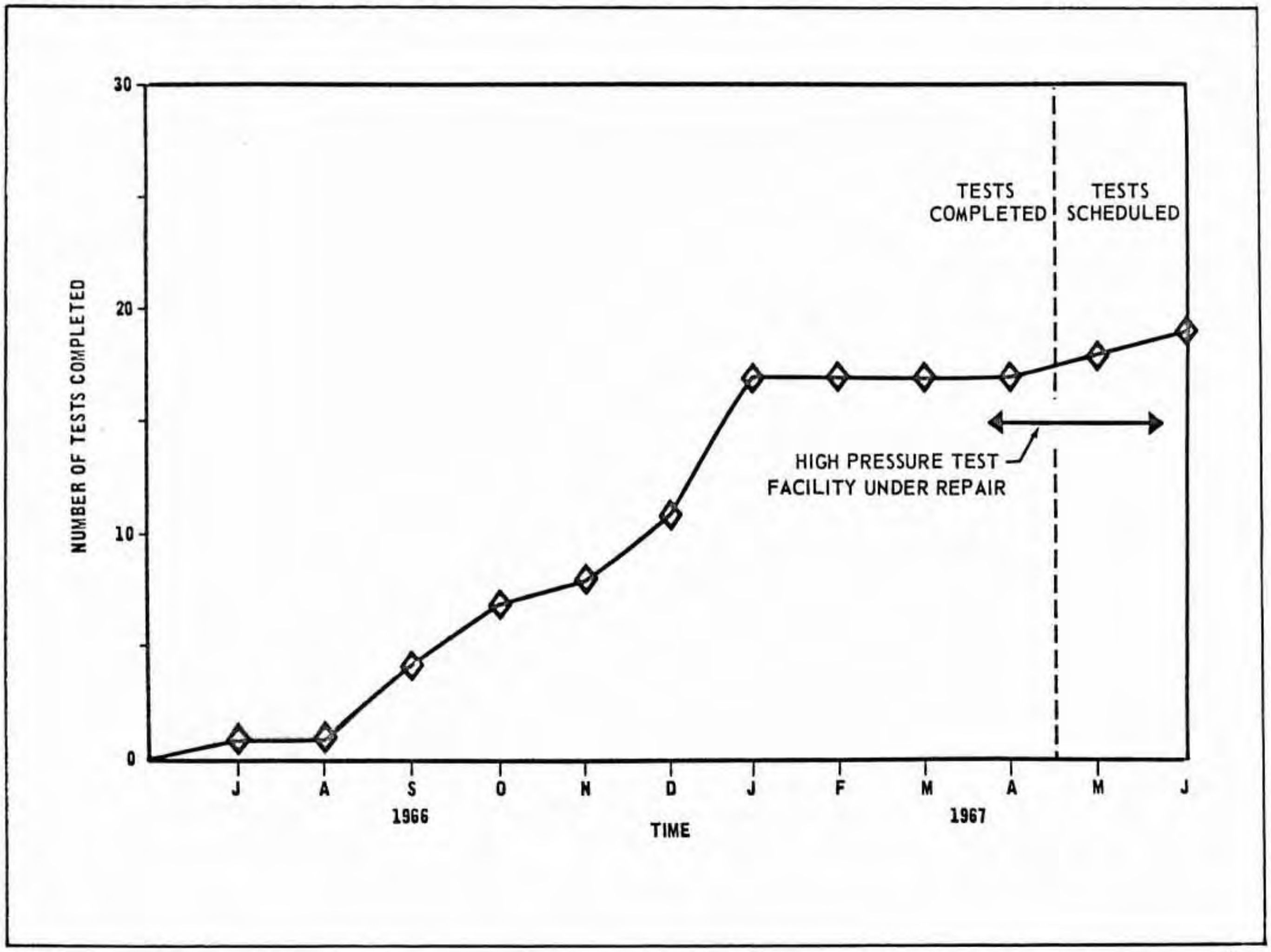
The following tests were successfully completed during the reporting period:

Propulsion/Mechanical Flow Tests

a) Helium container manifold;

b) Upper hot helium supply duct assembly;

Figure 2-19 Reliability Test Completions



c) Lower hot helium supply duct assembly;

d) Fuel pressure feeder duct assembly;

e) Cold feeder duct assembly; and

f) Hot feeder duct assembly.

Non-Flow Propulsion/Mechanical Tests

a) Fuel bi-level cutoff probe;

b) Pressure switch and bracket;

c) LOX interconnect duct assembly;

d) LOX prevalve; and

e) Pressure relief switch.

Electrical/Electronics Tests

a) Timer card;

b) Thrust OK distributor;

c) Propulsion distributor;

d) Sequence and control distributor;

e) Battery; and

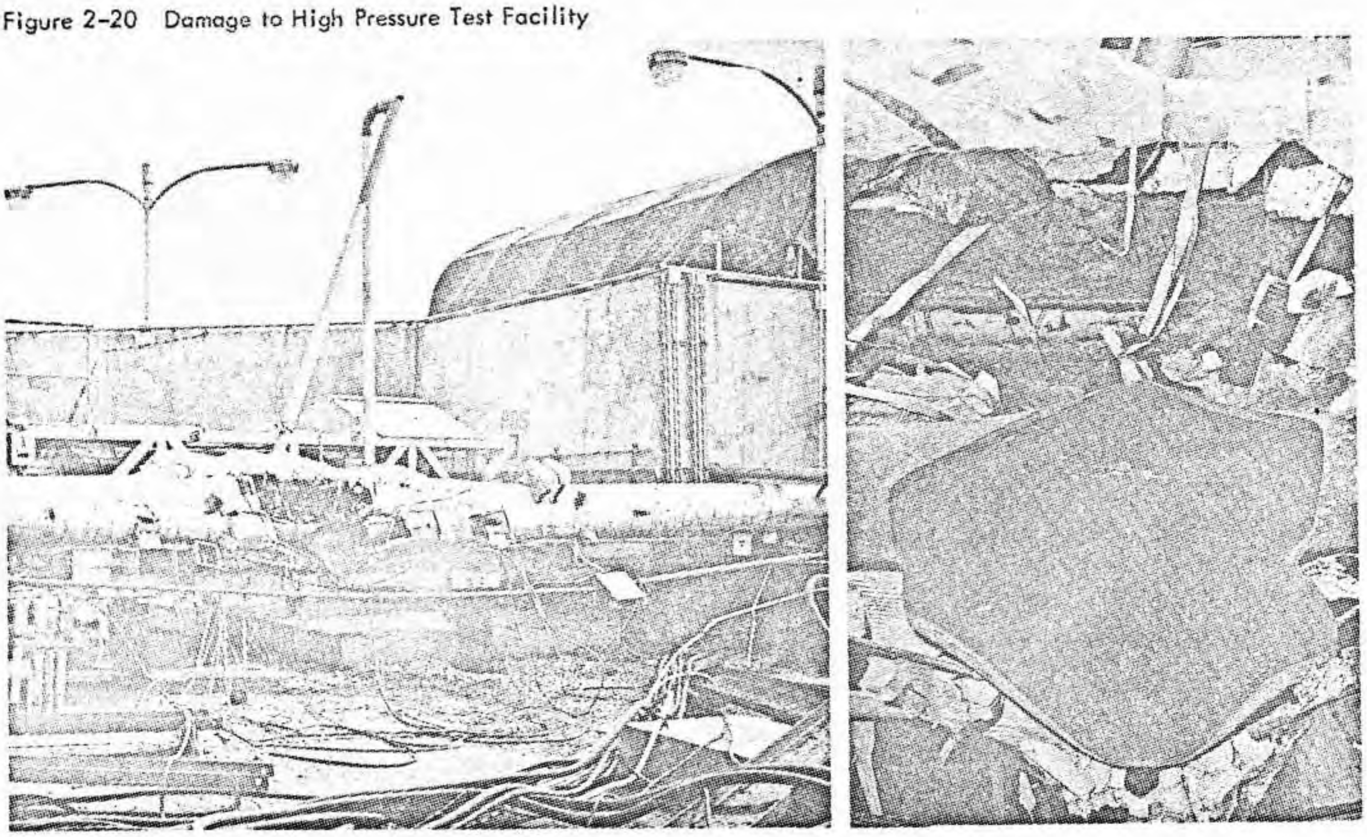
f) Main power distributor.

To improve the reliability schedule and date, the LOX interconnect duct assembly test was conducted by Boeing in Seattle. The engine purge system regulator test is scheduled to be conducted in the Chrysler Facility at Michoud.

HIGH PRESSURE TEST FACILITY FAILURE

On March 11, 1967, a six-inch hot nitrogen-helium test supply line ruptured after being pressurized with gaseous nitrogen to 3,200 psig at an indicated pipe

Figure 2-20 Damage to High Pressure Test Facility



temperature of 610° F. The pressurization was preparatory to conducting reliability test R409/413.

High pressure gas flow from the two-foot wide rupture caused the pipe to deflect into and damage the adjacent four-inch vent line, four-inch N/He cold line, and the three-inch LN line, all of which are supported by a common pipe rack. Movement of the pipes caused extensive damage to pipe supports nearest to the rupture, and, in addition, conduit cabling, instrumentation, and miscellaneous items were damaged from the force generated by the rupture. Figure 2-20 illustrates the damage to the testing facility. A board of investigation appointed by the Michoud Manager produced the following findings relative to the failure.

a) Metallurgical examinations of the area of the pipe that failed showed the material had a spheridized structure indicating that at some time the material had been heated to over 1,000 degrees F but less than 1,350 degrees F.

b) Properties of the ruptured pipe indicated an ultimate strength of 12,800 psi at 1,250 degrees F; therefore, it was concluded that the failure was due to overheating of the pipe caused by installation of improper heater elements.

In order to avert similar failures, the hot line system has been redesigned with suitable improvements in the heater and heater control design. The averaging thermocouple system was eliminated, and additional temperature monitoring instrumentation was included. More stringent procedures have been initiated to maintain facility configuration control.

Lightning struck an electrical power distribution line at Michoud on June 20. As a result of this, a power loss was experienced, affecting primarily the Stage Test Facility and High Pressure Test Facility. Steps were taken to make safe the S-IC stages (S-IC-6, -4, -3, and -F) in the Stage Test Facility. There was no stage hardware being tested in the High Pressure Test Facility. Several pieces of facility equipment were damaged. Full power will be restored to the building by July 1, 1967, and was restored to the High Pressure Test Facility by June 22, 1967.

The major actions taken by Boeing Management as a result of this incident were:

a) Emergency stage protection action was accomplished by stage test personnel immediately after the power interruption to make safe the S-IC stages (S-IC-6, -4, -3, and -F).

b) Second shift personnel, in affected areas, were notified not to report to work. Affected first shift personnel were reassigned to productive work.

c) Facilities immediately initiated the acquisition of emergency replacement equipment, i.e. 75 KVA motor/generator prime mover; rented two 312 KVA motor generator sets; obtained by loan from Mason Rust a 1,500 KVA transformer.

d) Issued Flash Report of incident.

e) Conducted a Boeing Management review the morning of June 21.

f) Michoud Contracts advised the NASA Contracting Officer of the Power Outage on June 21.

g) Released Facility Damage Report by June 22, 1967.

STRUCTURAL TEST

The S-IC Structural Test Program was initiated during January 1965 and was successfully completed in mid-June 1967. This test program demonstrated the adequacy of the S-IC structure by its ability to withstand the ultimate design conditions. (Ultimate design conditions exceed the maximum operating conditions by a factor of 1.4.) Components (S-IC-1 configuration) that were tested in FY 1967 were the LOX tank assembly, the forward skirt, the base air scoops, the fairing-to-stage attach fittings, and the apex gore assemblies. A design ultimate pressure test was performed on the S-IC-1 fuel tank. Testing of the short LOX tank was completed, including a design ultimate pressure test. The S-IC-5 apex gore assembly tests were also completed during the year. In addition to demonstrating the structural integrity of the S-IC stage, we were able to identify two potential structural problems (both of minor significance) and take the necessary corrective actions. In one case, higher strength bolts were used to fasten the heat shield support panels to the structure: and in the second case, the cruciform baffle stiffener in the fuel tank was reinforced to provide a sturdier structure.

DEVELOPMENT TEST

Development test activities during the fiscal year concentrated on the resolution of design data problems and discrepancies identified during manufacturing, static firing, and qualification testing. Support was also provided for Boeing and contractor out-plant development problems.

During the fiscal year, 196 new development tests were initiated. These include 105 mechanical electrical tests and 91 materials and processes tests. Figure 2-21 illustrates the number of tests initiated and completed during the year. Tests completed during the year totaled 169. At the end of the fiscal year there were 37 tests scheduled and 14 tests in progress.

The following tests completed during this period contributed to a change in part design:

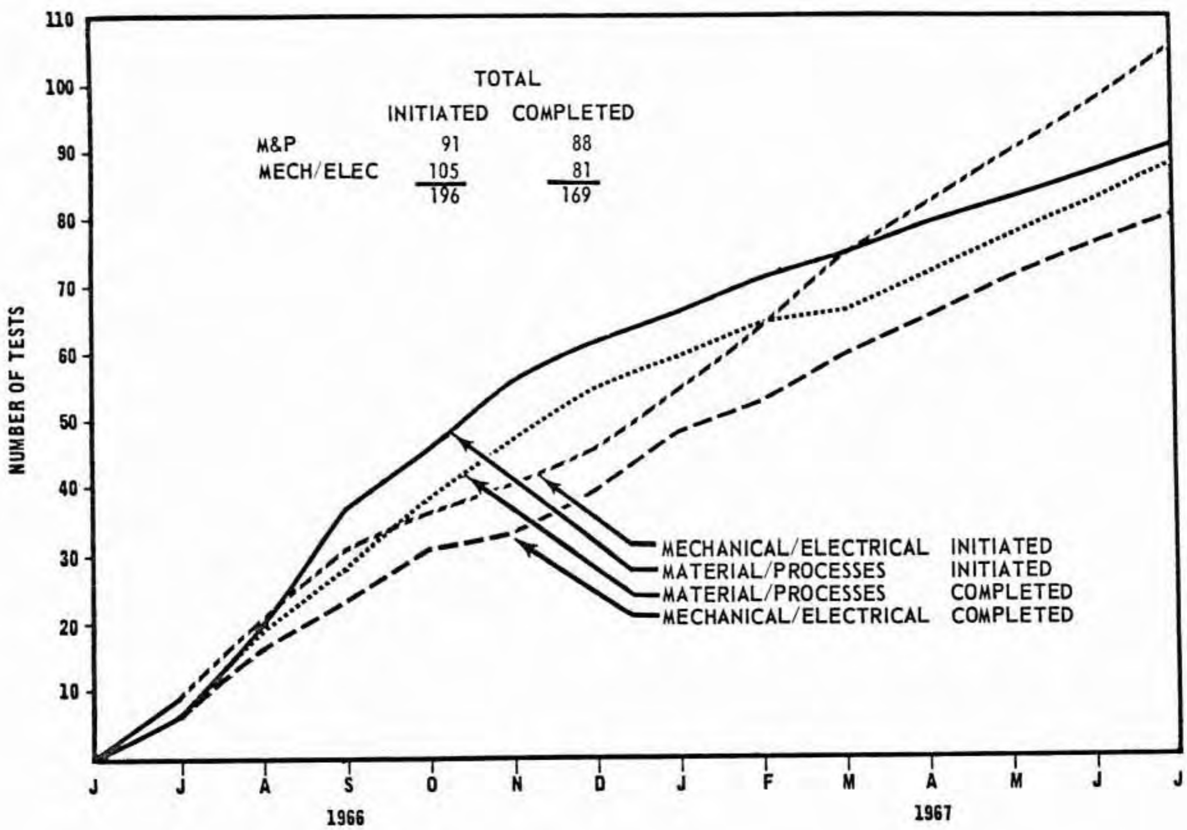
a) D504 - System integration of LOX tank optics, strobe, timer, and camera: and

b) D13105 - Timer cards.

The following are development tests, scheduled for completion by July 1, 1967, that deal with current problems:

a) D13072 - Seal leakage test;

Figure 2-21 Development Tests Initiated and Completed During FY 1967



b) D13169 - Fuel tank drain test;

c) D13175 - Evaluation of MBR 37496-9 and -10 relays;

d) D13177 - Quality Assurance Inspection of MBR 37496-10 relays; and

e) M/P 171C - Dimensional stability of BMS 8-38 foam (heat shield).

SYSTEMS AND STUDIES

DAMAGE STUDIES

As part of a branch system safety study, engineering conducted a stage damage prevention study for the S-IC-4 stage during countdown and static firing at MTF. The purpose of this study was to identify the sources of potential stage damage. For the study, damage was defined as an imposed condition (including hardware malfunctions, procedural, and operational errors) which caused a design limit to be exceeded. A form of fault tree analysis was used to establish the potential damage sources. At this time, the preliminary results of the study are being reviewed by Design Engineering to establish disposition. When completed, the total study will be documented in D5-13704 which is scheduled for release early in the next quarter.

ELECTROMAGNETIC COMPATIBILITY

Electromagnetic compatibility (EMC) testing of MSE Michoud Complex II was successfully completed early in the first quarter of FY 1967. This testing was accomplished on stages S-IC-3, S-IC-4, and S-IC-5 during FY 1967, and the test results documented in T5-6742-3, -4, and -5, respectively.

Out-of-specification transients were detected on a small percentage of the monitored stage circuits during the EMC testing on each of the three stages. None of these transients, however, caused a stage system failure or an electromagnetic incompatibility between stage components. Special tests showed that the primary source of these transients was the stage solenoids. Suppression of this source was implemented by ECP 0180. Additional testing has been accomplished to isolate and suppress the remaining transients which appear to result from power application, removal, and transfer operations. Analysis of the test results and initiation of feasible corrective action should be completed within the first quarter of FY 1968.

S-IC-F REINSPECTION

During November of 1966 the customer proposed an inspection of the ring baffles in the S-IC-F with the object of establishing the damage, if any, resulting from tanking operations. As a result of this suggestion, Boeing proposed an extensive reinspection of the S-IC-F for possible other damage or deterioration caused by handling, usage, and the Florida weather environment. Upon receipt of NASA authority to proceed with the complete reinspection, S-IC Engineering issued a reinspection plan which had been developed in a series of meetings among personnel of Engineering, Operations, Safety, Program Planning and Reporting, and Systems Test. The reinspection of S-IC-F was carried out in test cell 3 of the Michoud Stage Test Building over a period ranging from February to April. A full report containing the findings made during the reinspection was issued as Document D5-13730, "S-IC-F Reinspection Program." Each discrepancy found during the reinspection was dispositioned according to standard unplanned event record procedures. (See Page 20.)

CONTRACT END ITEM (CEI) SPECIFICATIONS

Part I CEI Specification CP02S00001103D, dated March 15, 1967, (stages S-IC-3 through S-IC-10) was authorized by Supplemental Agreement MICH-443 to CPIF Contract NAS8-5608. This CEI specification, which supersedes Addendum CEI Specifications CP02S00001103C through CP02S00001110C, contains all contractually approved changes through March 15, 1967. The S-IC-3 stage was delivered with four Boeing CEI nonconformances and one NASA nonconformance. Three of Boeing's nonconformances and the NASA nonconformance were related to certification of propellant dispersion systems components. Abbreviated draft copies of the PART II S-IC Stage (S-IC-3 through S-IC-10) CEI Specification, were transmitted to NASA in April 1967. This specification, which was based on the 66B10903 end item test plan, was approved by NASA in April. Completed copies will be incorporated into CPIF Contract NAS8-5608. Part II CEI Specification defines the CEI in terms of the detail product configuration and thus establishes the configuration baseline for delivery of all S-IC stages.

INTERFACE CONTROL DOCUMENTATION (ICD) AND INTERFACE REVISON NOTICES (IRN)

Via Supplemental Agreement Mod. MICH 434, all ICD's and IRN's with which Boeing concurred as of March 1, 1967, have been incorporated into the applicable CEI specifications. Updates of the CEI specifications are to be made on a monthly basis via administrative engineering change proposal. The first update (ECP 0032-55) was submitted on April 1, 1967.

Boeing (as of June 30, 1967) listed 11 ICD's not compatible with Class I documentation, 29 ICD's which are completely acceptable, four ICD's in Boeing review, one ICD which Boeing has rejected and NASA wants to delete from the S-IC contract, and seven ICD's not received. The ICD's are identified in the June 1, 1967, issue of MA-004-002-2H, "Saturn V-S-IC Interface Control Documentation Contractual Index and Status Report," which was incorporated into the CEI specifications for configuration baseline purposes by Mod. MICH-434.

GSE/MSE DESIGN

S-IC PNEUMATIC EQUIPMENT

S-IC pneumatic console - MTF - During the S-IC-T static firings at MTF, three problems were experienced with the S-IC pneumatic console and the interconnect piping between the console and the stage:

a) Both the LOX and fuel prepressurization module flowrates were low due to excessive pressure drop in the interconnect piping. PRR 1202G has been processed to correct the problem by increasing the piping internal diameter.

b) Excessive pressure drop was also experienced in the LOX dome purge module interconnect piping and the piping was changed to a larger diameter. The 1,000 psig required lockup pressure was exceeded on both MTF S-IC-T firings (1,100 psig and 1,047 psig, respectively). Analysis of all test data from R-Test static firings, S-IC-T through S-IC-3, revealed that the lockup pressure ranged between 960 psig and 1,140 psig with no adverse effects being detected. Rocketdyne has been requested to review the static firing data and to raise the lockup pressure requirements.

c) During the successful S-IC-4 static firing on May 16, 1967, all stage pneumatic requirements were met except that the LOX dome purge pressure locked up high at 1,025 psi. The helium bottle fill regulator was inoperative and the stage bottles were filled using manual control of the console isolation valve. Regulator failures during pre-static checkout operations posed a problem and corrective ECM's are in preparation.

S-IC pneumatic equipment - KSC - A critical design review was held December 18, 1966, on the S-IC pneumatic console, pneumatic checkout racks, and forward umbilical service unit, including MTF and KSC electrical controls and interlocks. No additional major design problems were discovered at that time. Design corrective action for component failures has been initiated by ECP's.

A member of Michoud Management (Michoud Facilities Manager) is now on special assignment to direct the resolution of the pneumatic equipment problems. A special study is being made to improve the reliability of the pneumatic console, to incorporate improvements prior to AS-501 roll-out (to obtain maximum reliability within the remaining time), and to plan for additional improvements subsequent to AS-501 flight.

Michoud Management has formulated a plan to preclude the possibility of pneumatic equipment problems causing a delay in the AS-501 launch. This plan includes six committed changes, one change which is now in the process of being committed, and seven items that Michoud Engineering is studying for additional improvements to resolve component failures.

On June 28, 1967, the NASA/MSFC S-IC Stage Project Manager reviewed this Michoud Management Plan. As a result, NASA concurrence was obtained to proceed on the changes as listed below.

Committed

ECP	119	Console Vent and Relief Circuitry
	220	The Pressure Transducers
	225	Manual Ball Valve
	229	Solenoid Valves
	246	APCO GN_2 Regulator
	262	Helium Bottle Fill Regulator

In Process

ECP 244 LOX Dome Purge Regulator

Additional Items

- Investigate Stage Damage Potentials
- Marotta Solenoid Valve
- Flodyne Ball Valves
- Redundancy of Components in Critical System
- Pneumatic Console Maintenance
- Pneumatic Console Improvement Program
- Qual Test of Ladewig Relief Valve

S-IC/SATURN V AFT UMBILICALS

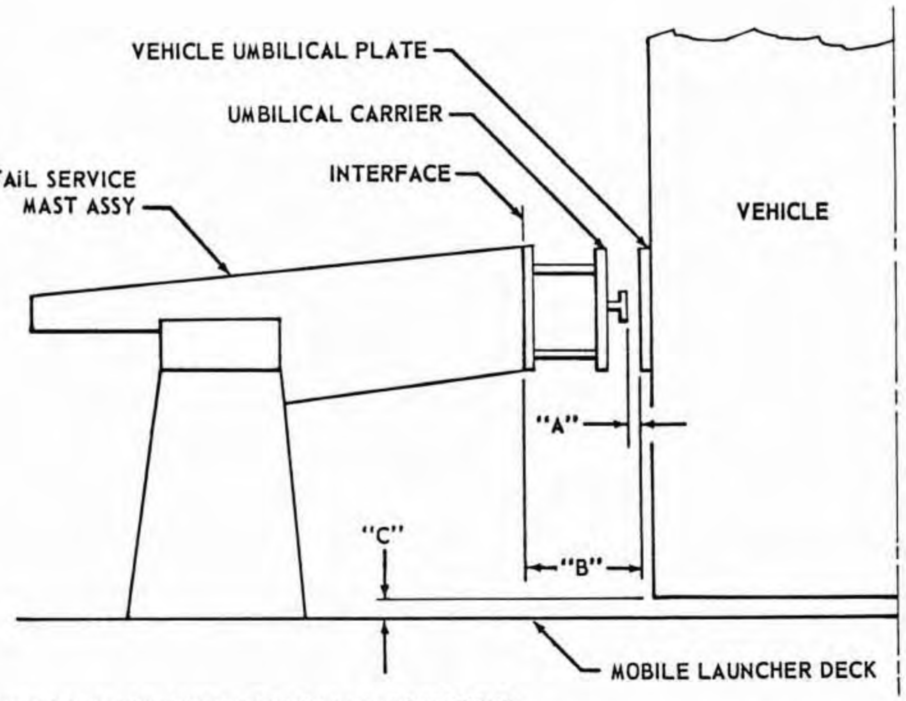
Three problems have been identified which could prevent satisfactory disconnect of the S-IC aft umbilicals at launch. These problems are:

a) The tail service masts for S-IC-1 are installed on the mobile launcher platform too close to the stage. The umbilical carriers were designed and qualified to a specified distance of 32.87 inches between the vehicle umbilical plate and the tail service mast: however, actual installed dimensions for the S-IC-1 are as much as two inches less than this dimension. (See Figure 2-22.)

Tests of the complete umbilical carrier/tail service mast systems have been conducted by NASA in Huntsville with the hardware installed to simulate the S-IC-1 configuration. Minor hardware modification (removal of rubber bumpers) and an increase of the kick-off pressure (500 psig to 750 psig) permitted satisfactory operation of the entire system. These tests included simulation of 2.5 inches of vehicle horizontal (radial and tangential) motion. The results were satisfactory. ECP 0205 has been approved to incorporate the above modifications.

b) The horizontal motion of the vehicle during the first 10 inches of vertical rise may exceed the

Figure 2-22 Stage Dimensions Versus Mobile Launcher Platform Dimensions



FOLLOWING DIMENSIONS ARE GIVEN FOR NOMINAL CONDITIONS.

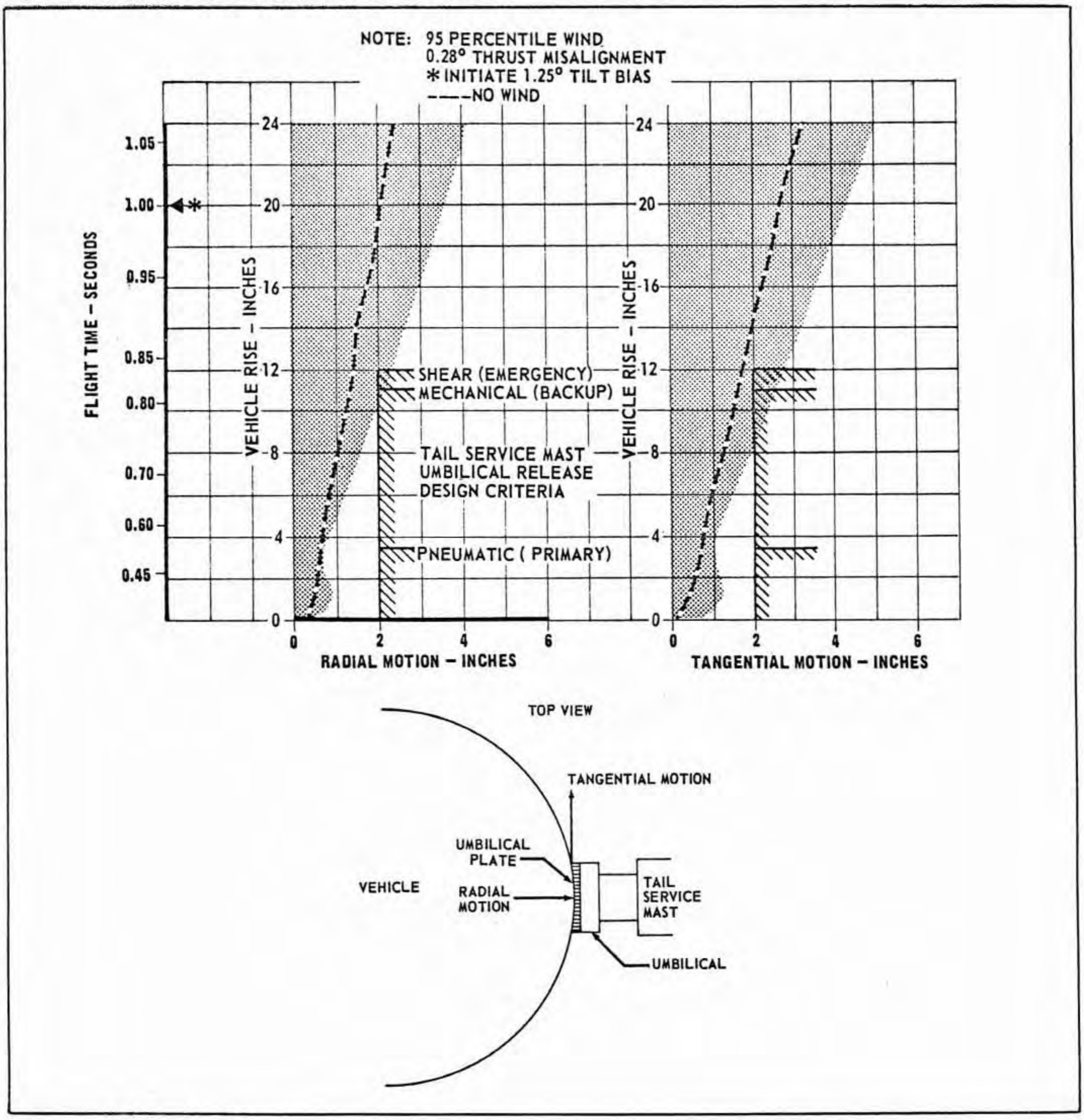
1. "A" = 3 IN. - MINIMUM CLEARANCE BETWEEN UMBILICAL CARRIER AND VEHICLE PLATE
2. "B" = 32.87 IN. - DIMENSION REQUIRED BY DESIGN CRITERIA BETWEEN VEHICLE PLATE AND INTERFACE
3. "C" = 3.5 TO 4 IN. - VEHICLE RISE AT NORMAL UMBILICAL DISCONNECT

MAJOR VARIABLES

1. VEHICLE KICK - 2" (SIDE MOVEMENT AT LAUNCH)
2. WORST CASE TSM - 2" (TSM INSTALLED ON MOBILE LAUNCHER PLATFORM TOO CLOSE TO STAGE)

movement capability of the S-IC aft umbilical carriers. Should horizontal displacement due to wind loading and engine misalignment exceed 2-1/2 inches before approximately 3-1/2 inches of vehicle rise, the primary umbilical disconnect mode (pneumatic) may not occur. If the horizontal displacement of the vehicle exceeds 2-1/2 inches before approximately 10 inches of vertical rise, the secondary (mechanical) and emergency (break-away) modes of disconnect may not occur. (See Figure 2-23.) Theoretical analysis of worst-condition vehicle motion indicates that horizontal

Figure 2-23 Radial and Tangential Motion of Vehicle



displacement will not exceed two inches until approximately eight inches of vehicle rise. Therefore, no difficulty is expected with the primary umbilical disconnect mode. ECP 0040-1 (KSC) was prepared by BATC providing for modification of the tail service masts to allow approximately 2-1/2 to 3 inches of motion capability of the umbilical carriers. Testing of the complete umbilical carrier/tail service mast system, which was begun in May 1967 to verify this increased motion capability, is proceeding successfully. Successful completion of the testing will mean that no difficulty is expected with secondary and emergency modes of the umbilical disconnect.

c) The third (emergency break-away) mode of umbilical disconnect was not previously tested. This mode is required to function if the primary (pneumatic) and secondary (mechanical) disconnect modes fail to operate. Documentation has been released under ECP 0213 to provide for redesigned stage umbilical hardware that permits satisfactory operation of the emergency mode of disconnect.

LIGHTWEIGHT MANUAL ENGINE ACTUATOR (LMEA)

The lightweight manual engine actuators (LMEA) required (by CCP 9001) to support the S-IC stage at KSC were received from the vendor. A considerable number of discrepancies were found in the power pack, resulting in its return to the vendor for corrective action. The delay in receiving adequate vendor hardware caused Boeing to provide heavyweight manual engine actuators to KSC to support SA 501 and SA 502 until useable LMEA hardware can be obtained.

GSE/MSE RANGE SAFETY

Stage level test equipment - Documentation necessary to reflect the GFE to contractor furnished equipment conversion of design responsibility for the range safety and ordnance test set as completed during the first quarter of FY 1967.

The data systems ground equipment, range safety test system, and ODOP test system met all design objectives during S-IC-3, S-IC-4, and S-IC-5 post-manufacturing tests and S-IC-3 post-static tests at Michoud. Data systems ground equipment also met design objectives during S-IC-3 static firing at R-Test and S-IC-T static firing at MTF. Minor modifications to correct design problems were initiated and incorporated without schedule impact. Final engineering evaluation tests on the above equipment were completed early in the first quarter of FY 1967. These tests demonstrated that equipment design objectives were met and that all equipment interfaces were compatible.

RP-1 MICROBIC CORROSION

As a result of identification of microbiological organisms in a GSE fuel storage system at MTF, fuel samples were taken from the S-IC-F vehicle to determine whether microbiological organisms were present in the fuel tank. The S-IC-F vehicle samples contained various microbiological organisms. Further analysis is in progress to identify the type of organisms present, since only certain micro-organisms are capable of causing corrosion of metallic containers by forming oxygen concentration cells. At present, no cases of corrosion have been identified; however, the investigation is being actively pursued.

PURCHASED COMPONENTS

Considerable effort was expended during the fiscal year in tracking and analyzing failures of purchased components. This effort was taken to insure timely resolution of problems in design testing usage. The overall indication is that the failure rate of purchased components is continuously decreasing.

KSC TEST PROCEDURE REVIEW

In October 1966, Change Order 305 was received, authorizing review of KSC prelaunch test procedures and launch vehicle test requirements as related to specific stage test requirements and test specifications and criteria. To date, 490 S-IC-1 stage and GSE procedures have been received from KSC for review and comment, and 404 of these procedures have been answered by 35 reports submitted during the period of November 14, 1966, to June 30, 1967. The remaining 86 procedures are presently in work.

Fifty-six procedures are required by Document D5-13618, "Specifications and Criteria for S-IC Stage Prelaunch Checkout and Launch Operations at KSC." Review has been completed on 42 of these procedures, six are still in work, and eight have not yet been received.

DEVELOPMENT TEST ACTIVITIES

Development test programs on the S-IC pneumatic console (D5-13158) and the ground prevalve accumulator assembly (D5-13156) have been initiated as a result of regulator failures experienced during S-IC-3 static firing operations. In order to define specific problem areas, a test which will operate the complete pneumatic console 25 cycles in the launch countdown mode, was initiated on June 1, 1967.

Individual launch critical components are in life cycle test under tests D5-13157 and D5-13158-1 through -8. Twelve of the component tests have been completed, leaving eight tests yet to be completed on relief valves, pneumatic actuated ball valves, and solenoid valves. Vacco and Grove regulators are being evaluation tested in a mockup that simulates the actual installed system as closely as possible. The test program began on May 19, 1967, and two out of the six tests have been completed.

R-QUAL

Post Static Checkout (PSC) was completed on the S-IC-1 and S-IC-2, and the stages were subsequently prepared for shipment to KSC in July 1966 and January 1967, respectively.

The test and checkout complex was transferred to the R-Qual laboratories in March 1967, with certain portions of the data transfer package (updated documentation, programs, etc.) scheduled to be delivered in the next fiscal year. Design support was provided until the transfer was completed.

R-TEST

During the successful static firing of the S-IC-3 at the R-Test static test stand on November 15, 1966, regulator failures in the pneumatic console were experienced. ECP 0171 was initiated to redesign the regulator, conduct developmental and qualification testing, and to develop a second vendor source. Design support was provided until static firings were completed.

MICHOUD

General technical consultation and design support were provided during the fiscal year as required for resolution of stage and GSE problems encountered during PMC of the S-IC-3, S-IC-4, and S-IC-5. This same service was also provided during PSC of the S-IC-3.

Environmental control system (ECS) air flow measuring capability was added to the ground cooling unit installation to allow verification of the installed stage ECS configuration.

MISSISSIPPI TEST FACILITY

Engineering design support provided on-site technical consultation to the Systems Test organization and their subcontractors in the installation, calibration, and checkout of support equipment in the test complex. An interim installation was made adjacent to the Test Control Center to allow checkout prior to installation on the test stand. Access to the test stand was granted during the first quarter of the fiscal year and installation of support equipment began in a few areas. During installation, design problems were resolved by on-site design support while appropriate corrective action was being initiated. CCP 9078 was initiated to cover those design changes in support equipment installation that resulted from inconsistencies in the interface requirements. CCP 9109 was submitted to assume design responsibility of certain static firing critical GFE. This CCP was subsequently disapproved by the customer, but a drawing review of the static firing critical GFE has been initiated.

A magnetic tape machine was ordered to augment the data retrieval capability of the digital events evaluator (DEE). A critical design review was held on the terminal countdown sequencer and the ignition sequencer with a verification of design resulting from the review. A critical design review of the ground hydraulic system was held and resulted in PRR 1188, which added over pressurization protection and filtration capability.

CCP 9202 was approved to provide for installation of GFE backup hydraulic power supply unit (HPSU) and associated equipment at MTF. The basic unit at MTF is identical to the R-Test unit which has experienced numerous failures and has a poor reliability history.

The S-IC-T arrived on-site on October 23, 1966, and was stored in the Booster Storage Building. Configuration checks, consisting of a Brooks Analyzer checkout of all wiring and a physical verification of mechanical equipment were completed on December 17, 1966, and the stage was installed in the static test stand on December 18, 1966. The S-IC-T static firing test plan for demonstration of MTF site activation, was released on December 30, 1966, as a part of MTF test plan 66B500002. On December 1, 2, and 6, 1966, an on-site critical design review of MTF control circuits and interlocks was conducted. Action items generated at this review were assigned and completed prior to the S-IC-T captive firings.

The S-IC-T captive firings occurred on March 3, 1967, and March 17 with no major problems. These firings verified a suspected deficiency in the LOX and fuel prepressurization systems. The requirement for flowrates of four pounds per second could not be met due to excessive pressure drop in interconnect piping. PRR 1202 was initiated to correct this deficiency. The S-IC-4 captive firing occurred on May 16, 1967, without CCP 9202 (backup HPSU) or PRR 1202 implemented. However, no major problems were encountered.

KSC configuration was provided for the MTF test stand by Mod. 102. This change necessitated the reworking of the bulkhead protection equipment (MTF) to a new configuration that can be used with the GFE static firing S-IC internal access platform set (Previous configuration was not compatible with the new KSC configuration). Engineering changes have been released for this rework.

KSC

Proposed engineering changes to the bulkhead protection equipment to accommodate a North American Aviation request to revise the S-IC/S-II Interface Control Document were disapproved by NASA. Revision would have permitted stage personnel to walk on the protected LOX bulkhead. Disapproval of the changes by the NASA Level III CCB has created a serious problem for S-II personnel in providing maintenance access to the S-II engines. Boeing is working with S-II and NASA personnel in an effort to resolve this problem.

AUTOMATED BOEING CALIBRATION DATA SYSTEM (ABCD)

S-IC Engineering Software System Operations has been organized within one engineering group to assure consistent control and operation of automatic test procedures and ABCD products. Documentation has been released to define:

a) The total S-IC software system requirements encompassing all automatic procedures and data products;

b) The tape format of the Apollo/Saturn Calibration Tape (A/SCT) and ATOLL Test Procedure Tapes; and

c) Input data type and format.

These documents, transmitted to NASA per CCP 9140 (MICH 263), are as follows:

a) D5-13681 "S-IC Test and Checkout Software System Requirements"

b) D5-13708 "The Apollo/Saturn Calibration Tape and Microfilm Data Requirements"

c) D5-13674 "Specifications for ATOLL Procedure Tapes"

d) D5-13159-1 "On-Line Data Input System Tape Version II Specifications (ODIS II Tape)"

e) D5-13746 "Description of Instrumentation/ Telemetry Data on Computer Tapes"

ABCD data products have been delivered in the form of magnetic tapes and computer printouts as follows:

Stage	Test Location or Phase	Product	Date
S-IC-1	KSC	A/SCT Tape and 4020 Microfilm Plots	4/24/67
S-IC-2	PSC	ODIS Tape and Associated Listings	2/13/67
S-IC-3	PSC	ODIS Tape and Associated Listings	5/16/67
S-IC-4	MTF	A/SCT Tape and 4020 Microfilm Plots	5/8/67
S-IC-5	PSC	ODIS II Tape and Associated Listings	6/2/67
S-IC-5	MTF	ODIS Tape and Associated Listings	4/6/67
S-IC-6	PMC	ODIS II Tape and Associated Listings	5/29/67

RELIABILITY ANALYSES

SYSTEM DESIGN ANALYSIS

Documents D5-12572-1, "S-IC System Design Analysis - Propulsion/Mechanical", and D5-12572-2, "S-IC System Design Analysis - Electrical, Electronic and Ordnance," are continuously being updated with failure mode and effect analyses (FM&EA) and probability analyses. All data for the S-IC-2 has been input to the computer and agrees with the latest S-IC-2 configuration.

SPECIAL STUDIES

"Hydrogen Explosion Hazard Survey," was released as Document D5-13693 in December 1966. This survey revealed that no hydrogen explosion hazards exist for the S-IC-2 and S-IC-3 stages.

The "Maintenance Action Rates" (MAR-1 for S-IC Components) report was released in September 1966. This report, making extensive use of the digital events evaluator for its content, permits the use of time cycle data from the DEE printout in the assessment of part failure rates provided by logistics. Individual MAR's for 22 S-IC stage electrical components were included in D5-13604-1, "S-IC-4 Stage Maintenance Analysis."

A special redundancy study was conducted to support the Saturn V Hold/Recycle Decision Criteria. This study, which analyzed the probability of multiple failure, was completed and the results forwarded to NASA.

RELIABILITY TEST PROGRAM

A review of the S-IC Reliability Program was held on July 28, 1966. NASA and Boeing reliability personnel participated in this review as required by the Reliability Program Plan, D5-11013. The review summarized the program to date, provided the current status by audit findings, and described the activities currently in progress and projected for the future. No major conflicts were noted.

The Reliability Program Plan was signed by NASA and Boeing and released on November 18, 1966. This release reflects the format and requirements in IN-I-V-S-IC-65-18, NAS8-5608, Schedule I, CPIF, dated November 1, 1965.

A product quality survey was initiated to review and update existing stage and GSE failure mode and effect analyses (FM&EA). The updating covered hardware and time intervals not previously analyzed, identified single failures which could cause abort, and identified single failures which could cause loss of stage, vehicle, or crew.

An audit of selected S-IC reliability program categories was conducted by MSFC during August 1966. This audit was designed to ascertain the S-IC reliability program conformance with CPIF contract document IN-I-V-S-IC-65-18. During the audit, deficiencies in the information contained in the propulsion/mechanical piece part data packages were discovered. The data necessary to satisfy the audit findings has been established and steps have been taken to rectify this problem.

RELIABILITY ASSESSMENT

FAILURE ANALYSIS

Extensive emphasis has been placed on the S-IC failure analysis program, which has continued to show improvement during this period.

In addition to monitoring receiving and subassembly discrepancies, major emphasis has been placed on monitoring and evaluating in-service failures that occur on stage and GSE hardware during post-manufacturing checkout, static firing, and post-static checkout and after delivery to KSC.

Each in-service failure is posted in the weekly "Failure Status Summary" (unresolved failures) published by the Michoud Reliability Data Center. The responsible action agency is logged against the item, and the unresolved problem is carried in the Failure Status Summary until it has been evaluated and program corrective action is provided.

A second document, "Failure Review," is published for each stage. These documents, which are published to assist management at prefiring and preflight readiness reviews, list the cumulative failure history and corrective actions taken for each stage.

EQUIPMENT QUALITY ANALYSIS

The Equipment Quality Analysis (EQA) laboratory was expanded during the third quarter of FY 1967. Greater emphasis has been placed upon the disassembling of parts to verify their quality and design. This was done to prevent the possibility of costly major malfunctions due to component failures. EQA is presently concentrating on reliability critical components but will eventually move on to other production hardware as well.

Twenty-nine parts were analyzed between July 2, 1966, and June 8, 1967. Receipt of satisfactory replies from suppliers enabled three EQA's to be closed out, 16 closed with no reply required, and 10 remaining open pending supplier replies. Forty-five EQA's are scheduled for next quarter.

The 24 EQA's performed during the fourth fiscal quarter are listed below:

EQA No.	Part Number	Nomenclature
085	RN 60C5111F	Resistor
	RN 60C1000F	Resistor
086	224P-1-503	Potentiometer
087	MBC 11A-1	Capacitor
088	S1N649	Diode
089	S1N3026B	Diode
090	MBS20-1	Transistor
091	SP-67	Transformer
092	BAC-B30GP6-5	Hi-Lok
093	MBR37496-4B	Relays
	MBR37496-10B	Relays
094	60B41028-1	Helium Check Valve
095	60B59802-3D	Power Transfer Switch
096	60B59803-1E	Battery, Silver Zinc
097	60B37476-3D	Pneumatic Pressure Regulator
098	60B41006-3	LOX Interconnect Duct
099	60B41149-39	Seal Naflex
100	60B43063-39	Seal Gasko
101	60B83109-1A	Duct Assy.
104	MBS1B-1	Rectifier
105	MBS2C-1	Transistor
106	S1N547	Diode
109	60B73059-1B	Measurement Calibrator
110	CL64CJ470MP3	Capacitor
111	MBC 11A-2	Capacitor
112	MBC 11A-4	Capacitor

DATA COLLECTION AND ANALYSIS

Two hundred sixty-five special computer printouts concerning failure data were supplied to requesting organizations by the Launch Systems Branch Reliability Data Center (RDC). These special printouts were required to support such varied activities as cost accounting, human engineering, and logistics.

One hundred requests were received by the RDC for Interservice Data Exchange Program (IDEP) data. All IDEP data requested was obtained and supplied to the using organizations. Boeing furnished nine releases to the IDEP.

A total of 624 Corrective Action Requests (CAR's) were initiated by the Launch Systems Branch or assigned to Boeing by NASA during FY 1966. Five hundred twenty-nine were closed out; 95 remain open and are programmed for completion and closeout next quarter.

Continuous effort is being expended to isolate repetitive failure trends. Some of these collective analyses have resulted in further laboratory analysis and/or design corrective action. The requests for design corrective action are included in the CAR statistics above.

RELIABILITY AUDITS

The findings of the FY 1967 reliability audits in compliance with D5-11013, "Reliability Program Plan," and related documents were published in the three quarterly "Reliability Program Status" reports: D5-13556-2, D5-13556-3, and D5-13747-1. The fourth report, D5-13747-2, will be published after the end of the fourth fiscal quarter.

RELIABILITY DATA ANALYSIS MODEL

Thirty-five thousand cards containing input to the computerized reliability data analysis model (RDAM) have been put on tape. Single-engine firing data has been analyzed and input to the model. Pertinent time cycle and configuration data which has been accumulated at the F-1 single-engine test stand in Huntsville, at the static test tower west in Huntsville, and at the Rocketdyne single-engine stand at Edwards Field has been gathered, analyzed, and input to the model.

STAGE DESIGN ASSESSMENT

Sufficient S-IC static firing, reliability, and qualification test data has been gathered to enable a preliminary stage reliability assessment to be performed. Additional data is being gathered, evaluated, and loaded into the RDAM on a daily basis.

Those results of the November 15 static firing of the S-IC-3 that were applicable to stage reliability assessment were analyzed and entered in D5-11954-1, "Saturn S-IC Stage Reliability Analysis Record." All UER's and UCR's written against S-IC reliability critical hardware during testing in simulated flight environment were analyzed, and applicable failures were put into the reliability assessment mode. A matrix showing the total test times from qualification testing, reliability testing, S-IC-T static firing, and single engine static firings versus the applicable failures for each critical component in the stage has been prepared for use in further stage reliability assessment.

SYSTEM AND COMPONENT ASSESSMENT

A preliminary reliability assessment of the thrust vector control system (servoactuator) was completed. At 50 percent confidence levels, the reliability of this system was assessed at .9951 compared to a .9944 system goal. This assessment was based upon the failure mode and effect analysis (FM&EA) and upon time and failure data accumulated during stage and single engine firings.

Due to contamination problems encountered with the MBR37496-7 and -8 relays, a reliability assessment was conducted on all -7 and -8 relays used on the S-IC. All relays were tested rather than testing the critical applications as done in the RDAM. The reliability for one -7 and -8 relay, based on both critical and noncritical applications and performing a successful 160-second mission (at a 50 percent confidence level), is .9984. The reliability for the 34 relays in reliability critical applications is .947 (at a 50 percent confidence level).

MANUFACTURING DEVELOPMENT

Manufacturing Development continued to support Manufacturing in all areas necessary to production of the S-IC stages. During the fiscal year, efforts were concentrated to maximize process improvements, product reliability, and cost savings. Activation of additional manufacturing capabilities, emphasis on the Zero Defects program, and acquisition of new business were fully supported. Processes and materials developed in industry were monitored, and close liaison was maintained with Engineering Design and other technological groups to keep abreast of new trends in materials, designs, and product improvement items applicable to advanced launch systems.

WELD DEVELOPMENT

ELECTRON BEAM WELDING

Y-ring assemblies are presently being fabricated from three 5-1/2 by 27-inch billets joined by metal-arc (MIG) welding. Development effort is being conducted to develop electron beam welding to maximum penetration and quality capability and to arrive at a more dependable process to replace the pure MIG process. An electron beam welder from Marshall Space Flight Center is being used (see Figure 2-24).

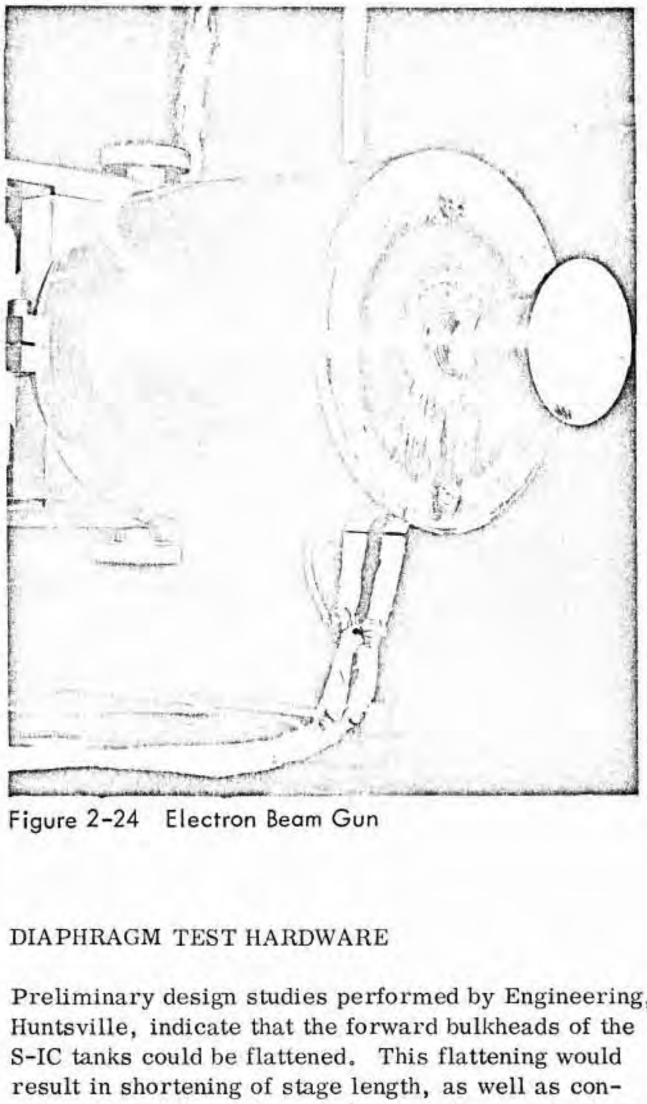


Figure 2-24 Electron Beam Gun

DIAPHRAGM TEST HARDWARE

Preliminary design studies performed by Engineering, Huntsville, indicate that the forward bulkheads of the S-IC tanks could be flattened. This flattening would result in shortening of stage length, as well as considerable weight savings. These studies require test hardware to verify strain distributions in the diaphragm and cylinder sidewalls upon pressurization. Two articles are being fabricated for satisfaction of concept information requirements.

SUPPORT FROM ENVIRONMENTALLY CONTROLLED ASSEMBLY AND MILLING AREA

TIG (tungsten inert gas) tube welder - Manufacturing Development investigated the cause of poor weld quality produced by the TIG tube welder. An adjustment was made in the angle of the tungsten electrode to the part. It was suggested that a more careful check be made of fittings prior to welding and a daily check be made of weld travel to assure consistent travel. After these recommendations were followed, the weld quality improved to acceptable limits.

VAB SUPPORT ON GIRTH AND TEE WELDS

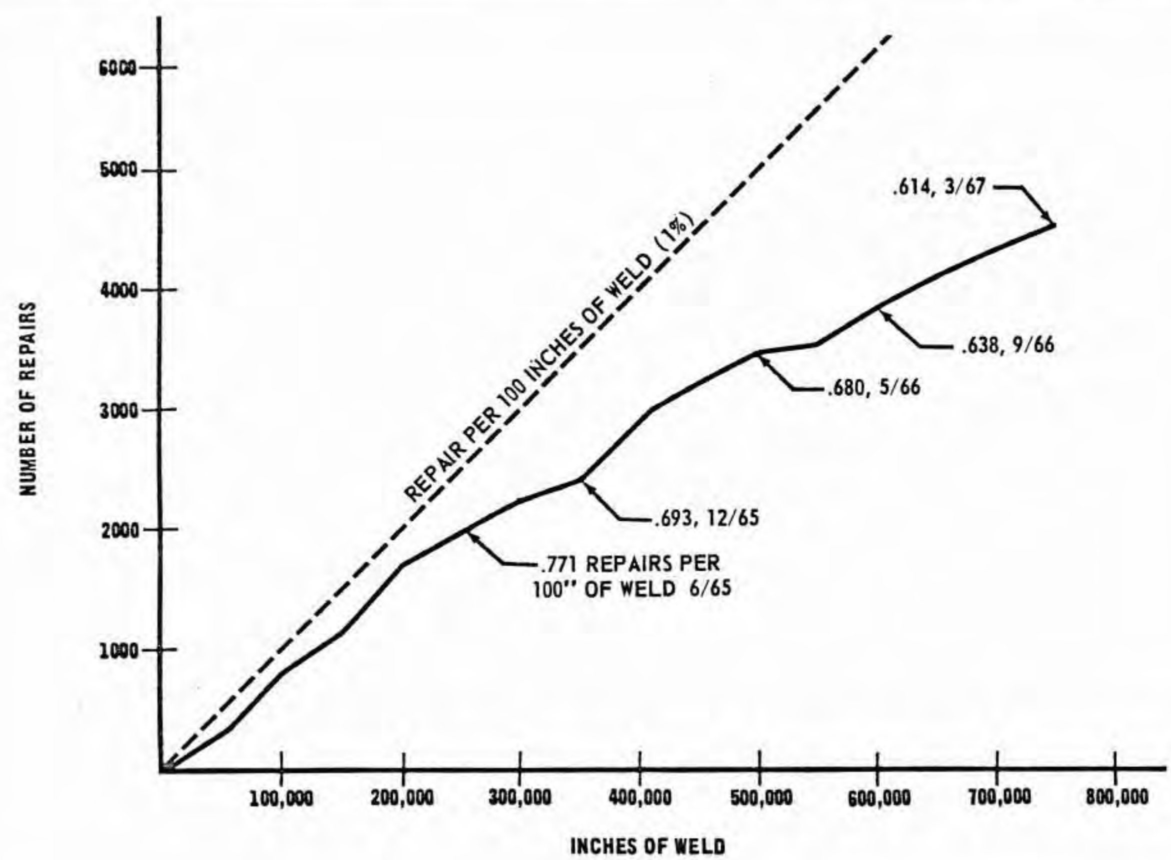
Manufacturing Development support was requested to solve the distortion problem caused by making the 104-foot girth welds in the VAB. Support was also requested for solution to erratic manual tee weld quality. Distortion was reduced to an acceptable level by using proper weld sequencing and strongbacks (internal stiffeners) and by making the tee-top welds during the mechanized fill pass.

Intermittent gross porosity and weld cracking was the major tee-top weld problem. By pre-planned trimming, the tee-tops were made to come within .010 to .020 of each other during the mechanized fill pass. A scraping tool to clean the faying surfaces just prior to welding was developed. With optimum part gapping and pre-weld scraping, high quality, repeatable welds can be made.

WELD REPAIR HISTORY

Fuel and LOX tank weld repair records from the S-IC-D, S-IC-F, and S-IC-3 through -11 stages produced the data plotted in Figure 2-25 (data for stages -9 through -11 is incomplete because welding for these effectivities has not been completed).

Figure 2-25 Fuel and LOX Tank Weld Repair



CHEMICAL PROCESSES

FORWARD SKIRT INSULATION

Two demonstrations of spray foam applications were evaluated. The first, given by Polyfoam, Inc., Harvey, La., used a scrapped section of thrust structure, which consisted of two sections approximately 10 feet by 5 feet. This is much heavier gage material than that used in the forward skirt and is thus more difficult to foam onto at ambient temperatures. Polyfoam's equipment has a modified Gusmer gun head. The second demonstration, conducted by NASA at the Redstone Arsenal, made use of the Binks foam gun.

New information on predicted temperatures reached in the forward skirt areas forced a re-evaluation of polyurethane foam. Materials and Processes Engineering conducted an investigation of insulation material suitable for the forward skirt. Current planning is to use Dow Corning Silicone Rubber (93-044) ablative material, in place of polyurethane foam, on S-IC-1 through S-IC-15. (See Page 32.)

A 4-feet by 10-feet simulated forward skirt test panel was fabricated and sprayed with Dow Corning Thermal Barrier Coating 93-027 ablative material. The paint finish has been subjected to accelerated drying at 175 degrees F to avoid a three-week wait for completion of air curing. Specimens for engineering tests will be cut from this sprayed panel. Problems exist in using the spray type silicone (93-027) due to the effect of solvents on the substrate paint finish system. This problem is currently being studied.

MACHINING AND FORMING

ADVANCED DRILL DESIGN

Manufacturing Development personnel have demonstrated the capabilities of the Speedicut Chipbreaker drill in S-IC assembly areas. The unique feature of the drill is the Chipbreaker rib which runs the full length of the drill flutes. One of its purposes is to minimize the size of the chip in order to prevent it from fusing and jamming up in the flute. This jamming is the major drawback of the conventional drill. Not once during the drilling of 480 holes in a 1-1/8-inch thick 7075-T651 plate did a Chipbreaker drill become inoperative due to chip jamming, even with 2,800 rpm and .003 ipr feed. The drill point showed negligible wear damage which was due to the free floating chip in the drill flute (see Figures 2-26 and 2-27).

Figure 2-26 End View of Chipbreaker

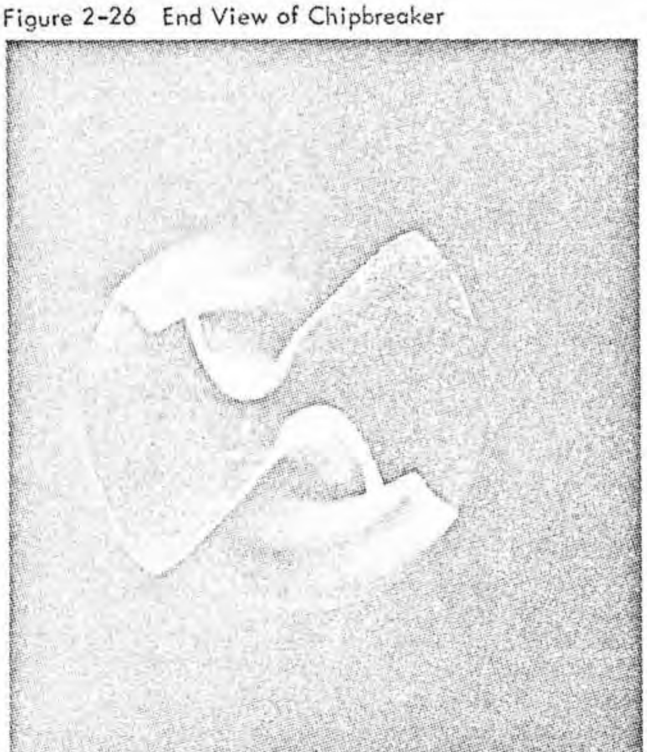
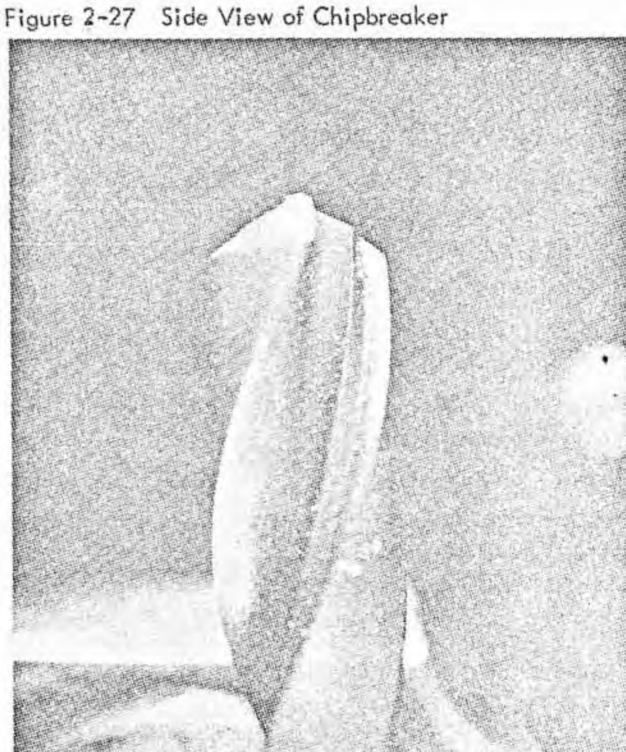


Figure 2-27 Side View of Chipbreaker



Evaluation tests conducted in the manufacturing development laboratory have proved conclusively that considerable manhour savings and hole quality improvement can be realized by using the Chipbreaker drill in the Vertical Assembly Building and in the intertank and thrust structure assembly areas. During the drilling of attach holes common to the forward skirt, intertank structure, thrust structure, and Y-rings of the fuel and LOX tanks, it takes two minutes to drill a hole, with coolant, using a conventional drill. Using a Chipbreaker drill, it requires only 25 seconds per hole. There are 7,700 holes per S-IC assembly being drilled in the vertical assembly tower; the Chipbreaker saves approximately 180 manhours per assembly.

Additional savings were realized when the freon TB-1 drilling coolant was replaced with the cetyl/dodecyl-BMS 3-2 drilling lubricant. Also, less overloading of drill motors and greater drill point life will be realized. The point life of this drill is 10 times that of the conventional drills. Drilling manhour savings can thus be realized in the thrust structure, intertank structure, and forward skirt structure assembly areas.

Changeover to this drill will not require a change in present facilities, and the drill is sharpened in the conventional manner with existing equipment.

DRILL BIT EVALUATION

A standard drill bit evaluation test criterion has been prepared by Manufacturing Development. The test specification indicates Boeing/Michoud standard material, thickness, hole size, lubricant, drive motor, and air supply to aid drill manufacturers in recommending corresponding conventional drills based on number of holes drilled, tolerance, feed, and speed. The ultimate aim is to reduce corporate procurement costs by means of bulk purchases.

DRILLING LUBRICANT

The lubricant TB-1 used in drilling is costly and removes the grease from drill motors and passivity from tools. Cetyl/dodecyl-BMS 3-2 drill lubricant offered improved hole finish in tests conducted by Manufacturing Development personnel. A substantial cost savings was realized with the use of this lubricant. Because of the low flash point of the BMS 3-2 solvent, it can only be applied by squeeze bottle application. Further studies are being conducted to find a solvent to replace the BMS 3-2 solvent, which has a high flash point. This is especially important because of the safety hazards within the mist system.

TOOL AND MACHINE DEVELOPMENT

Y-ring/bulkhead mill cutter - Excessive breakage and wear was occurring on the High Speed Steel (H.S.S.) mill cutter that is used to back gouge the Y-ring to bulkhead weld joint prior to welding. The necessity of machining dry, to prevent contamination from the lubricant residues that can affect weld quality, results in high heat and wear on the cutter.

Manufacturing Development modified a standard cutter by reducing the number of teeth from 24 to 12. This increase in clearance overcame the problem of chip adherence to the cutter, consequently improving the surface finish.

It was also observed that the cutter would break down if any segment of the stainless steel clamping strap is trapped between the Y-ring and bulkhead. The H.S.S. cutter was further modified with brazed carbide inserts. The H.S.S. cutter with brazed carbide inserts was utilized on two bulkheads with excellent results. For both bulkheads, inner and outer peripheries have been machined dry, showing no wear on the cutter whatsoever. Previously the cutter required resharpening after machining either inner or outer periphery.

The feed was doubled to 28 inches per minute, and surface finish was excellent. A savings of four manhours per bulkhead was realized, as well as considerable reduction in time for cleaning the milled slots.

MULTI-STEP CUTTER

A new two-step six-flute end mill cutter for milling edges of tank skins and Y-ring assemblies was tried out in the VAB. Results showed that the desired surface finish and a one-pass step cut is possible. Before the cutter design was incorporated, cutter chucks on the Onsrud router heads in the vertical welding assembly bays were changed from one-half inch diameter chucks to one-inch diameter chucks. A cost saving of approximately 30 hours per stage will be realized through the use of this cutter.

SPECIAL GRINDING TOOL

A special grinding tool was designed and fabricated for blind grinding on the internal surface of the weld in the GOX line weld assembly. This tool was used on the S-IC-4 GOX line for weld repair. Results were excellent and the tool was accepted by shop personnel.

ELECTRICAL/ELECTRONICS

COMPOUNDS

One-part primers - Primers are used in the manufacture of electrical cable terminations to condition the neoprene sheath for adhesion to polyurethane. Two-part primers are subject to errors in mixing and weighing and are confused with one-part primers. Other problems are contamination, storage, and primer drying time. Tests conducted, using both one and two-part approved neoprene primers on various neoprene sheaths, indicated that pre-mixed one-part primers are the most practical. These pre-mixed primers have been recommended for production use to reduce cost by eliminating weighing, mixing, loss of primer due to contamination, and rejection due to primer malfunction.

Vacuum-formed plastic molds - Polyethelene sheet material was vacuum-formed into several cable mold configurations, and one configuration was selected for production implementation. The use of the polyethylene material has deleted the requirement for mold release being applied to the mold cavity. Cable molds of this material are capable of being reused several times.

QUALITY ASSURANCE

PROGRAM DEVELOPMENT

SYSTEMS

An automatic spray system has been installed in the dye penetrant tank located in the nondestructive test area. This system is faster than the previous method of hand-spraying, does not contaminate the air in surrounding work spaces, and is more economical than the original method of dipping parts in the penetrant solution.

A mechanized procurement system was implemented by Receiving Inspection. When a purchase order is released, an IBM card is fed into the data system causing the computer to call out all inspection requirements and routing information.

A new system for revising the requirements for test equipment calibration intervals has been developed using a computer data bank. The bank collects revision information and prints out, every two months, the compiled data as a revision to Section 15 of D5-12620, "Calibration/Certification Record System - Launch Systems Branch."

A delayed dating system has been established for all certified general purpose measuring equipment and certain MSE/GSE. "Delayed dating" means that the equipment is calibrated but not dated until it is issued; however, a limit is set as to the maximum time allowed between calibration and the date of issue. The end result is fewer calibration operations per item in a given time period.

TECHNIQUES

The quality evaluation laboratory developed a new use for the Budd, Radar 158 Instrument. The unit has been calibrated to measure electrical conductivity to verify the heat treat conversion of 7075-T6 aluminum to 7075-T73.

Quality's gas chromatograph has been modified with a new gas sampling device, which enables it to detect minute impurities in gases.

The measurement control laboratory (MCL) implemented a means of reading gas volumetric flow by using alignment optics and closed circuit television. Using this method, one man can perform a calibration previously requiring two people. In addition, the process can be performed 25 percent faster and with more accuracy.

The MCL adopted a method from the National Bureau of Standards for calibrating its volt box in such a manner as to include the resistance factor of internal interconnecting rods. This makes it possible to obtain absolute relative voltage ratios, consequently assuring maximum accuracy of the volt box.

The standard universal ratio set in the MCL was modified to allow the reading of direct values rather than reading ratios and then interpolating to derive the value. This significantly improves the accuracy of the ratio set.

Two nondestructive test (NDT) techniques were developed and documented to further enhance our ability to verify the integrity of S-IC components. They are:

a) Eddy current inspection of titanium weld wire material; and

b) Eddy current thickness measurement of stainless steel tubing.

PROCEDURES

The basic technical document for Factory Operations, D5-11982, "Special Inspection Procedures," is being updated and expanded as necessary to reflect changes on the hardware.

LABORATORY - TOOLS AND EQUIPMENT

The capability of the quality evaluation laboratory was expanded by the addition of the following equipment:

a) A Polaroid close-up camera (3X magnification) to be used in taking pictures of corrosion and contamination in rejected parts;

b) A set of tungsten carbide ball gages used to measure fluid passages in fittings and other critical internal dimensions;

c) A set of standards for calibration of the Dermitron plating thickness tester, including cadmium plating on steel, copper, silver, and brass for the special applications utilized on this program; and

d) The Model 600 Vistascope optical inspection instrument with a micrometer and adjustable work table. (This instrument has the capability for measurement of small components and is especially useful for inspecting electronic circuit boards.)

The measurement control laboratory had a coaxial cable installed connecting Boeing's lab to Chrysler's lab. This will provide each lab with an alternate means of frequency correlation.

PRODUCTION INSPECTION - TOOLS AND EQUIPMENT

Development of special inspection equipment continued throughout the fiscal year as production expanded. Examples of special inspection equipment developed by Quality Assurance personnel are:

a) A mechanical tape applicator was developed to apply leak detection tape to the LOX and fuel tanks during hydrostatic test;

b) A depth gage was developed to measure the underside of the tee flanges for undercoat and scratches;

c) A small scratch depth and mismatch gage was developed when a need arose for a utilities gage;

d) Special designed units were built and are now being used to check flatness on the bulkhead fittings;

e) Optical targets were built to find the center of larger openings than previously anticipated;

f) An eddy current unit was purchased to check the titanium helium bottles for various titanium alloys; and

g) An ultrasonic digital readout system was purchased to give a higher degree of accuracy and closer tolerance readout.

QUALITY ASSURANCE ACTIVITIES

QUALITY ENGINEERING REVIEWS

During the fiscal year, Quality Engineering reviewed 639 engineering drawings, 232 supplier drawings, 1,425 engineering orders, 245 supplier acceptance test procedures, and 122 supplier cleaning documents for compliance with the requirements of NASA quality publication NPC 200-2. They also participated in nine critical design reviews for supplier furnished hardware.

QUALITY AUDITS

Figure 2-28 shows the 50 special audits made during FY 1967 (19 in-plant, 19 supplier, and 12 special). A total of 166 discrepancies were reported from these audits. Fifteen safety audits were conducted with 60 findings reported. Each item either has been or is being satisfactorily resolved.

In addition to the normal quality program audits, Quality has developed in-plant hardware audits over and above the requirements of NPC 200-2, Section 15. In this type of audit, certain pieces of significant structural hardware are selected and after the design requirements have been reviewed, the components of the assembly are removed from stores, checked for inspection acceptance, and sent to Receiving for a complete reinspection. Conformance to traceability, receiving tests, and supplier data package requirements are verified even so far as verifying procured standards such as rivets and bolts. Then the entire in-house manufacturing process is analyzed; the manufacturing planning, critical process control and personnel certification, chronology of inspection buy-off, and the integrity and configuration of tooling are all included. Finally, all Material Review Board (MRB) action involving the assembly or its details is reviewed to provide the final assurance that all related quality systems are intact and functioning properly.

Figure 2-28 Quality Audits

	1966						1967					
Inplant Audits	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN
CONFIGURATION ACCOUNTABILITY AND PRODUCT DELIVERY						●						
RECEIVING INSPECTION	●	●		●					●			
STAGE ASSEMBLY AND TOOLING INSPECTION			●	●						●		
QUALITY EVALUATION LABORATORY				●								
SOURCE CONTROL		●										
CONTAINERS & WELDED ASSEMBLIES	●					●						
ENGINEERING ANALYSIS				●								
RELIABILITY DATA CENTER						●						
INDUSTRIAL RELATIONS TRAINING				●								
MICHOUD TEST INSPECTION		●		●		●						
MTF									●			
Special Audits												
MOBILE EQUIPMENT					●				●			
HARDWARE							●					
FACTORY SURVEY		●										
NON CONFORMING MAT.		●								●	●	
OXYGEN USAGE											●	
MRB												●
ENGR. BLUEPRINT FILES							●					
HEAT TREAT	●											
Supplier Audits												
FLEXONICS										●		
BENDIX										●		
SOLAR										●		
PARKER AIRCRAFT										●		
STERER ENGINEERING										●		
EAGLE-PICHER										●		
RESISTOFLEX										●		
FLOWDYNE										●		
MARROTTA VALVE											●	
THIOKOL											●	
CCC											●	
ARROWHEAD											●	
MOOG											●	
STAINLESS STEEL											●	
PUROLATER											●	
HYDRAULIC RESEARCH												●
WHITTAKER												●
PARKER SEAL												●
AIRESEARCH												●

SOURCE EVALUATION AND SURVEILLANCE

The source control chart room was revised by addition of a procured hardware problem-action board. This room proved to be an effective tool in the solution of program problems, maintaining the status of suppliers, and deciding the extent of source control coverage required for each supplier.

Process supplier surveys were regrouped, giving all Florida supplier survey responsibility to BATC; and all Tennessee, North Carolina, South Carolina, Northern Mississippi, Northern Alabama, and Northern Georgia supplier survey responsibility to Boeing/ Huntsville Test Operations.

Because of the importance of critical hardware to the successful launching of the Saturn V, management teams were sent to the suppliers of critical hardware items. These teams, consisting of Boeing Quality, Materiel, and Engineering personnel, visited 39 suppliers. (For geographical location of suppliers, see Figure 2-29.) During these visits, quality motivation presentations were made to each supplier. The presentations contained charts, graphs, and other visual aids and were designed to make the suppliers realize the importance of their role in the S-IC program. It was demonstrated to each of the suppliers what would happen to the stage if their products failed. The response received by Boeing from these suppliers indicated that our motivation effots were successful.

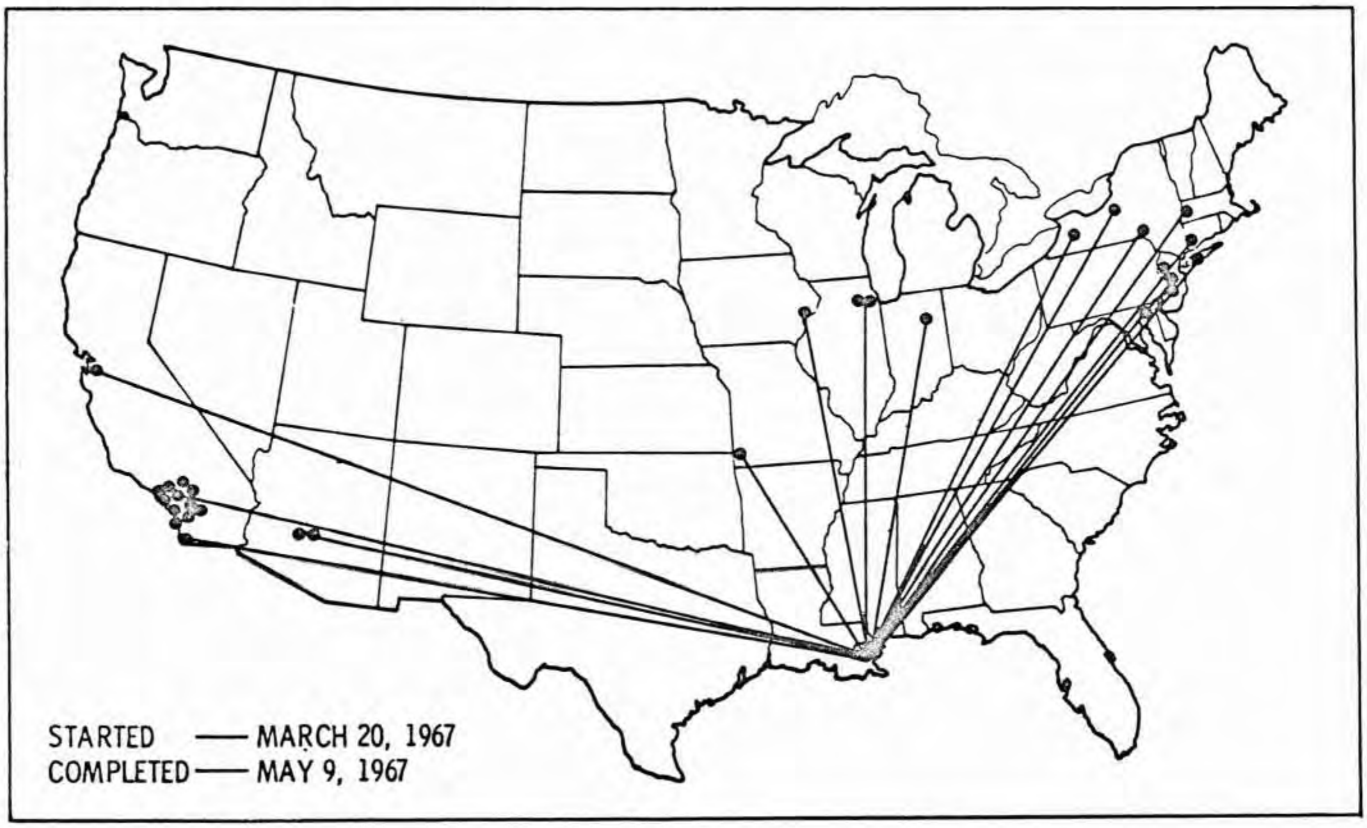
Following these presentations, Source Control made in-depth quality audits of critical hardware suppliers' systems and procedures. A complete study was also made of their fabrication of applicable parts, and the efficiency of the source representatives was evaluated.

Source Control surveillance at suppliers is being increased by placing more source representatives in the field and widening the scope of our surveillance.

RECEIVING INSPECTION

Total receiving inspection receipts for FY 1967 were 47,615. The receiving inspection group inspected and processed 47,598 lots during the year.

Figure 2-29 Locations Subcontractors Visited



QUALITY EVALUATION LABS

Major investigations were conducted by the laboratory in these areas:

a) An examination of BAC-B30GP aluminum fasteners, which failed in the S-IC-D fuel tank, was made. The failures were primarily attributed to fatigue cracking with a few failures due solely to overstress;

b) Failure analysis was made of a weld assembly of retrorocket thrust support. Magnetic inspection revealed base metal cracking. It was determined, through macro and micro examinations, hardness determinations, and chemical analysis that the failure was attributed to insufficient pre-heat treatment and lack of stress relief after welding;

c) Failure analysis of cracked thrust structure ring splice-angle plates taken from the S-IC-T and S-IC-D was conducted. This failure was attributed to a combination of internal stress during machining, installation stress perpendicular to grain flow, low elongation property of material, and noticeable intergranular corrosion. This problem was corrected by redesign of splice angles and changing the heat treat from 7075-T6 to 7075-T73, which is less susceptible to stress corrosion;

d) An extensive study was made to determine the affect of cadmium plating burns on BAC N10B and BAC N10CT nuts. No evidence of failure could be attributed to the plating burns;

e) Failure analysis was performed on HL 22 7075-T6 aluminum fasteners, taken from the S-IC-T and S-IC-D. Penetrant, tensile, and microscopic examination revealed only two bad fasteners out of those checked. The failures were attributed to stress corrosion. It was decided to change the heat treat of the fasteners in future stages from 7075-T6 to 7075-T73, which is less susceptible to stress corrosion;

f) An analysis of the cracked ring baffle web from the S-IC-6 vehicle was conducted. The appearance of alodine in the crack indicated that initial cracking may have occurred during manufacture, forming, or heat treating. Although some intergranular corrosion was evident, failure was attributed to stress corrosion.

PRODUCTION INSPECTION

FY 1967 was a year marked with factory completion and transfer of three boosters, with a fourth nearing horizontal completion. Inasmuch as inspection equipment requirements have been nearly satisfied, equipment procurement was at a slow pace.

The S-IC-3 Terminal First Article Configuration Inspection (FACI) began September 8, 1966. During this review, the S-IC-3 stage, as described by the released Class I engineering documentation, was compared to the S-IC-3 stage as manufactured, assembled, and tested. Also, the exact relationship between the configuration of the installed components and the qualified components was established. This was successfully completed with the customer acceptance of the Part II Contract End Item Specification on September 22, 1966. The S-IC-3 was delivered to the customer on March 15, 1967.

MTF

Final quality acceptance of the S-IC test complex was given after two successful demonstration static firings of the S-IC-T. Exceptions to Quality's approval of the complex consisted primarily of software not yet delivered to Boeing and minor reworks to the facility and its systems.

PRODUCT PERFORMANCE ASSURANCE

The objective of the Product Performance Assurance Organization is to provide increased confidence and assurance to the customer that activities critical to the mission or program are identified, planned, and accomplished. The organization reports directly to the Michoud Manager and assists him in discharging his obligations for successful S-IC stage flights. This organization is responsible for monitoring and assessing the adequacy of technical disciplines throughout design, production and test, and the integration of those disciplines to ensure total product integrity and stage flight readiness, with supporting auditable data. Figure 2-30 illustrates the assurance processes from mission requirements to flight readiness.

FY 1967 marks the first year of operation for Product Performance Assurance. The year was characterized

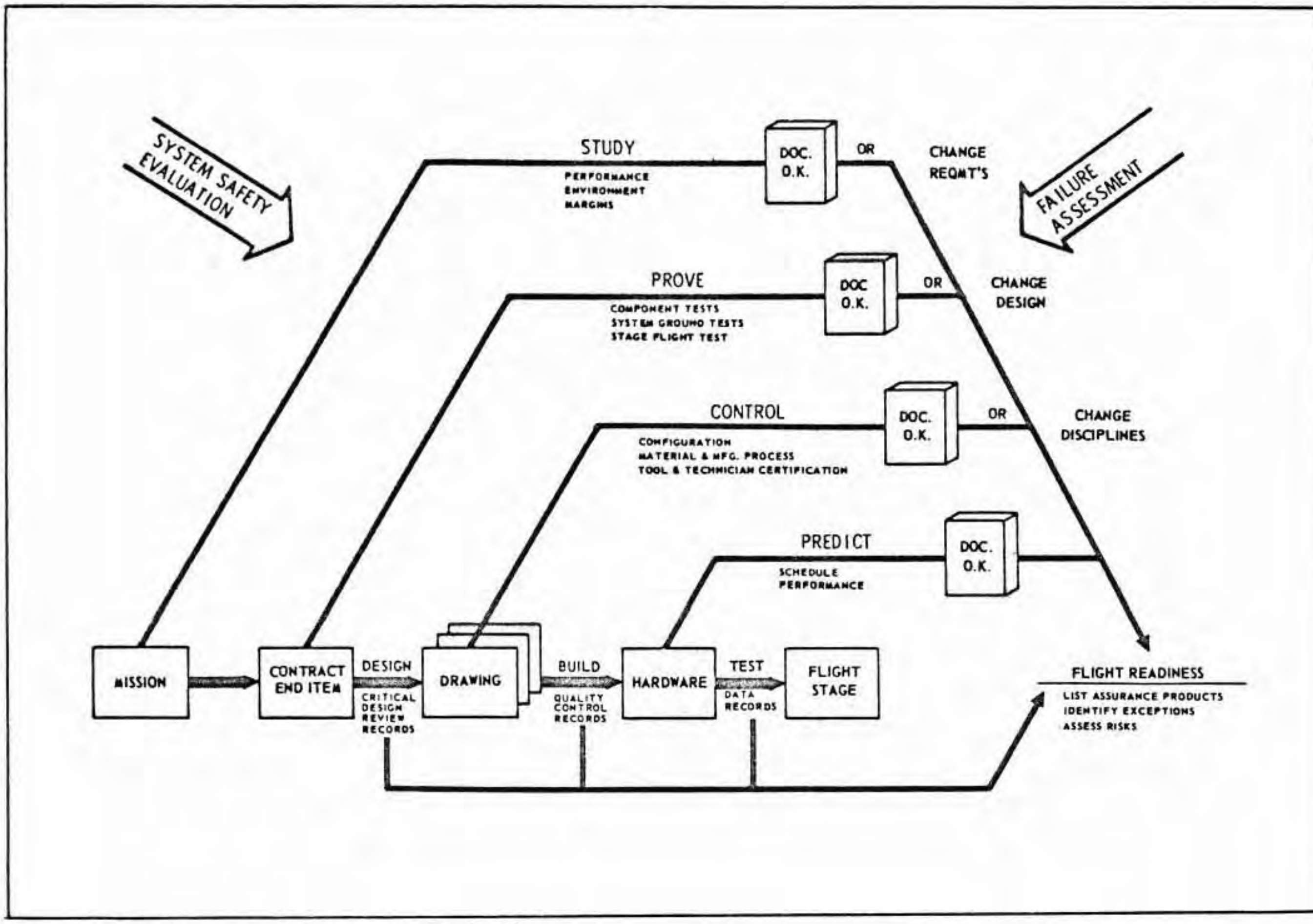


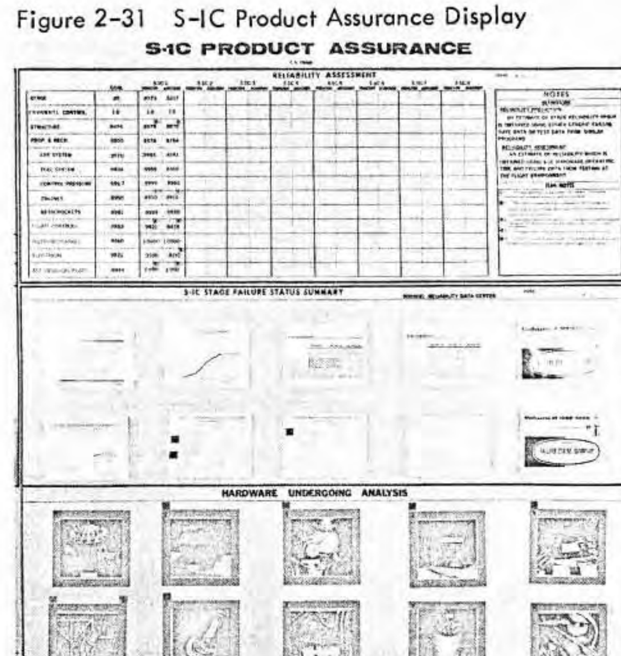
Figure 2-30 Structure of Design and Production

by a risk assessment approach and the promotion of techniques to strengthen disciplines which would minimize or eliminate identified risks. Emphasis during the year was placed on ensuring the flight readiness of the S-IC-1 stage. Figure 2-31 shows the S-IC product assurance display (emphasizing S-IC-1 reliability) in the Boeing/Michoud Program Control Center.

DESIGN ASSURANCE

A documentation review was conducted to ensure that the S-IC stage contract end item (CEI) specification supported the specific mission requirements and that the design met the CEI specification. This task involved assessing the capability of the stage, as designed, to meet the mission requirements. It also involved identifying and assessing design differences between stages and compatibility with the CEI specification. Differences noted between the CEI specifications and design drawings have virtually all been resolved with MSFC.

Figure 2-31 S-IC Product Assurance Display



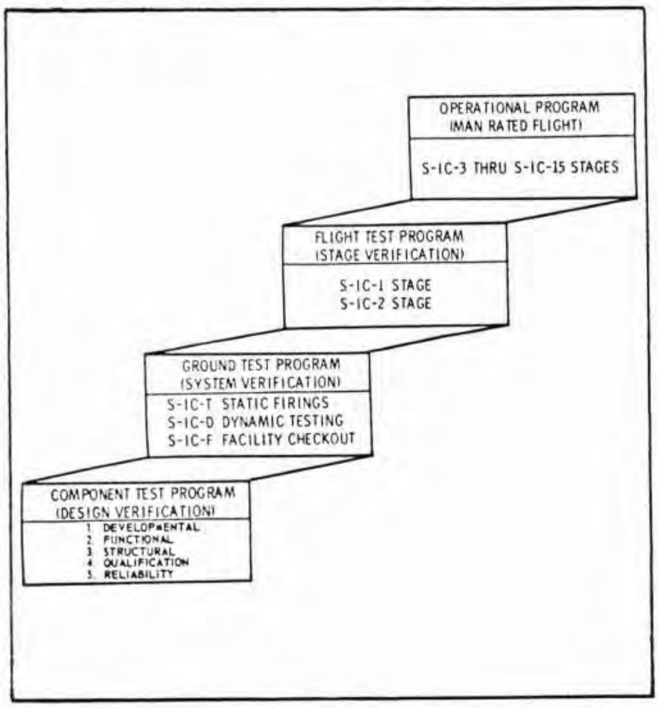
The interface control documentation (ICD) program, while still incomplete, has shown considerable progress during this reporting period. It is expected that the remaining few items will be resolved satisfactorily with MSFC to support the S-IC-1 launch.

Design assurance is demonstrated through a series of verification test programs at the component, system, and stage levels leading finally to the operational program of man-rated flight (Figure 2-32). At the close of FY 1967, component and system verification test programs have essentially demonstrated the expected integrity of the stage and supporting GSE and facility design for successful flight test of the S-IC-1 stage.

PRODUCTION AND TEST ASSURANCE

Configuration audits were conducted to ensure that as-built hardware met drawing requirements. This was accomplished by comparing as-built records with engineering parts' lists for the applicable stage configuration at key points in the production process. A graphic system was instituted to track apparent and real differences and to record progress in resolving these differences. All such differences must be resolved by the time of stage launch.

Figure 2-32 Verification Test Programs



Support was provided to the pre-static firing reviews for the S-IC-3 at Huntsville and the S-IC-T and S-IC-4 at the MTF. Such reviews represent standard product assurance practices. The role of Product Performance Assurance in these reviews was to ensure that the functional organizations were in agreement on the relative readiness of the stage for static firing and could produce substantiating auditable data. All three stages were successfully static fired.

Considerable attention was given to the area of hardware failures. This was done to improve the disciplines involved in identifying, evaluating, tracking, and closing out such failures. Steps taken to assure proper handling of failures included streamlining and strengthening operating procedures, categorizing failures by priority action (flight critical, launch delay, others), and providing current status visibility to management.

A team of specialists, familiar with the history of the S-IC-1 design, manufacture, and test, was assigned to the Boeing Atlantic Test Center during the second fiscal quarter to assist in resolving problems encountered at the launch site. This arrangement provides for added product assurance during the transition from stage delivery to launch.

During the third fiscal quarter, a program was established to further assure the quality of vendor hardware, with primary emphasis placed on that hardware where failure would cause loss of crew or mission (reliability critical hardware). Steps taken relating to this reliability critical hardware assurance program include (also see page 57):

a) Michoud management team visits to vendors to re-emphasize the significance of their hardware in successful Saturn V launches;

b) Re-survey of each vendor's receiving inspection, processing methods, and quality control standards for adequacy;

c) Identification and scheduling of representative vendor hardware for equipment quality analysis, consisting of destructive and nondestructive tests;

d) Initiation of a program to physically identify the hardware (and associated documentation) as reliability critical to highlight its unique stature in the function of the stage or GSE; and

e) Preliminary studies to select hardware candidates for a limited re-qualification program.

SYSTEM OPERATION AND SAFETY ASSURANCE

A comprehensive survey of all systems susceptible to damage or over-pressurization was inaugurated in conjunction with the functional organizations. This survey was conducted on an integrated basis encompassing system design, manufacture, test, and operator indoctrination to assure that hazardous operations are fully identified and controlled. Preliminary documents have been prepared covering system familiarization, integrated stage/GSE facility functional schematics, detail logic diagrams/fault trees, and a hazard identification matrix of manufacture and test events requiring formal control disciplines. Completion of the survey is scheduled for the first quarter of FY 1968.

Representation was provided to the MSFC sponsored system safety network for Saturn prime contractors at its first two meetings in April and June, respectively. The purpose of the network is to promote interchange of information and development of new techniques relating to system safety.

S-IC-1 STAGE FLIGHT READINESS ASSESSMENT

The MSFC Saturn V Program Manager's preflight review (PMPFR) for the S-IC-1 stage portion of the AS-501 vehicle was held on May 17, 1967, at Huntsville. This review represented the first formal assessment of the flight readiness and design maturity of the S-IC-1 stage and was preceded by a similar review at the MSFC stage manager's level on March 9, 1967. The PMPFR presentation consisted of an overall stage contractor and stage manager's assessment, a system by system review of the stage and a design certification review of the propulsion and mechanical system. The mutual assessment was that the S-IC-1 stage was considered flight ready upon completion of certain open items pertaining to hardware failure, qualification, change incorporation, and interface control documentation. All of these open items will be completed in time to support the S-IC-1 launch. The final flight readiness assessment of the S-IC-1 stage will be conducted during the Apollo program director's flight readiness review, currently scheduled for the first quarter of FY 1968.

Assessments of S-IC stage flight readiness (a product assurance activity) are supported and validated through reviews by the Boeing Performance Board and Launch Readiness Board which comprise top management representatives from all Boeing/Saturn programs. (See Page 16.)

NEW TECHNOLOGY REPORTING

The reporting of new technology was emphasized by management throughout the reporting period. Approximately 70 items were documented and forwarded. A modification to Contract NAS8-5608 (MICH-412) was received during February 1967, directing the implementation of a reporting plan wherein full-time new technology representatives are assigned to various organizations. The sole purpose of these new technology representatives is to increase the flow of reports to NASA. Three full-time engineers were assigned to this task in May 1967.

DELIVERABLE DATA

Data submitted during FY 1967, in compliance with the requirements of Contract NAS8-5608 (Schedules I and IA), are included in Appendix D. Delivery of these data items was accomplished in accordance with the requirements of Documents IN-I-V-S-IC-65-10 and IN-I-V-S-IC-66-10, "S-IC Program Deliverable Data," which includes the document requirements list (DRL) and the document requirements description (DRD).

TECHNICAL SUPPORT DATA

As required by line items 82 (TM-027) and 80 (TM-017) of IN-I-V-S-IC-65-10, "S-IC Program Deliverable Data," static firing flash reports and final static firing reports were delivered as shown below:

S-IC-3 - T5-6727-3, static firing report (flash), Test 19, November 21, 1966
T5-6541-3, static firing report (final), Test 19, January 13, 1967

S-IC-T - T5-6776-1, static firing report (flash), Test T-1, March 10, 1967
T5-6776-2, static firing report (flash), Test T-2, March 24, 1967
T5-6777, static firing report (final), Tests T-1 and T-2, May 1, 1967

S-IC-4 - T5-6727-4, static firing report (flash), Test 4-1, May 29, 1967

FACILITIES PLANNING & ACTIVATION

3

SUMMARY

Facilities activity at Michoud during FY 1967 was directed toward maintaining existing facilities and increasing fabrication capabilities. Twenty-three pieces of machining and fabrication equipment were purchased during FY 1967. Eighteen of these had been installed by the end of FY 1967, and the installation of the remaining machinery was in the planning stage. This activity was part of a comprehensive plan, initiated in the last quarter of FY 1966, to transfer major elements of S-IC machining and fabrication from Wichita and Seattle to Michoud.

The Test Control Center, static test stand, and Booster Storage Building at the Mississippi Test Facility were activated during FY 1967. The Test Control Center is completely operational and Boeing has taken total occupancy. The S-IC Booster Storage Building is also completely operational and occupied by Boeing. The S-IC static test stand, B-2 position, was completed and turned over to The Boeing Company for static firing of S-IC stages on May 19, 1967. Prior to turnover of the test stand to Boeing by NASA, the S-IC-T was fired twice to verify the integrity of the test stand and its supporting systems.

MICHOUD ASSEMBLY FACILITY

The basic facilities activation tasks authorized under CPIF Contract NAS8-5608 were completed in FY 1966. In spite of this, a significant level of facilities activity was maintained during FY 1967. This activity maintained and/or increased operating efficiency and made normal conversions and improvements to existing capital facilities.

During FY 1967, 18 facility subcontracts representing a total value of approximately $1,010,000 were awarded, 15 were completed, and three were in work at the year's end. Contract modification No. 23 added $1,895,195 to the SFC (special facilities contract) Equipment Contract NAS8-5606(F) to bring the total contract value to $27,093,000. Of this total, $25,612,000 had been committed at Michoud at the end of FY 67.

SHOPS

A comprehensive plan was initiated in the last quarter of FY 1966 to transfer major elements of S-IC machining and fabrication work from Wichita and Seattle to Michoud. This effort required rearrangement of existing equipment, procurement of new equipment, and related minor brick and mortar construction tasks. Of the 23 items of equipment purchased (representing a total dollar value of $1,968,000), 18 had been installed and checked out at the end of this report period. This number included three numerically controlled machines. (Figure 3-1 shows one of the major pieces of machinery now in use at Michoud.)

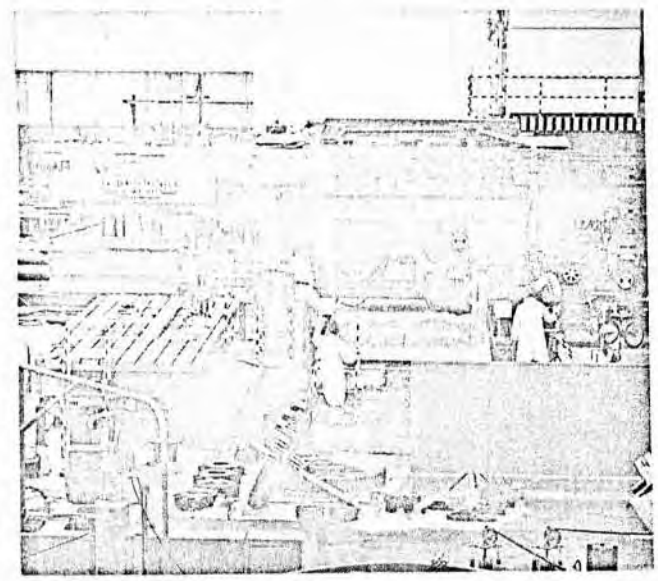


Figure 3-1 Kearny And Trecker Skin Mill

By June of 1968, three contouring mills, one numerical control (retrofitted) skin mill, one point-to-point system, one numerical control assist jig mill, and one five-axis contouring mill, will also be operational. All associated brick and mortar subcontract construction work, totaling $145,000, was completed. The new heat treat facility scheduled for activation in the first quarter of FY 1968 will provide heat treating to a maximum temperature range of 1,450 degrees F, with quick quench capability. Availability of this capability at Michoud will significantly decrease reliance on numerous, widely dispersed, vendor sources.

Numerous minor construction projects were accomplished in the VAB to improve operational efficiency. The major VAB modification was the changing of the 180-ton crane bridge to permit the 12-ton hoist to center over the tank assembly positions. This allowed use of the 12-ton hoist for numerous production operations which had previously been done by the 180-ton crane.

The 30'/40' Niles boring mill, which arrived at Michoud in March 1966 with a crack in the center table segment, was repaired by August 1966. During functional checkout of the mill, severe damage to the table bearing ways was discovered. This necessitated their removal and complete rework. A variety of electrical problems were also encountered. The majority of these problems have been corrected. The tracer unit is still not operative, but additional checkout of the mill is under way, and completion of all remaining work is anticipated early in FY 1968.

Analysis of the S-IC project schedule revealed that an additional horizontal assembly position will be needed. Since basic facilities at Michoud provided only one production horizontal assembly position, a second position will be activated to preclude adverse impact on S-IC schedules. This work involves only minor concrete and utility extensions and will be completed in July 1967.

TEST

MSE ACTIVATION

Test and checkout of MSE-II were completed to support post-manufacturing checkout of the S-IC-3, S-IC-4, and S-IC-5 and post-static checkout of the S-IC-3. At the end of FY 1967, S-IC-6 PMC was in progress in MSE II and the S-IC-4 was undergoing PSC in MSE I.

STAGE TEST FACILITY

Differential settlement of the floor slabs in the four cells and control building at the stage test facility was corrected by leveling and pressure grouting with soil cement. The initial subcontract corrected the deficiencies in the control building and cells #1 and #2; subsequent subcontracts were awarded for cells #3 and #4. Periodic surveys since completion of this work indicate continued settling. This will necessitate additional grouting.

TUBE AND VALVE CLEANING FACILITY

A detailed evaluation of the operations required to clean pneumatic, hydraulic, and LOX tubing indicated that significant cost savings could be effected relative to flow-times, material handling, packaging, etc., by using a closed loop cleaning console. This would permit degreasing, cleaning, passivating, etc., in the closed loop system as opposed to the in-use method which necessitated processing tubing through several different cleaning facilities. As a result of this study, a closed loop console was procured and installed in the tube fabrication area, via a construction subcontract. Operational status was achieved in June 1967.

LABORATORIES

Major tasks were initiated and completed at the high pressure test facility during FY 1967. A permanent water flow facility was completed in January 1967 to replace the interim set up, which was required to support tests associated with redesign of the LOX fill and drain ducts. Because of continued emphasis on safety, certain preventative safety items were established, and designed, and provided via a construction subcontract at a total project cost of $39,900. Additionally, approximately 10,000 square feet of adjacent apron paving was replaced with a six-inch concrete surface to facilitate entrance and exit of heavy equipment, and eliminate possible damage to test specimens during movement to and from the facility.

In March 1967, an N_2/He hot line in the high pressure test facility ruptured while under static pressure. Adjacent piping was damaged by deflection of the ruptured line. Design and construction of the necessary repairs were completed by June 1967. (For a more complete description of the damage and its effect on the reliability test program, see pages 37-39.)

SUPPORT & GENERAL PLANT

Modification of the proof load test facility to resist increased single direction horizontal loads was completed by September 1, 1966. The requirement for this work evolved when static firing of the S-IC-T demonstrated that the forward handling ring was subjected to greater stress characteristics than originally anticipated.

Approximately 6,000 square feet of additional storage area were provided in the Vehicle Component Supply Building by the addition of a second level of shelving. This increased the available floor area for storage of major components, permitting more efficient utilization of storage resources. This also reduced storage space requirements in the manufacturing building.

Checkout and initial operation of the data source collection system "Control Data Source Recorder

System" began in March 1967. This system replaces the time clock system and also provides a mechanized collection system for labor, payroll material, and inventory control data. The Facilities Organization designed and then subcontracted installation of the cable distribution system required.

FACILITY PLANS

As part of the negotiations which resulted in conversion to the CPIF contract, it was recognized that continued utilization of the existing production equipment, without changes, would result in a serious constraint to cost effective operations. As a result, an augmentation and modification, replacement, and rehabilitation plan was made part of the negotiations and included in the subsequently executed contract. In FY 1966, $3,367,343 was funded to this part of the contract. The initial request for funds for FY 1967 was $2.5 million, of which $1,895,195 was subsequently approved. The FY 1968 requirement of $3.2 million has been submitted, and final approval is pending at an anticipated level of $1.6 million.

Because of the damage caused by Hurricane Betsy, it was apparent that a comprehensive plan was required to improve overall Michoud performance in preparation for and subsequent recovery from such a natural disaster. Because of this need, the Facilities Organization initiated a revision to the "Michoud Hurricane and Tropical Storm Plan." Compliance with this plan will minimize the potential damage to facilities and critical stage-oriented hardware in case of another hurricane/tropical storm.

Significant progress was made relative to traffic planning, including both Michoud and adjacent areas. The Facilities Organization, in conjunction with the NASA-Michoud Traffic Safety Board, maintained close coordination with local, state, and federal officials, law enforcement agencies, etc., to alleviate overall safety and traffic problems which evolved with the rapid expansion at MAF and the immediate New Orleans East Area.

MISSISSIPPI TEST FACILITY

During FY 1967 the Facilities Organization was responsible for administration and completion of all MTF subcontract tasks. These tasks included: (1) installation of all GSE in the S-IC static test stand and the Test Control Center; and (2) the installation, test, and subsequent removel of the spider assembly in the test stand. This latter item was required to proof test the S-IC stage holddown arms.

Additionally, significant effort was provided to NASA via award of a call-type contract to Boeing in the amount of $380,000 (Contract NAS8-19528). This included administration of construction subcontracts to assist NASA in the activation of the S-IC test stand. The work involved installation of various facilities systems, and alterations, repairs, and modifications to existing facilities. Design support was also provided, as well as maintenance and general engineering services during the activation phase of the S-IC test complex. Further, detailed maintenance plans were developed for use upon achievement of operational status at MTF.

All basic work on the S-IC test complex was performed by the Corps of Engineers. In the following sections, particularly those dealing with the test stand, beneficial occupancy date (BOD) is defined as the date that Boeing accepted the portion of the facility being discussed as adequate for them to perform their contractual obligations. Joint occupancy date (JOD) refers to the date that Boeing (or subcontractor) was allowed to move in and begin working on a portion of the stand although no BOD had been reached. Testing of the S-IC test complex was performed by Boeing under the direction of the NASA Activation Task Group (ATG).

TEST CONTROL CENTER

The notice to proceed with removal of interim installation support equipment from the Test Control Center (TCC) by the subcontractor, was given on July 29, 1966. (This equipment was installed on an interim basis awaiting completion of the test stand). The first day of work was August 1. The interim equipment, which was located within and immediately beside the TCC to form closed loop systems with TCC test equipment, was removed and reinstalled in the static test stand. All subcontract work in the TCC was completed August 25, 1966. Figure 3-2 shows the S-IC TCC at MTF.

Change incorporation was one of the major activities in the TCC during the first quarter of the fiscal year. A major modification, to update the configuration of MTF support equipment to be compatible with changes made by MSFC Test Laboratory to the R-Test GSE, was 87 percent complete at the close of the first fiscal quarter. Modification effort on support equip-

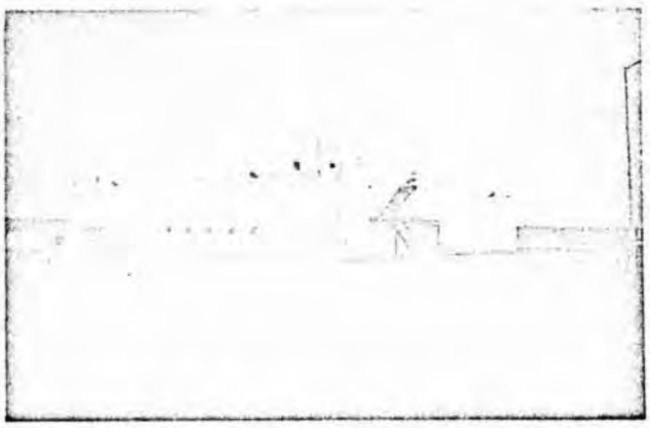


Figure 3-2 S-IC Test Control Center

ment in the TCC was worked on an expedited basis to insure incorporation of requisite changes prior to support equipment checkout and calibration. All testing of the support equipment in the TCC interim installation was completed. As a result of transferring equipment from the TCC to its permanent location in the test stand, and the changeover from temporary power panels to permanent panels in the TCC, it was necessary to repeat approximately 50 percent of the calibration and functional tests on this equipment.

COMPUTER ROOM

The RCA 110A computer has been used for system checks and computer program development. All three work shifts utilize the computer on a five-day week basis. This utilization has reduced on-off temperature cycles, which has helped reduce cracked solder joint failures on printed circuit boards. Modifications to the RCA 110A computer were installed on August 22, 1966. Acceptance of these modifications was delayed due to intermittent discrete input-output data channel problems. These problems, present throughout the computer system, developed from minute cracks on printed circuit board solder joints. The solution to these problems required the replacement of 3,400 of the computer's printed circuit boards with the boards reworked to new specifications. Problems were also encountered in the analog calibrations (computer interface) of the RCA 110A computer. Computer analog calibrations were intermittently out-of-tolerance. Discrete output problems with an internal jumper wire installed during factory checkout, also caused much delay and many problems during the second fiscal quarter.

A computer program was set up and initiated for preparation of computer interface listings for distribution. Prior to September 2, the computer station was operated on a 75 KVA transformer with a temporary power panel in place of the motor-generator set and the operational circuit breaker panel. Initially the motor-generator set was not accepted because of mechanical problems. With these problems eliminated, the motor-generator set was accepted.

Checks of the count clock tie-in with Technical System's timing networks were completed during August 1966. Input circuits from the GFE timing system had to be modified, in the RF terminal equipment, to include filters in order to stop ringing and noise problems on the lines. It was necessary to modify the GFE timing distributor in order to accept our down-range timing logic levels. Level III testing on the count clock system was completed in July after encountering extensive logic and cable problems. Level I calibrations were completed September 16, after correction of additional logic problems. In order to continue testing, it was necessary to revise the count clock and associated interface equipment (PRR 1080G) using prototype engineering parts as a work-around. Production parts for this modification were received and installed in early January. Manual and automatic functional tests were completed in January and February 1967.

The digital events evaluator (DEE) is operational, and has been used to verify manual functional test procedures. Mnemonics have been assigned to DEE channels for easier recognition of functions and have been included in the interface listings.

The 404 recorder distributor was discovered to have bad pin crimps in the connectors of the distribution panels. These bad crimps caused shorts between discrete inputs. Most of them had to be completely reworked. The completion of automatic tests of the complex and the de-bugging and start of dry runs of the automatic stage tests were performed during the second and third fiscal quarters.

ELECTRICAL SYSTEMS

Integration and calibration of electrical systems in the TCC was completed during the reporting period. Installation work was also completed on the stage power supply support equipment. Initial checks on wiring for recorders were completed, and these tests verified wiring from the test stand through the control room distributor and to the recorders. These tests were re-run, and interfacing with the data acquisition facility (DAF) was accomplished when the DAF was completed. The functional test verification of the equipment was performed during the second fiscal quarter.

Operation of the data system was intermittent due to the transfer from an interim to permanent operation. Calibration of all data systems, with the exception of the RF terminal equipment, was completed in August 1966. The RF terminal equipment was calibrated only after installation in the test stand was completed. The timing distribution system and strip chart recorders were turned over to Boeing for operation and maintenance during September 1966.

DATA SYSTEMS

The test conductor's view (prior to the first S-IC-T firing) of the LOX and fuel loading panels, barge valve configuration, and closed circuit television monitors is shown in Figure 3-3.

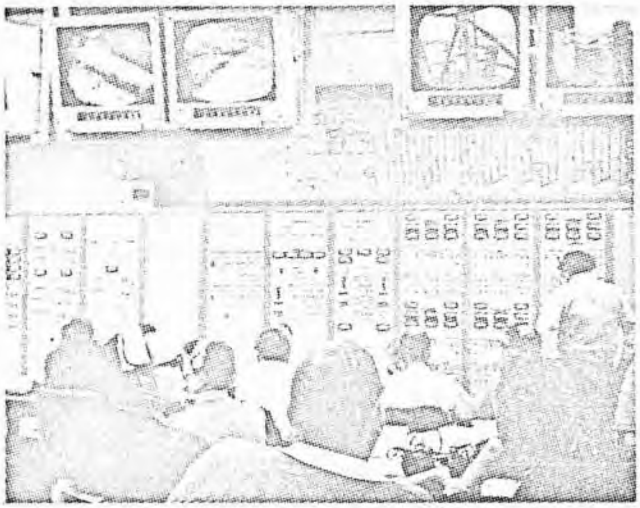


Figure 3-3 Interior of S-IC Test Control Center During Firing

STATIC TEST STAND

During FY 1967, all major work on the S-IC test stand (B-2 position) was completed, and the site was formally turned over to Boeing by NASA. Formal turnover and designation of the site as activated occurred on May 19, 1967.

At the beginning of the fiscal year, all basic concrete work on the stand (positions B-1 and B-2) was complete. Basic construction of the B-2 portion of the stand was essentially complete in November, and NASA assumed a total beneficial occupancy date (BOD) of the B-2 portion from the Corps of Engineers on December 2, 1966. Figures 3-4 and 3-5 show the stand under construction.

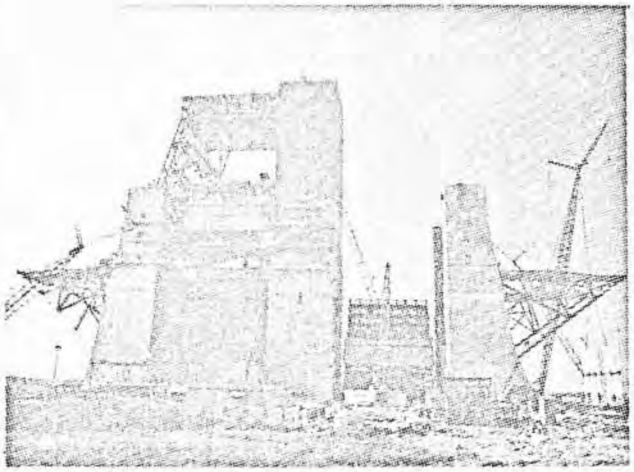


Figure 3-4 North Side of Static Test Stand

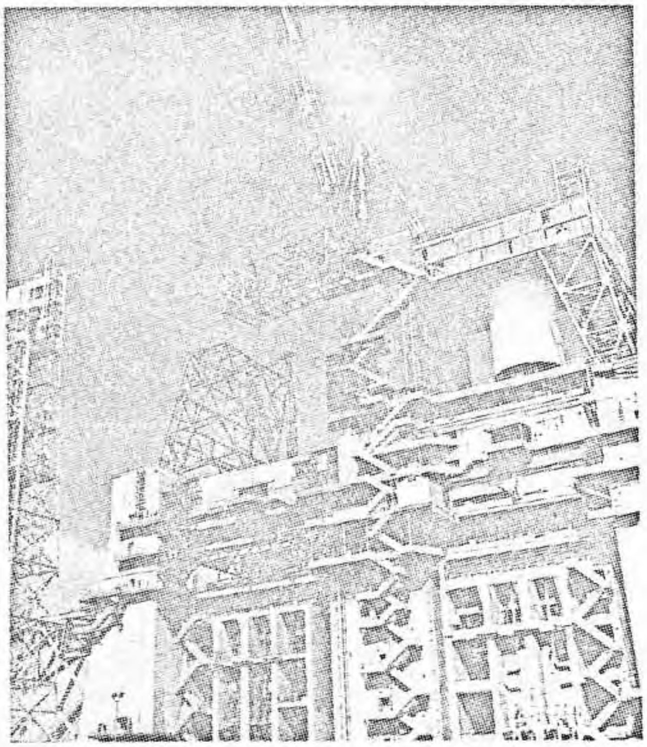


Figure 3-5 Erection of West Pier (B-1) Upper Steel Work

To expedite completion of the test stand, the NASA/MTF Manager formed an Activation Test Group (ATG) in July 1966. The purpose of this group (which was made up of representatives from all major contractors, NASA, and the Corps of Engineers) was to expedite the solutions to problems which were currently affecting completion of the test complex on schedule. Boeing was designated as integrator of the ATG for NASA. Under direction of the ATG, an ATG Work Control Center and Program Control Center were established; a facilities design group was established; and an operating and maintenance work force (a Davis-Bacon Act Craft) was created for the purpose of completing miscellaneous work on the test complex.

Bids for the installation of test stand support equipment were received from subcontractors in July 1966. The notice to proceed with the installation of support equipment in the test stand was given to the subcontractor, Blount Brothers, and work began on an incremental basis in July. Support equipment arrived at MTF during the first and second fiscal quarters. At the close of the first fiscal quarter, approximately 98 percent of the support equipment for the test stand had been received. Installation of support equipment in the test stand was difficult because of conflicts between original design and actual installation. Incremental installation was advanced to an accelerated basis in October and conducted in six different phases. In Phase I, the 6th and 7th levels of the center pier and the 8th and 9th levels of the support equipment pier, were completed in November. In Phase II, the removal of TCC equipment was completed in September. In Phase III, the 12th, 17th, 18th and 19th platform levels and 19th floor of the center pier, began on August 25, were completed on October 31. In Phase IV, the 7th, 8th, 9th, 10th and 11th platform levels were started on September 9 and were completed on November 19. In Phase V, electrical interface connections, began on November 7 and were completed on December 1. In Phase VI, the piping interface connections and pick-up work, began on December 5, were completed on December 15.

Early in July, holddown arm actuators were placed on the test stand to await welding. The arms were brought into position on the load frame in July (Figure 3-6). Welding of the holddown arms commenced on August 5 and was completed in September. This completion, coupled with turnover of the auxiliary derrick to the ATG, on September 30, 1966, resulted in studies and status reviews to identify work that needed to be accomplished in order to perform the holddown arm test earlier than anticipated.

It was decided in August that installation of the holddown arm test fixtures would be subcontracted. The notice to proceed with the installation of the holddown

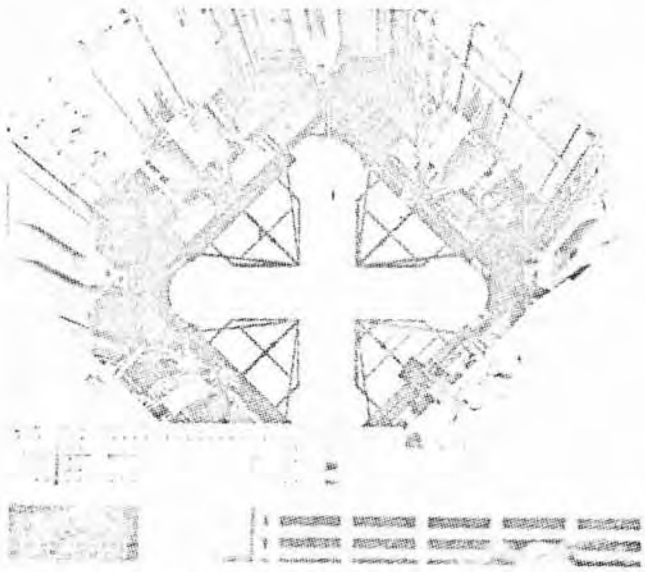
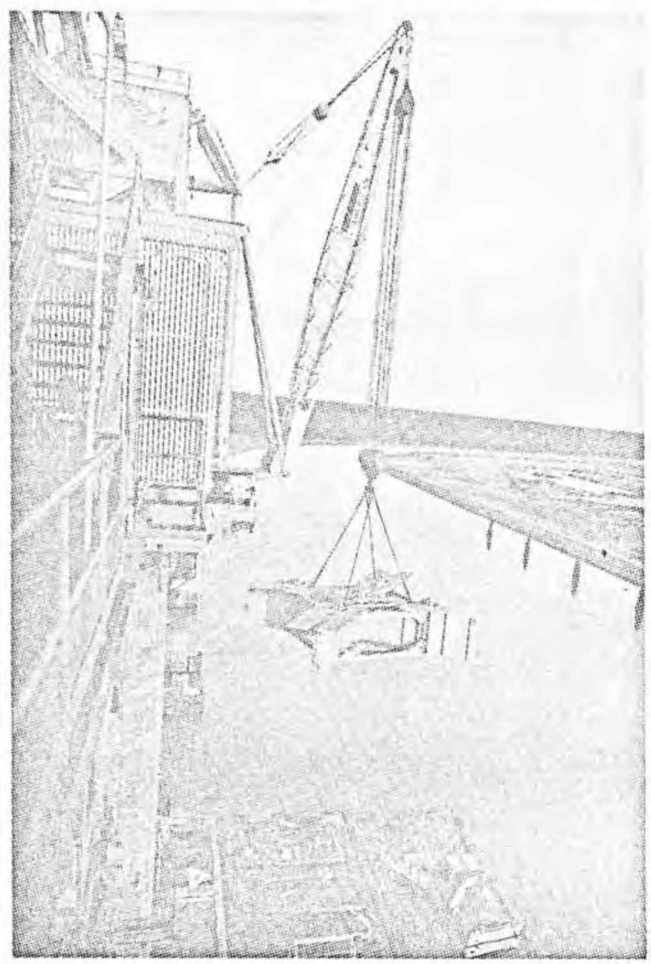


Figure 3-6 Holddown Arms In Position On Load Frame

Figure 3-7 "Spider" Being Hoisted Into Test Stand



arm test equipment was given by Boeing on September 23. A detailed plan for the preparation and conduct of the holddown arm testing was developed to be consistent with current test stand status and ATG directions (for results of testing see page 71).

Installation of strain gages for the static load test began on September 10, 1966. Initial installation was completed September 25; however, due to bonding problems, several gages had to be reinstalled in October. Bridge network installation, and hookups from gages were completed in time to meet our static load testing schedule.

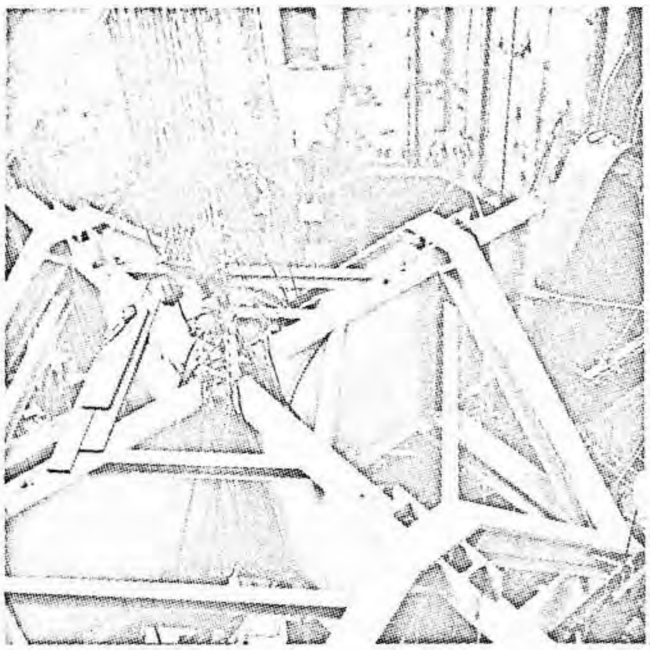


Figure 3-8 Upper Spider Installation

The access date for start of the static load test spider installation and related activity was September 26, 1966. The upper spider was hoisted into the stand and then placed in the hold down arms on October 4, as shown in Figure 3-7 and 3-8. The roll ramp actuators operated correctly, and the load cells and strain gages performed satisfactorily for data purposes. Side load brackets and hydraulic cylinders were staged on the engine access platform and the lower spider was placed in position under the load frame on October 12. Welding of the column, which attached brackets to the load frame, was completed on October 17. (For results of testing see page 71.)

Installation of high-pressure industrial water (HPIW) piping has been completed in all areas for one portion of the S-IC test stand. Spray nozzles are all installed, and all control panels pertinent to the system are in place. Final inspection, with the Corps of Engineers and NASA, was completed in November, and the HPIW was accepted by Boeing.

Early in FY 1967, Boeing surveillance activity was expanded to support NASA in systems cleaning and component installation work on the test complex. Extended, multiple shifts were also implemented to provide support for the handling, transporting, and cleaning of S-IC components between the Booster Storage Building and Michoud. MTO (Quality and Reliability Assurance) performed 100 percent surveillance of the facility support systems component installation work which was done in the S-IC complex by Corps of Engineers contractors during FY 1967. Cleaning of the high pressure gas (HPG) storage bottles was completed in August 1966; on-stand high pressure air (HPA) and helium systems cleaning and flushing was completed in September; cleaning and blowdown of the GN_2 system on the stand was finished in September; and completion of the S-IC HPG systems was accomplished in December. (See Figure 3-9.)

Figure 3-9 S-IC High Pressure Gas System

Considerable maintenance work was required on the HPG System, particularly to complete the changeout of valves and components, and to implement the critical change request on the GN_2 and air systems. Installation of the engine GN_2 purge system was completed during January. (See Figure 3-10). The fourth and final GN_2 bottle was installed by the COE contractor and completed on January 20. The technical systems controls and master facility panel were accepted by Boeing on January 25 and February 21, respectively.

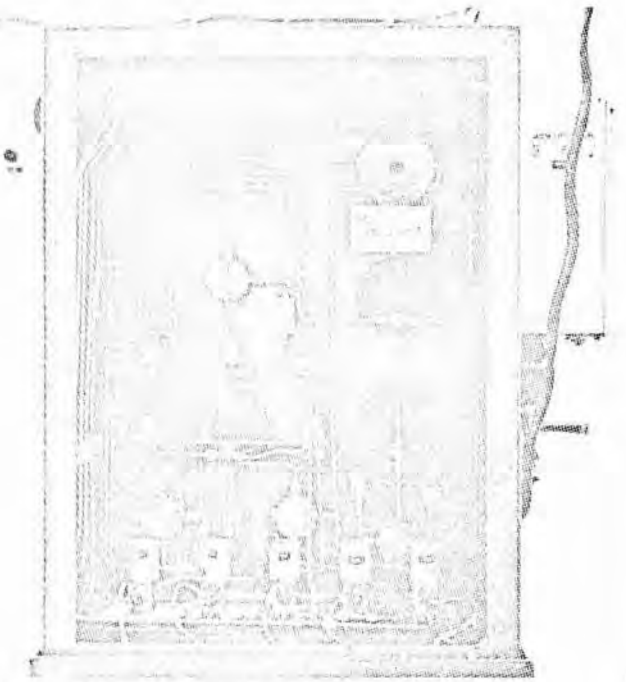


Figure 3-10 Engine GN_2 Purge System

The liquid oxygen (LOX) system was satisfactorily cleaned, and the installation of components started in October, 1966. Boeing accepted the LOX System piping on November 17. A major effort to complete the LOX System prior to the LOX High Flow Test was successful. (See page 72.)

The cleaning of the fuel (RP-1) system was completed in early November 1966. Delays, caused by the extensive amounts of flushing required to remove loose particles from the system, were encountered. Completion date of the RP-1 system was November 19, 1966.

NASA requested of Boeing additional activation efforts pertaining to the S-IC test stand. These requests were: to provide for a gaseous nitrogen purge system; to provide engine and fuel drain system; and to revise cable lengths and/or routing to terminal receptacle boards. These requests were justified.

Certain activation functions in the S-IC complex were awarded to SIP, Inc., by ATG (on Boeing recommendation). The cost-plus-fixed-fee (CPFF) Open Call Contract was signed in December 1966. A survey of complete brick and mortar requirements and discrepancies in the test stand was made during the first week in February. This survey specifically identified over 1,000 items which required completion or correction before the stand could be fully operational. Completion of the S-IC test complex required the use of work-arounds, incremental JOD, and BOD change requests. Engineering support to NASA for modifications and additions to the facility for the preparation of change requests and detail design packages was extensive during the third fiscal quarter.

The installation of support equipment continued during the third fiscal quarter with the working off of punch list items, including tagging and identification of installed tubing and piping. The contractor was required to spend additional effort to complete the installation of the emergency fuel drain assembly resulting from engineering problems.

BOOSTER STORAGE BUILDING

Boeing took full occupancy of the S-IC Booster Storage Building during the second quarter of FY 1967. Prior to this, the Booster Storage Building had been shared with North American Aviation.

All Level III testing of high voltage power supply in the Booster Storage Building has been completed. No major problems were encountered during this testing, and the S-IC-D is now stored in the Booster Storage Building. The stage is being placed on permanent storage stands in order to free the transporter for other use. The Rocketdyne clean room in the Booster Storage Building was used by Boeing for re-assembly of GN_2 service panels. In June, NASA agreed that the clean room should be adapted to Boeing use. Planning is now underway to accomplish these changes.

CHECKOUT AND ACCEPTANCE OF THE GOVERNMENT FURNISHED MTF S-IC TEST STAND

PRE-STATIC FIRE TESTING

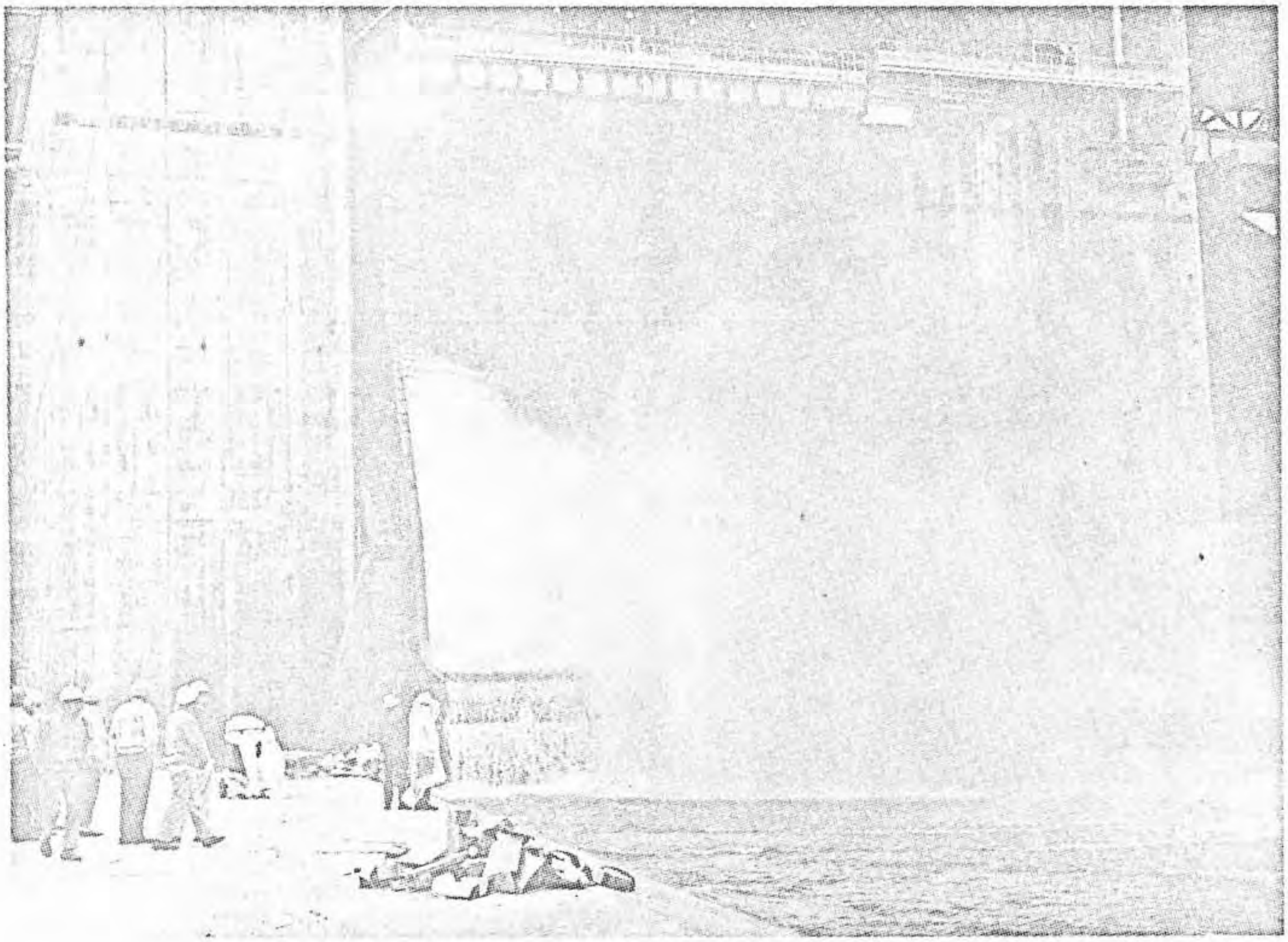
Prior to the first test firing at MTF (S-IC-T), a number of tests were performed to verify the structural integrity of the test complex and its support systems. Testing, which was performed during FY 1967, consisted of 30 different facility activation tests.

The HPIW system was successfully tested in three different phases. The water flush operation on the flame deflector was completed on November 12, 1966. The first full deluge test was completed on November 21. This test was followed by the deflector full flow test on November 30 (Figure 3-11). Static load testing of the test stand was conducted during late October. Test results verified that the holddown arm and load frame system met all requirements. Proof testing of the forward stabilization holddown parts was satisfactorily completed in December.

Dynamic testing of the stand was scheduled for late December. Problems arose concerning the acquisition of two mechanical shakers which were to be used for this test. Therefore, testing procedures were revised to establish requirements and test methods for obtaining test stand structural vibration data during static firings.

Activation testing of the S-IC high pressure gas system, which included subsystems checkout, was completed during January. Calibration and functional tests of the Greer hydraulic unit and S-IC pneumatic console were also completed during January.

Figure 3-11 B-2 Deflector Flow Test



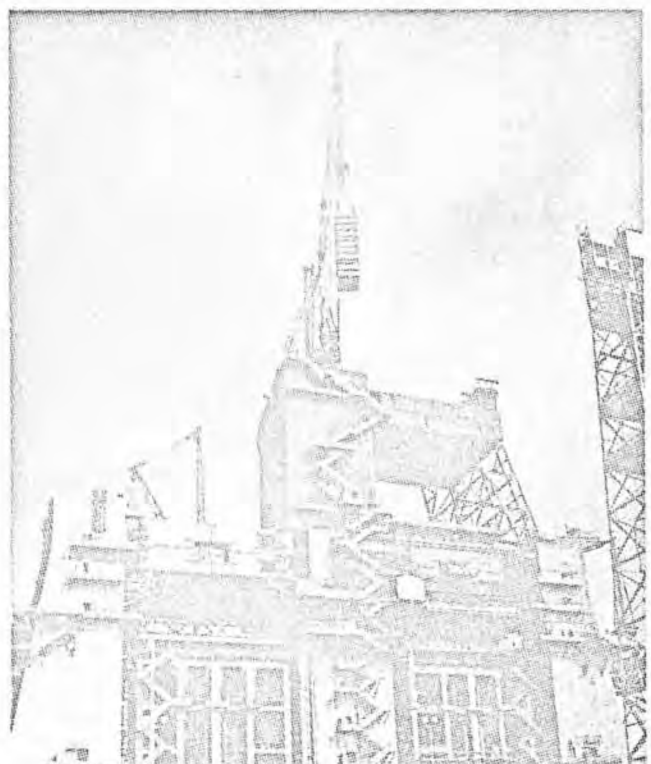
The main 14-inch line was completed when the expansion joints were installed in November. The system was then recleaned. The cold shock and low flow test were satisfactorily completed in December. The LOX system high flow test was conducted in mid-January 1967. The first test verified a flow rate of approximately 9,000 GPM and proved the fill and drain system dynamically sound. The following week, a successful LOX topping test completed the LOX system high flow test.

The propellant load test, RP-1 stage tanking test, LOX stage tanking test, wet simulated static firing countdown, and detanking were all completed successfully in mid-February.

Functional testing of power supply systems of equipment installed in the test stand, were started in mid-October. A total of 69 calibration, functional, and automatic tests were required to verify this equipment. These GSE integrated complex tests were completed during April.

The 250-ton proof load test of the main test stand derrick was completed during November (Figure 3-12). The only discrepancy discovered in this otherwise successful test, was that the main hook would not swivel when loaded beyond 130 tons. This deficiency was resolved.

Figure 3-12. 250-Ton Proof Load Test of Main Derrick



The Lebus compensator leveling block on the main derrick failed during February. Repairs were begun immediately and completed with a week. Following a proof load test, a component failure occurred in the power amplifier on the 250-ton crane on March 26. This failure caused loss of control in the main derrick hoist system. Thorough investigation revealed that this failure (control circuit power amplifier cards were at fault) imposed no restrictions on the use of the derrick. The derrick control system was repaired and successful proof load tests were performed again.

During removal from the test stand of the S-IC-4, on June 5, the swinger circuit on the main derrick ceased to function just as stage rotation was about to begin. Failure of the derrick to respond to command caused a 12-hour delay in placing the stage on the transporter. Investigation disclosed an intermittent control switch in the cab, an open emergency stop switch, and an out-of-tolerance power amplifier card. Inspection of the auxiliary derrick disclosed a grease hose had broken loose from its tie point and had been cut in two by the gears; the right and left hand end sectors of the bull gear were displaced downward approximately two inches; the outboard end of the horizontal strut was bent upward; and the boom had passed beyond the limit switch in the parking position and had come to rest in contact with a hand rail. Interim repairs, improvements, and modifications were accomplished. Both derricks were satisfactorily proof load tested June 21. At the initiation of attempts to install the S-IC-5 into the test stand on June 22, the main derrick controls again malfunctioned. Circuitry modifications were made and, a load test successfully completed on June 23. Another load test was satisfactorily conducted June 28. The S-IC-5 was then installed in the test stand June 29.

S-IC-T TEST STAND CHECKOUT

A major rewrite of the plan for the activation of MTF facilities utilizing the S-IC-T (D5-11789), "Stage Sequence/Operation Plans for the Saturn S-IC-T/4 Stage," was completed in October 1966. Boeing's S-IC-T/4 measurement program was approved by NASA/MTF on December 28, 1966 (S-IC-T/4-S-IC-T stage built up to S-IC-4 configuration).

The S-IC-T arrived at MTF on October 24, 1966 (Figure 3-13). The stage was placed in the Booster

Figure 3-13 Arrival of S-IC-T at Bascule Bridge

Storage Building where, by use of the Brooks Analyzer from Michoud, circuitry of the stage was verified (Figure 3-14). On December 16, the stage was transported, by barge, to the static test stand. Installation into the test stand was completed on the following day (Figure 3-15).

After required preliminary tests were conducted, and instrumentation was in place, hookup of the stage began.

By mutual agreement between Boeing and NASA, the first static firing was changed from January 27, 1967, to March 3. This change was made because of problems with the Greer hydraulic unit, fitting problems with interconnects, late checkout of the pneumatic console and GN_2 Panels, and late availability of the stand.

The first MTF firing took place on March 3. This was the 16th firing of the S-IC-T. Operational capability of one position of the test stand and its support equipment and systems was verified by this successful 15 second firing.

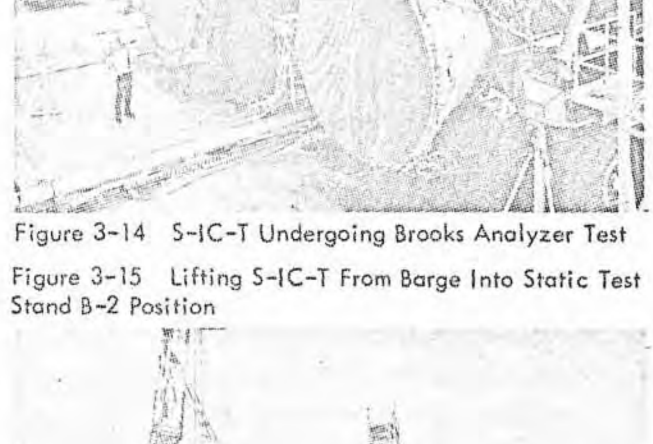
A quick look report, representing the preliminary results of the March 3 firing, was presented verbally to MSFC personnel, and others, at a meeting held on March 7 at MTF. The printed release was submitted on March 10. The stage, GSE, and facility systems performed satisfactorily, with some anomalies being noted. Data gathered from the static firing of March 3 was developed and evaluated prior to the second successful firing (60 seconds) of the S-IC-T on March 17 (Figure 3-16). This successful test demonstrated the capability of the test stand flame bucket.

MTF DOCUMENTATION

Boeing/MTF's document preparation effort is approximately 85 percent complete. Individual document status is indicated in Appendix G.

Figure 3-14 S-IC-T Undergoing Brooks Analyzer Test

Figure 3-15 Lifting S-IC-T From Barge Into Static Test Stand B-2 Position



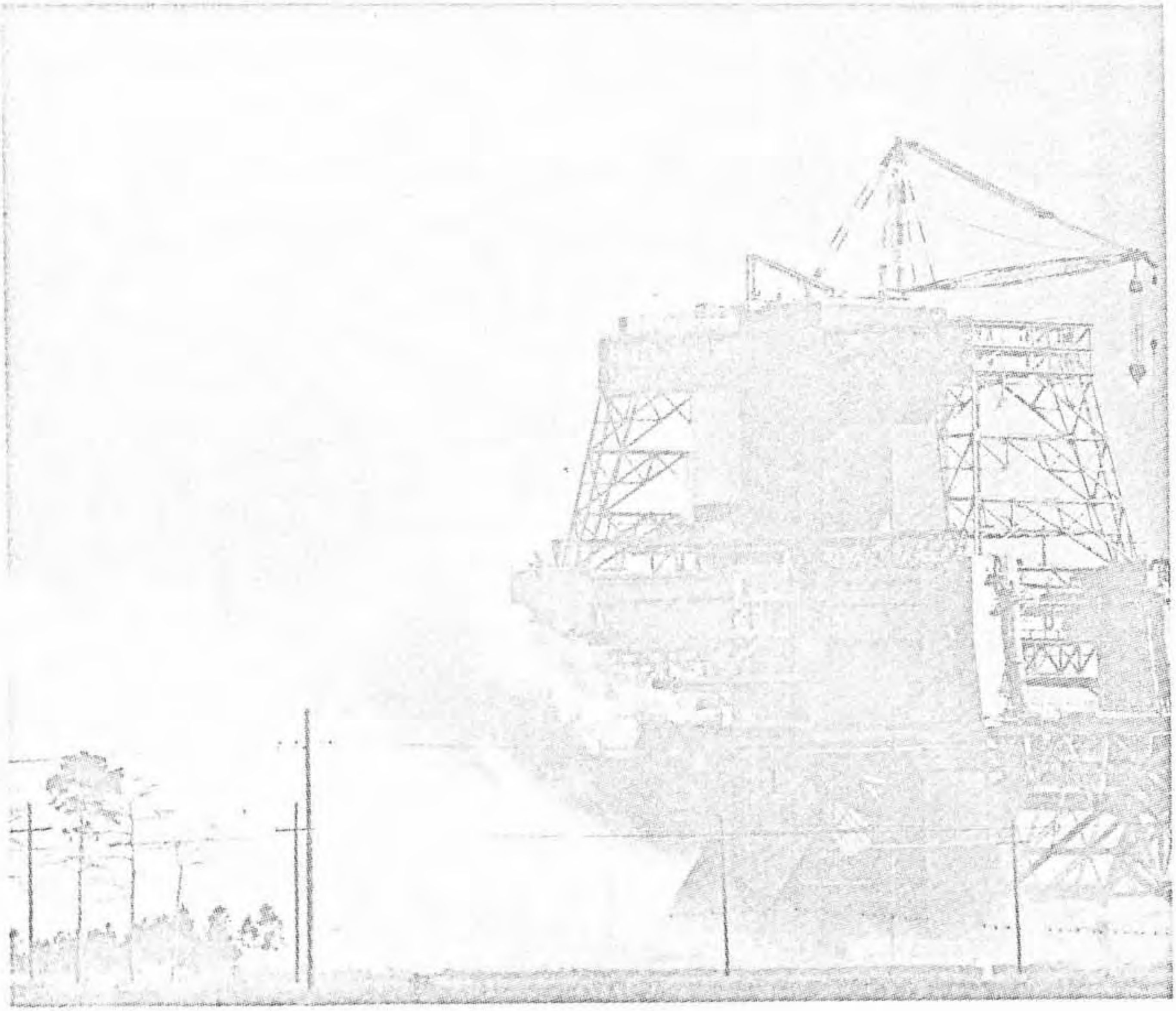
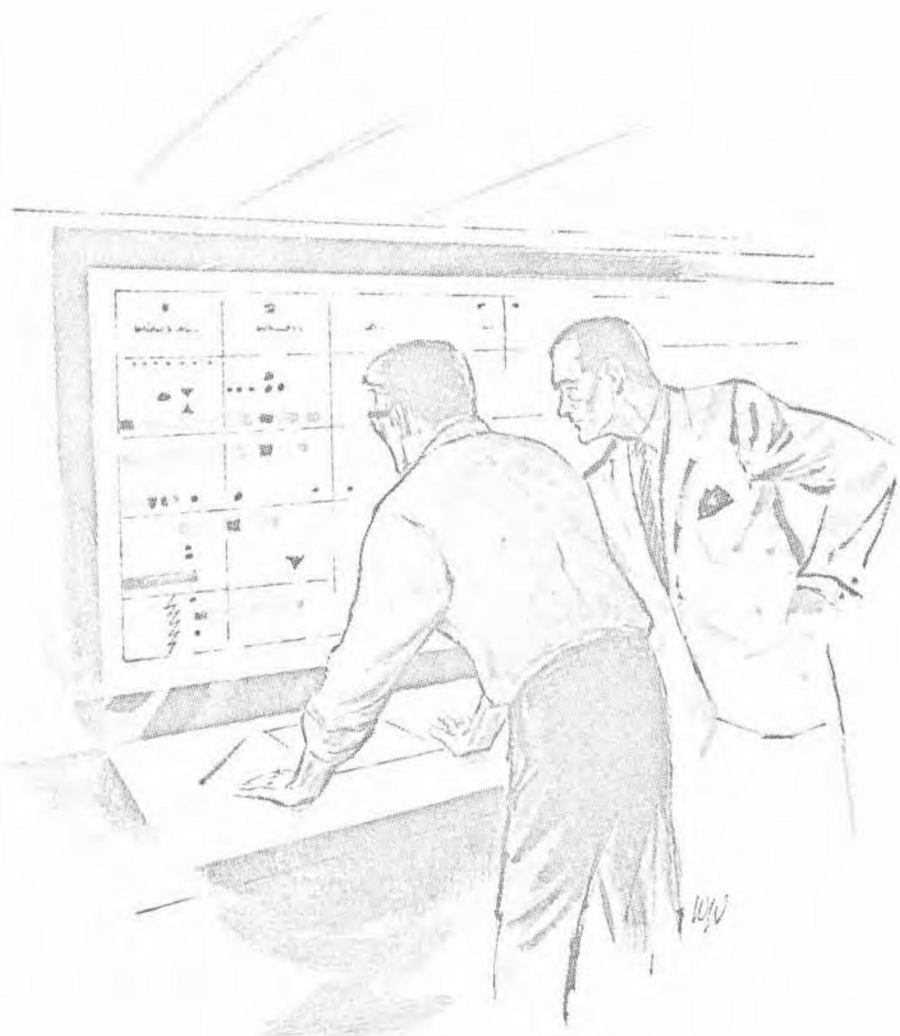


Figure 3-16 17th And Final Firing of The S-IC-T

LOGISTICS 4



SUMMARY

Boeing's participation in the S-IC Logistics Support Program consisted of the following for this report period:

a) Spares support for the S-IC-T stage at MSFC and MTF, for the S-IC-F stage, and for stages S-IC-1 through S-IC-6 at Michoud, MTF, MSFC, and KSC;

b) Spares support for test and checkout equipment at Michoud and MTF;

c) Spares support for Boeing-furnished S-IC stage-peculiar GSE delivered to MTF and KSC;

d) Spares support for the MSFC R-TEST umbilical carrier hardware; and

e) Field support engineers at MSFC, MTF, and KSC.

DOCUMENTARY SUPPORT

MAINTENANCE ANALYSIS

Stage maintenance analysis documentation for S-IC-3 and S-IC-4 was completed during the past year. It was submitted to NASA/MSFC via documents D5-13604-3, "S-IC-3 Stage Maintenance Analysis", and D5-13604-4, "S-IC-4 Stage Maintenance Analysis". The baseline for preparation of the stage maintenance analysis documentation was the Saturn V Document D5-16004-910, "Sequence of Events - Time Line Analysis - Assembly, Checkout and Launch Saturn V Vehicle". The requirement for documenting and accomplishing a formal maintenance analysis for stages S-IC-5 through -10 is being deleted by contract change. All previously submitted GSE maintenance analysis documentation, D5-13603-1 through -8, was updated in accordance with design changes which occurred during this period.

TECHNICAL SUPPORT DATA

Publication of S-IC stage and GSE technical manuals continued on or ahead of schedule throughout the past year, with subsequent changes or revisions keeping pace with approved design changes. The following technical manuals were submitted during the past year:

MSFC-MAN-034	"S-IC-1 Stage Maintenance Information and Part Index"
MSFC-MAN-034-2	"S-IC-2 Stage Maintenance Information and Part Index"
MSFC-MAN-034-3	"S-IC-3 Stage Maintenance Information and Part Index"
MSFC-MAN-034-4	"S-IC-4 Stage Maintenance Information and Part Index"
MSFC-MAN-035-2	"S-IC-2 Stage Buildup Information"
MSFC-MAN-035-3	"S-IC-3 Stage Buildup Information"
MSFC-MAN-034-4	"S-IC-4 Stage Buildup Information"
MSFC-MAN-040	"S-IC-1 Stage Systems Description"
MSFC-MAN-040-2	"S-IC-2 Stage Systems Description"
MSFC-MAN-040-3	"S-IC-3 Stage Systems Description"
MSFC-MAN-040-4	"S-IC-4 Stage Systems Description"
MSFC-MAN-042	"S-IC-1 Stage Flight Measurements"
MSFC-MAN-042-2	"S-IC-2 Stage Flight Measurements"
MSFC-MAN-042-3	"S-IC-3 Stage Flight Measurements"
MSFC-MAN-042-4, -5	"S-IC-4 and -5 Stage Flight Measurements"

STOCK STATUS AND CONSUMPTION REPORT

The Stock Status and Consumption Report, which reflects the total spare parts inventory by location, was released during the third quarter of FY 1967. This report reflects quantities on hand at each location and the quantities which were received, issued, transferred, reallocated, and disposed of during the report period.

SPARES SUPPORT

PROVISIONING

Four spares hardware stores were supported during the reporting period. The store at Huntsville, Alabama, was operated in support of S-IC-1, -2, and -3 testing and static firing. It was closed following completion of S-IC-3 static firing, and the spares stock was reallocated to other stores. Stock build-up at the KSC store continued throughout the year and, at the year's end, was approaching the level needed to support the first flight stages. Stock at the MTF store was built up during the third and fourth quarters to support static firings of the S-IC-T (facility checkout) and the S-IC-4. The Michoud store was utilized both as a central supply for test site provisioning and as a site support store for post-manufacturing checkout (PMC) and post-static test checkout (PSC) operations conducted at Michoud.

Late in FY 1966, S-IC-1 and -2 spares support responsibility was transferred to Boeing by Contract Supplemental Agreement MICH-269. This has created some rather severe problems in timely support of the two stages at KSC. It has been necessary to provide some particularly critical long-lead-time items by removal from later production stages. This condition is easing and no serious difficulty is expected in supporting the S-IC-1 launch.

PERSONNEL SUPPORT

FIELD SUPPORT ENGINEERS

In support of increased logistics activity at the sites, three spares maintenance representatives (SMR) are now assigned to KSC. Spares maintenance representatives are also assigned to MTF and the Michoud Assembly Facility. These representatives perform liaison between site personnel and logistics engineering to assure that spares are available to meet test and launch schedules.

FIELD COMMUNICATIONS

A teletype system, used exclusively for spares, was instituted in the fourth quarter of FY 1967. This system is designed to improve communcations on spares hardware transactions between Michoud, MTF, and KSC.

AUTOMATION OF LOGISTICS INVENTORY CONTROL

Criteria for a third generation on-line computer system for spares inventory control was completed and released in Document D5-13664, "Logistics Inventory Control System". The system is presently awaiting programming. At the present time, posting of approximately 19,000 ledger items is being performed manually.

SPARE PART EQUIVALENCY

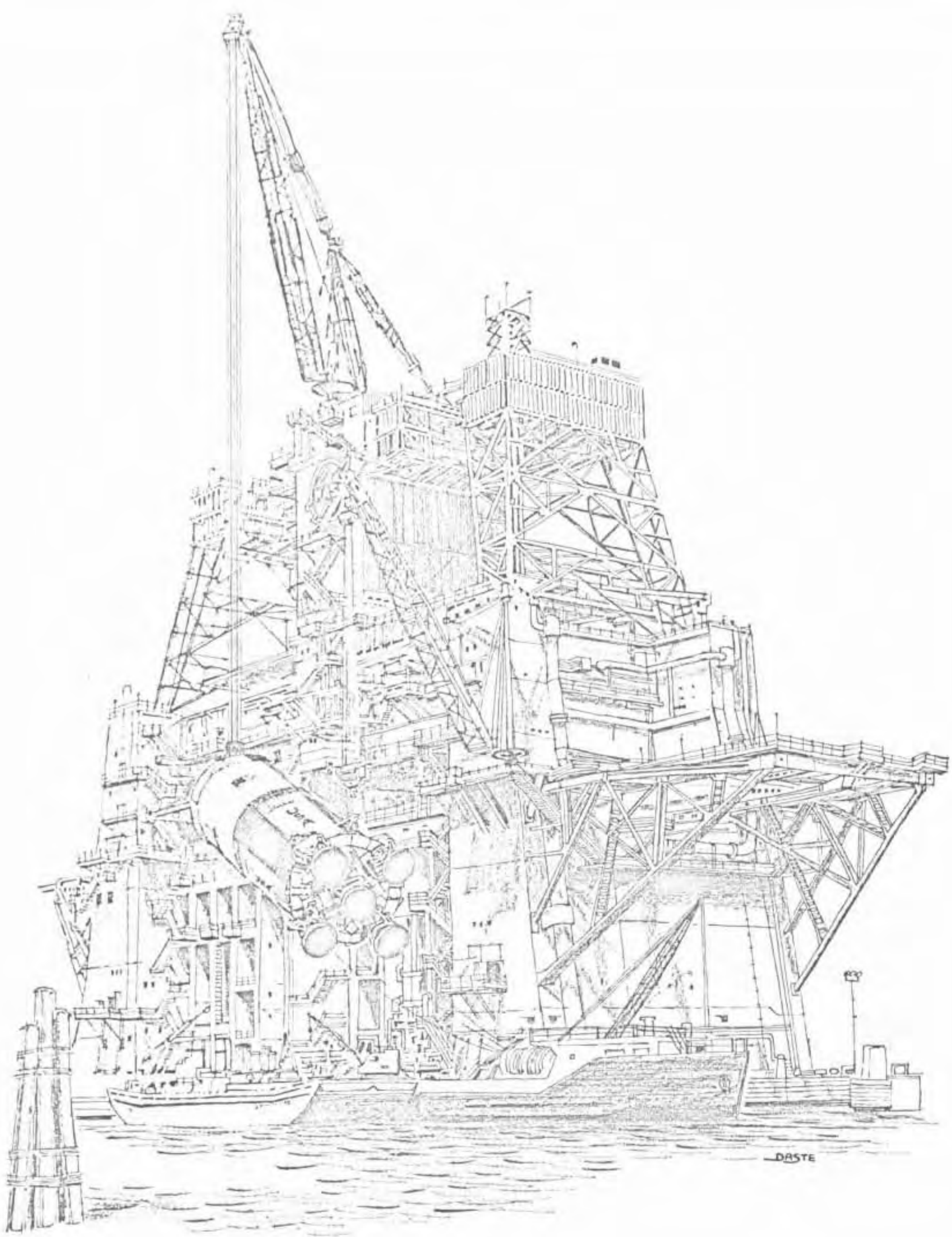
Lack of an approved method of authorizing the use of equivalent spare parts has been a severe handicap in the provisioning of these parts. A solution to this problem, utilizing special multi-sheet "Spare Part Equivalents" Class I drawings, was approved by NASA and implemented in the fourth quarter of the fiscal year.

SPARES FOR GOVERNMENT-FURNISHED PROPERTY (GFP)

The most serious spares support problems are those associated with GFP items for which spares support responsibility has been transferred to Boeing and also for items to be supported by MSFC. Generally, the problem is the inadequacy of, or failure to receive, the spares ordered by MSFC; however, lack of adequate drawings, and particularly lack of configuration change information, are also creating serious problems.

STAGE SYSTEM STUDIES

5



PREPARATION FOR MTF STATIC FIRINGS

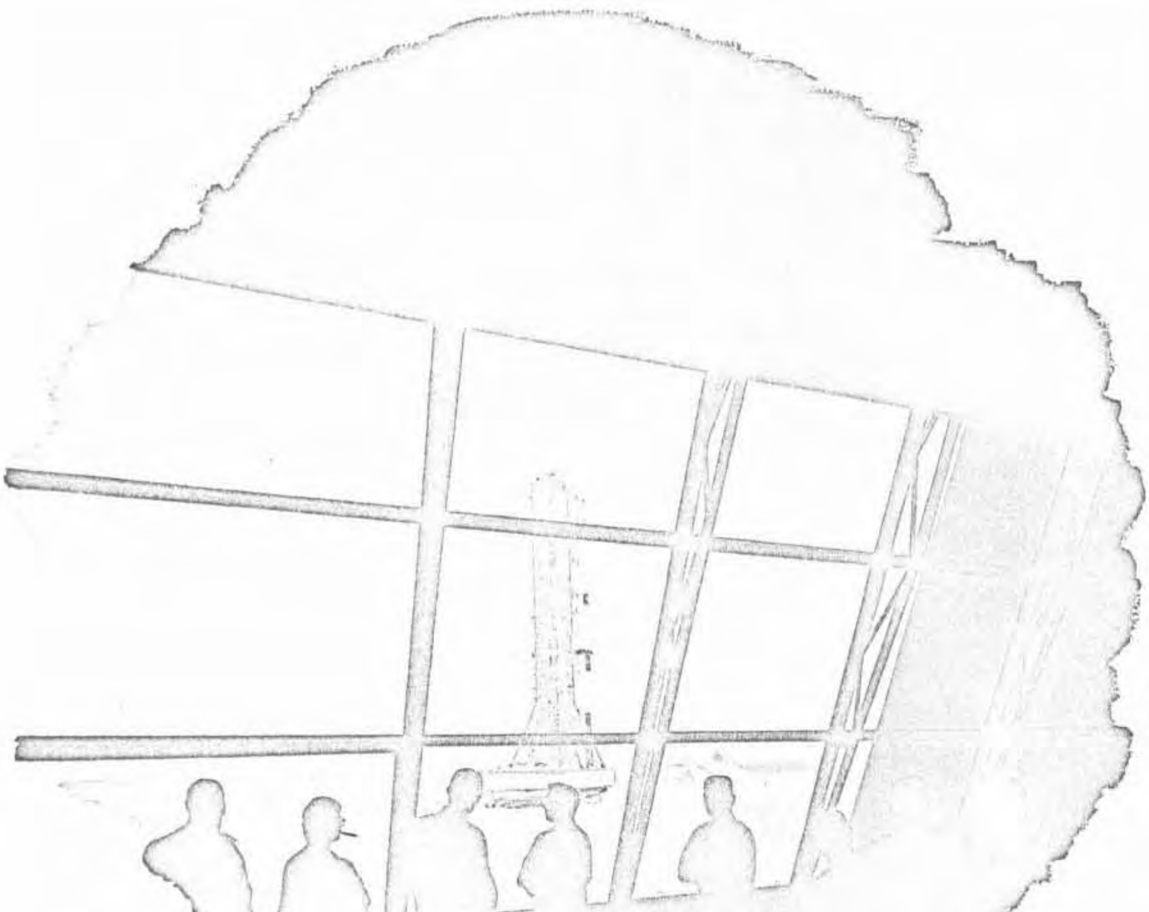
In preparation for MTF static firings, Boeing/MTF personnel were assigned to Boeing/Huntsville on a loan basis to assist in the S-IC-T static firing program. These loans, which were made in FY 1966, were made to help Boeing/Huntsville complete its task and to provide valuable on-the-job training for Boeing/MTF loanees. The loaned personnel assisted in preparation of instrumentation, control equipment, engines, and test stand. They also participated in the static firings as console operators and chart observers and in refurbishment after static firing.

Upon completion of the S-IC-T static firings at Huntsville, these loanees returned to MTF for preparation of test and checkout of the MTF test complex. Subsequently, they returned to Huntsville to assist in the firing of the S-IC-3. After this firing, the test crews returned to MTF, where, after two more firings of the S-IC-T and one firing of the S-IC-4, they now make up the nucleus of Boeing's Systems Test - Mississippi Test Operations Organization.

S-IC STORAGE STUDIES

A study was performed to establish a plan for storing S-IC stages 7 through 15 at Michoud, MTF, and MSFC for a period of 24 months or less on a non-interference basis with present plan VIIIA production schedules. The plan was based on inside storage, utilizing available facilities with moderately controlled temperature and humidity. The F-1 engines and all "ship loose" hardware would be stored separately while all other factory installed equipment would be stored on the stage. The propellant tanks would be protected from contamination and negative pressure by pressurization. All other pressurization and control systems would be protected against contamination by pressurization. The stages would be stored horizontally on storage stands or transporters following manufacture and a special pre-storage checkout. Assessment and inspection during storage would be held to a minimum.. Upon removal from storage, the stage would be inspected for damage, all age-sensitive parts would be checked out, cable insulation tests would be conducted, and a thorough configuration inspection would be performed. Following this, the stage would enter the normal operational sequence beginning with a complete post-manufacturing checkout. The results of this study were submitted to NASA on November 15, 1966.

LAUNCH OPERATIONS 6



S-IC ENGINEERING LIAISON TO BATC

The S-IC liaison activity established at Kennedy Space Center has performed the in-scope design effort requirement of supporting the processing of the S-IC-F, -1, and -2 stages. Working relations have been established with the MSFC resident office, KSC, and the Boeing Atlantic Test Center operating organizations. The liaison activity has, in addition to the efforts involving technical coordination and clarification of engineering requirements, originated and released Class I documentation for 58 compatibility ECP's, participated in the Materiel Review Board dispositioning of 606 discrepant parts, and identified the requirement for additional analysis and evaluation of 85 failed parts during FY 1967.

Engineering is also providing traveling specialists to support prelaunch activities at BATC. These specialists act as engineering consultants on both stage and ground support equipment problems.

FLIGHT DATA EVALUATION

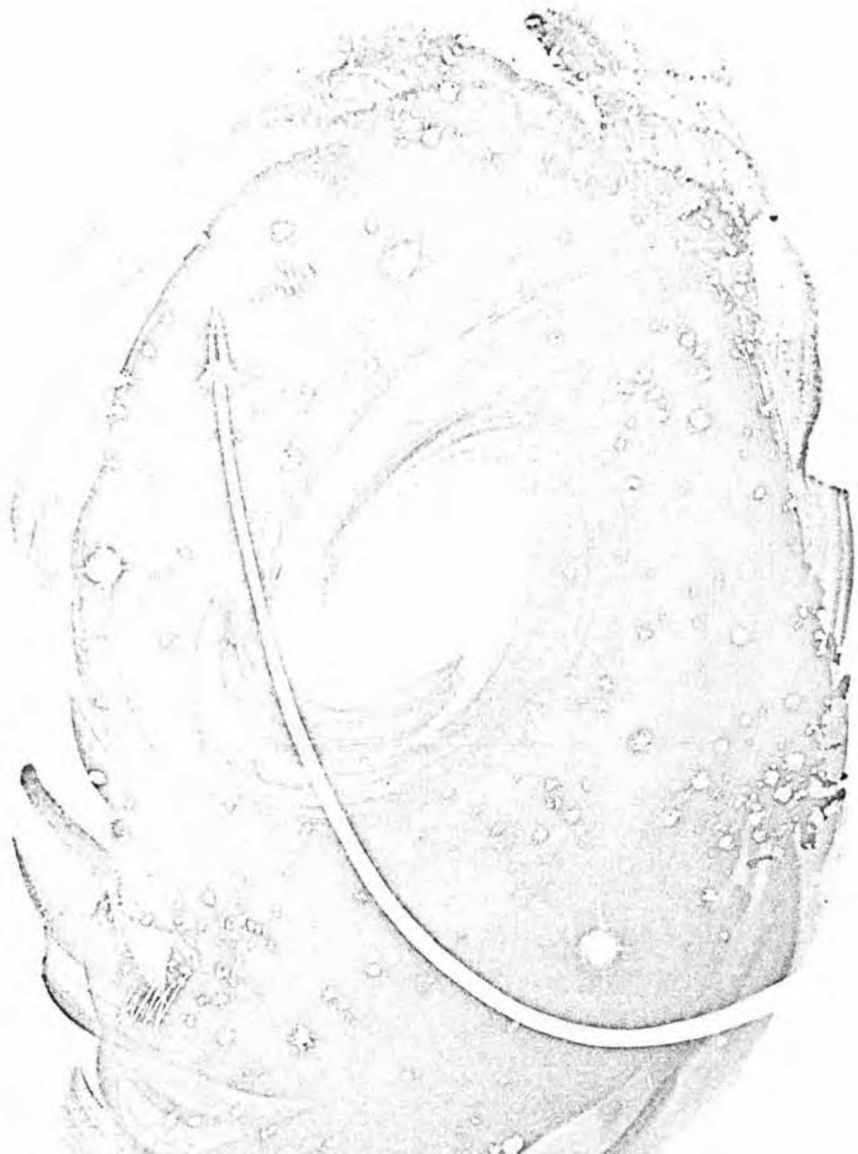
A Flight Evaluation Planning Committee (FEPC) has been organized to coordinate the overall flight data evaluation problem. This committee is responsible for inter-organizational coordination to establish data requirements, basic data processing computer requirements and programs, computer analysis program requirements, and reporting requirements. All required data has been identified, and computer programs required for analysis of data have been completed.

Members of the Boeing flight evaluation team have been named and their areas of responsibility defined. Close coordination between this team and the NASA Flight Evaluation Working Group (FEWG) has been maintained and several members of the team have attended the S-IC FEWG meetings to become familiar with the operations of the FEWG.

LAUNCH MISSION RULES

A Huntsville Operation Support Center (HOSC) committee has been organized to provide support for the Saturn V Launch Information Exchange Facility (LIEF) activities. This committee is responsible for coordination and implementation of the S-IC launch requirements and restraints into the Saturn Launch Mission Rules which are issued by KSC and MSFC concurrence. The committee also provides S-IC stage support to MSFC during the Countdown Demonstration Test, the Flight Readiness Test, and the final countdown and launch of the Apollo-Saturn V vehicles.

ADVANCED STUDIES 7



No work was done under the Advanced Studies part of the contract in FY 1967.

APPENDIXES

APPENDIX A

CONTRACT MODIFICATIONS

The number of contract modifications received during the period July 1, 1966, through June 29, 1967, by contract is as follows:

Contract NAS8-2577	- 1
Contract NAS8-5606(F)	- 2
Contract NAS8-5608	- 303
Contract NAS8-17218	- 5
Contract NAS8-19528	- 3
Contract NAS10-4141	- 4

APPENDIX B

PROPOSALS SUBMITTED

The number of firm cost proposals submitted to NASA during the period July 1, 1966, through June 29, 1967, by contract is as follows:

Contract NAS8-5606(F)	- 1
Contract NAS8-5608	- 189
Contract NAS8-17218	- 5
Contract NAS8-19528	- 4
Contract NAS10-4141	- 2

APPENDIX C

NEGOTIATIONS COMPLETED

The number of negotiations completed with NASA during the period July 1, 1966, through June 29, 1967, by contract is as follows:

Contract NAS8-5606(F)	- 1
Contract NAS8-5608	- 144*
Contract NAS8-17218	- 3
Contract NAS8-19528	- 2
Contract NAS10-4141	- 2

* Includes 26 proposals submitted during FY 1966.

APPENDIX D

DELIVERABLE DATA SUBMITTED

The number of items of deliverable data submitted to NASA during the period July 1, 1966, through June 29, 1967, by contract is as follows:

Contract NAS8-5606(F)	- 14
Contract NAS8-5608	- 1,291*
Contract NAS8-17218	- 24
Contract NAS8-19528	- 10
Contract NAS10-4141	- 24

* Under contract NAS8-5608, single items of data average approximately 30 pages each.

APPENDIX E

ENGINEERING CHANGE DOCUMENTATION COMPLETED DURING FY 1967

CHANGE NO.	DESCRIPTION	EFFECTIVITY STAGE	EFFECTIVITY GSE
0001	Reduce Reseat Pressure Requirements of 60B51002 Vent/Relief Valves	1-10	
0002	Modify Outboard Engines Cutoff Signal to the Instrument Unit	F, 1-10	MSE 1,2, R-Qual

CHANGE NO.	DESCRIPTION	EFFECTIVITY STAGE	EFFECTIVITY GSE
0004	Delete Six S-IC Pressure Switches	1-10	MSE 1,2, R-Test, MTF, MILA 1,2,3, MAB
0005 R1	Revise the 60B41223-1 Prevalve Ground Control System	T, F 1-10	MSE 1, R-Test, R-Qual, MTF 1, MILA 1, MAB
0006	Replace 50M35008 Stress Corrosion Susceptible Servoactuators with 60B84500 Contractor-Designed Servoactuators	1-10	
0013	Modify Flight Combustion Monitor System	1-10	
0015	Modify F-1 Engine Thrust OK System	1-10	
0023	Increase the GN_2 Flight Storage Capacity for the LOX Seal Purge System	F, 1-10	
0024	Install Four Thermistors in the Aft Compartment	1-10	
0025	Implement Cleanliness Specification 60B32086B	1-10	
0026	Revise Stage Instrumentation to Add & Delete Secure Command Systems Measurements	1-10	MSE 1,2, R-Test, R-Qual, MTF
0029 R1	Modify the S-IC Pneumatic Console & Associated GSE/MSE		MSE 1, R-Test, R-Qual, MTF-1, MILA 1,2,3, MAB
0030	Delete S-IC Stage Control Sensors	F, 1-10	MSE 1,2, R-Test, R-Qual, MTF 1
0033 R1	Revise Stage Instrumentation to be Compatible with Rocketdyne ECP's 229 R1 and 185 R1	T 1	
0036	Add Tubing from the Leakage Detection Ports on the LOX Fill & Drain System and the Emergency Drain Pipe Flanges to the Exterior	1-3	
0037	Provide Thermal Protection for Exposed Ordnance in S-IC Forward Skirt	1-10	
0038	Initiate Early Center Engine Cutoff	1-10	MSE 1,2, R-Test, R-Qual, MTF 1
0039	Add Fairings Around Total Calorimeters Located on the F-1 Engine	1-5	
0040 R1	Incorporation of a Hazardous Gas Detection System	1-10	MSE 1,2, MILA 1,2,3

0041	Modify S-IC Umbilicals	F, 1-10	MILA 1,2,3
0042	Modify LOX Level Cutoff Circuitry to Preclude Premature Engine Cutoff	F, 1-10	MSE 1,2, R-Test, R-Qual, MTF 1
0043	Provide "Two Adjacent Outboard Engines - Out" Automatic Abort System	F, 1-10	MSE 1,2, R-Test, R-Qual, MTF 1
0046	Add Heater Blanket Assembly to Separation Transducers	1-3	
0048	Conversion of GFE-Designed 20M32010 LOX and 20M32011 Fuel Prevalves and Emergency Drain Valves to Contractor Design Responsibility	3-10	
0050	Conversion of GFE-Designed 20M32010 LOX & 20M32011 Fuel Prevalve Flowmeter to Contractor Design Responsibility	1-5	
0054	Deleting the Pressurization Purge System	1-10	MSE 1,2, R-Test R-Qual, MTF 1, MILA 1,2,3
0055	Add GN_2 Pressure Drain Capability to the S-IC Pneumatic Console		R-Test, MTF, MILA 1,2,3, MAB
0060	Revise the Manual Engine Actuator (MEA) Adapter Assembly		MSE 1,2
0061	Removal of Electrical Timers, Provide Orificing for Control Pressure for LOX and Fuel Prevalve Time Delay and Removal of Solenoid Valves	1-10	MAB
0064	Replace Helium Fill and Dump Valve with a Modified Check Valve	3-10	MSE 1,2, R-Test, R-Qual, MTF 1, MAB
0065	Incorporation of NASA Document Se-008-001-1 "Project Apollo Coordinate System Standards" Dated 6-1-65, in S-IC Documentation	1-10	
0066	Delete Fuel Bubbling System	1-15	MSE 1,2, R-Test, R-Qual, MTF 1, MILA 1,2,3
0068	Provide new Filter Manifold Delta Pressure Transducer	1-10	MAB
0070	Modify S-IC Pneumatic Console Solenoid Ball Valves		R-Test, R-Qual, MTF 1, MILA 1,2,3, MAB
0072	Modify Stage and GSE Equipment	1-10	MSE 1,2, R-Qual, MTF 1
0073	Revise Telemetry Channel Assignment	4-10	

0077	Revise (60B02741) Propellant Dispersion Component Specification Requirements for Installation	1-10	
0079	Modify Forward Skirt Structure to Reduce Stress Concentration on S-II Stage	1-10	
0083	Redesign Heat Shield Lift-Off Switch Roller Pads	1-10	
0084	Modify Pressure Measuring Assembly in S-IC Pneumatic Checkout Rack		MILA 1,2,3, MAB
0085	Standardize S-IC Telemetry Channel Code	1-10	
0088	Replace Fasteners on Flow Tube for AiResearch Fuel Prevalves and Emergency Drain Valves	3-10	
0089	Modify the Base Air Scoop to Eliminate Interference with the Flow Release Mechanism During Lift-Off	1-10	
0090	Revise Controls for Fuel and LOX Vent Relief System During Static Test and Add GSE Pressure Sensing Provisions	3-10	MSE 1,2
0091	Redesign Forward Skirt Compartment Hardware to withstand Post Separation Environment	1-10	
0092	Install Heater Blanket Assembly on Servoaccelerometers	F, 3-10	MSE 1,2, R-Test, MTF 1
0093	Modify Stage Electrical Cabling to be Compatible with Engine Relocated J-106 Connector	4-15	
0094	Revise GSE Quick Disconnects to be Compatible with the New Rocketdyne Flight Fittings		MTF 1, MSE 1,2,3, R-Qual
0095	Revise the Static Firing Viewing Configuration of the S-IC Stage TV System	3	
0096	Modify the Intertank Umbilical Purge System (N/H P/N 65B80191-1)		MILA 1,2,3, MSFC 1,2, MILA SPARES, 1 & 2
0098	Relign Fuel and LOX Loading Servos	1-10	
0099	Revise the LOX Prevalve (20M32010-15 and 21) to Meet Vibration Requirements	1-10	
0100	Revise Longitudinal Acceleration Measurements	3-10	
0101	Change Quick Disconnects in Propellant Tank Pressure Monitor & Control Assy (65B64146) & Associated Equipment	4-10	MTF 1, MILA 1,2,3, MSE 1,2
0102	Revise Winching Fixture Assy Installation Kit, S-IC Propellant Dispersion System		MAB

0104	Replace Heat Shield Support Structure Attach Bolts	1,2	
0105	Increase FUSU (Forward Umbilical Service Unit) Inlet Pressure Capability		MILA 1,2,3
0106	Replace 50M35008 Stress Stage Corrosion Susceptible Servoactuators with 60B84500 Contractor Designed Servoactuators	3-5	
0108	Modify Cable Insulation for Measurements C-9 and C-10 on the F-1 Engine	2-10	
0113	Revise 60B62101 Timer Cards to Filter Out Spurious Gate Signals	1-10	
0114	Add Protective Covers on Engine Compartment Calorimeters	1-2	
0116	Modify Fuel Cutoff System	1-10	MSE 1,2, R-Qual, MTF 1
0117	Correct Design Deficiencies in S-IC Umbilicals	1-15	MSE 1, MILA 1,2,3
0120	Replace ODOP Transponder	1-10	
0122	Change Ranges of Temperature and Vibration Measurements	1-5	
0126	Redesign of Engine Thermal Insulation Part No. 60B84013-1 and -3 and 60B84057-1 and -3	1-10	
0127	Replace Printed Circuit Cards in LOX and Fuel Loading Electronics	1-10	
0129	Modify Parker Valves to Eliminate Possibility of Contamination thru Open Actuator Port	2-10	
0131	Replace NAS1022A Shear Nuts with MBN10F Nuts on the Center Engine Alignment Strut	1-10	
0132	Add Vacuum Seal-off Valve to Umbilical LOX Line		MILA
0134	Rework 60B76123-1A DC-to-DC Converter	1-5	
0136	Delete the Requirement for the Fin Leading Edge Measurements	1-3	
0137	Transfer of Common Ordnance Items from Contractor Furnished Equipment to GFE	1-10	
0143	Acceptance Static Firing Incentive Revision	3-15	
0145	Delete Instrument Unit Programmed Center Engine Cutoff & Provide LOX Depletion with Fuel Depletion (Back-up) Cutoff for Center Engine	2	

0146	Reassign Telemetry Channel for Forward Skirt Pressure Measurements	3-5	
0147	Modify 60B51047-5 and -7 Pneumatic Check Valves	1-15	
0150	Modify Parker Valves to Eliminate Stress Corrosion of Actuator Housing	1-15	
0152	Eliminate Stress Corrosion in TVC System Filter Manifold Housings	1-15	
0154	Modify RDSM (Remote Digital Sub-Multiplexer) Power Supply	3-15	
0155	Revise Paint Markings on S-IC Stage	F, 1-15	
0156	Revise the Splice Configuration of the Upper and Lower Thrust Ring Caps	T, F, 1-15	
0159	Replace Sensor Couplings in Aft Umbilical Carriers #1, #2 and #3		MILA 1, 2, 3
0162	Paint Exterior of 60B84500 Servoactuators per MIL-C-22751A	3-15	
0168	Delete the Base Heat Shield Vapor Barrier	1-15	
0173	Modify Filter Manifold Delta Pressure Transducer	1-15	
0175	Modify Holddown Pad Anti-Friction Plate (29-42550-1)		KSC,General
0185	Revise Engine Fairings to Stage Attachments to Eliminate Susceptibility to Stress Corrosion	1-15	
0186	Revise Insulation Used on the Actuator Support Strut	1-15	
0187	Halogen Leak Test of LOX and Fuel (Low) Pressurization Systems	3-10	MSE 1, 2
0188	Revise LOX Depletion Cutoff Timer Settings of Outboard Sensors, 118A1, 118A2, 118A3, 118A4 and Inboard Sensor 118A5	1 & 2	
0192	Revise the 65B24326 Prevalve Ground Control System (PGCS)		MTF, MILA 1, 2, 3, MAB
0199 (Cancelled)	Eliminate Gap on Outboard LOX Anti-Vortex Devices	T, 1-2	
0201	Modify Visual Instrumentation Distributor to Prevent Resetting of Film Camera Timer	2, 3	
0202	Modify LOX Tank Bulkhead Covers to Prevent Damage to Stage Components	2-15	

0204	Rework of Intertank Umbilical Carrier (65B80191) to Replace Inadequate Regulators	1-10	
0205	Modify S-IC Aft Umbilical Carrier/Tail Service (TSM) to provide Additional Retract Travel Capability		MILA 1,2,3
0210	Add Automatic Closing of Prevalves to the Abort Sequence at KSC	1-15	
0219	Protect Engine Interface Connectors from Excessive Moisture	1-15	
0223	Revise Motion Targets on S-IC Stage	1-15	
0224	Revise Intertank Paint Pattern	1-15	
0806	Install Bonding Strap on the Engine Fairing and Replace Inaccessible Fasteners in the Thrust Structure	1-10	
0815	Modify Fuel and LOX Tank Bulkhead Covers to Eliminate Interference		KSC, General
0820	Correct Polarity of Pin Connectors of Electrical Cable 60B55851-1	S-IC-1	
0821	Revise Thrust Structure Hardware Where Handling and Weighing Fittings are Removed	S-IC-1	
0822	Revise Electrical Cable & Fuel Bubbling Tube Installation in Thrust Structure to Eliminate Interference with Internal Access Equipment	S-IC-1	
0823	Show all areas of GSE Coupling Assembly (65B80103 Umbilical Coupling Assemblies) where Lubrication is required		MILA 1,2,3, MSE 1 & 2
0824	Allow Substitution Clevis on Servoactuator Jack		KSC, General
0826	Correct Engine Fairing Installation Drawing	1-15	
0827	Revise Environmental Control System Duct Installation to Eliminate Interference with the GSE Internal Access Equipment	1-15	
0828	Eliminate Interference between S-IC Stage Hi-LOK Fasteners and the Arms of Intertank Reconnect Assembly 65B80191		MILA 1,2,3, MSE 1,2
0831	Revise Phase of Liquid Level Sync Signal	1-15	
0832	Correct Bolt Requirements for Installation of the Heat Shield Panels	S-IC-1	
0835	Revise 60B51950 Retrofit Drawing (ECP 0147) to Correct Drawing Errors	1, 2	
0836	Revise S-IC Pneumatic Console Documentation to allow Incorporation of ECP 0055 Prior to ECP 0070, and Re-identify Cable Assembly		MILA 1,2,3, MAB

0838	Modify the Base Heat Shield Panel Installation to Allow the Proper Alignment of the Panels and the Structure	1-15	
0840	Rotate the 65B23531-37 Manual Ball Valves 90° in order to correct the Installation		MILA 1,2
0842	Lengthen Cable 120W208 (P-15), (P-16), for the 502 to allow them to mate with (J1) on Transducer per Cable Installation Drawing	1-3	
0845	Modify the ECS to Eliminate Interference with the Forward Skirt Internal Access Equipment	2	
0850	Change the LOX and Fuel Tank Standby Pressurization Fittings	1-3	
0855	Modify Bolt Installation Callout on E016-60B18054-9 to allow Installation of the Light Base Air Scoops	F, 1-15	
0860	Eliminate Cadmium Plated Washers and Fasteners on the Fin Assemblies	1-15	
1001 R2	Modify Electrical Bonding of Electrical/Electronic Equipment Magnesium Housing to Aluminum	F, 1-10	
1005 R3	Increase Power Feeder Size to LOX & Fuel Loading Electronics Equipment	F, 1-10	
1010 R1	Replace PRC Type 5X Resistors in Instrumentation AC and DC Amplifier Assemblies	1-10	
1013	Provide "Fail-Safe" Circuitry for the Terminal Countdown Sequence (TCS)		MTF 1
	Provide Safety Interlock on Technical Countdown Sequencer Output Relays		MSE 1,2, R-Qual, MTF, R-Test
1015	Delete Overall Test (OAT) Battery Rack Assembly (65B15005) Next Higher Assy Nos. 65B10011-1, 65B10016-1,-3, -5, 65B10024-1, -9, 65B10124-1, -3		MSE 1,2 MTF 1
1018	Delete Second Ground Cooling Unit (GCU) S-IC 65B36096-1 (Next Assy 65B10090)		MSE 1, R-Qual
1025	Replacement of Manual Valves in Pneumatic Supply Unit		MSE 1,2, R-Qual
1026	Modify GOX Flow Control Valve Tester (GFCVT) to Increase Back Flow Capability		MTF 1, R-Test
1027	Revise the Battery Cell Scanner Panel Assy & Battery Charges		MSE 1,2, R-Qual, MTF 1
1028	Modify LOX Fill & Drain Duct	F, 1-10	
1038	Modify Distributor Terminal Boards	7-10	

1039 (Cancelled)	Replace Hog Out Parts with Die Forged Parts	11-15	
1040	Modify LOX Prevalve (20M32010-13) Control Actuator Pressure Connector	3-10	
1042 R1	Increase Remote Automatic Calibration System (RACS) Feeder Size to Unit 120 Measuring Racks	1-5	MSE 1,2, R-Qual MTF 1
1046	Modify Cathode Ray Tube (CRT) System Logic		MSE 1,2, R-Test, R-Qual, MTF
1047 (Cancelled)	Secure S-IC Display System Logic		MSE 1,2, R-Qual MTF
1056	Revise Hypergol Simulators Quick Disconnect		MSE 1,2, MILA
1058	Replace 60B52908-1 Main Power Transfer Switch	1-10	
1059	Delete Engine Area Thermal Insulation for the S-IC Stage Static Test Configuration	4-10	
1060	Add Additional Interconnection Cables to GSE at MTF		MTF 1
1062	Modify Sub-Carrier Oscillator Chassis Assy (a) 60B76374-1, (b) 50M65502-5	1-10	
1063	Add Vibration Isolators to the Objective & Coupling Enhancement Motors	2-3	
1066	Revise Sampling Rate of Range Safety System Signals	1-10	
1067	Replace MBR3749-4 & -5 Relays & Add Shock Mounts for Electrical Control Distributors	1-10	
1071	R-Test Changes to MTF		MTF 1
1072	Modify Pneumatic Pressure Test Racks 2, 3, 4, 6, 7, 8 & 9 to Correct Discrepancies Between Input Pressure & Stage Test Pressure		MSE 1,2, R-Qual
1076 R1	Provide Adequate Amplifier for Engine Gimbaling Signals		MTF 1, R-Test, R-Qual
1077 R1	Modify the Pneumatic Supply Unit Solenoid Ball Valves		MSE 1,2
1080	Revise Count Clock & Associated Interface Equipment		MTF
1082	Change Part Marking of Telemetry Components	4-10	
1084	Modify Range Safety and Ordnance Ground Equipment		MSE 1,2, R-Qual, R-Test, MTF
1085	Modify the Servoactuator Test Set	3-10	MSE

1091	Modify Method of Securing Excess Confined Detonating Fuse & Explosive Bridgewire Electrical Cabling	4-10	
1094	Revise Soldering Requirement for Diaphragm Assemblies in Pressure Switches 60B49003 and 60B51016	3-10	
1095B	Replace RF Filters in Telemetry RF Assemblies	1-10	
1096	Provide Adapter Cables for Spare Power Supply		Spares
1097	Redesign of Helium Pressurization Check Valve P/N 60B51407	1-10	
1098	Delete 65B23308 Relief Valves from Pneumatic Supply Unit		MSE 1,2, R-Qual
1101	Revise 600 VAC High Voltage Power Supply Distributor		MTF
1106	Replace Fasteners in Flow Tubes for AiResearch Fuel Prevalves Fuel & Emergency Drain Valves 20M32011	3-10	
1107	Modify Visual Instrumentation System Transient Suppression	2-3	
1108	Delete R-Qual Effectivity from CAM 909R1		MSE 1,2, MTF 1, R-QUAL
1110	Modify Metal Sheathed Cable Assy Installation	1-5, F	
1111	Level Probe Gusset Material Change	7-10	
1112	Replace the Main Supply & LOX Dome Purge Solenoid Valves in the Pneumatic Supply Unit		MSE 1,2
1113	Rework Servoactuator Insulation Part 60B84011-3	1-10	
1115 (Cancelled)	Substitute "As Extruded" Intertank Ring Frame	11-15	
1116	Modify the Method of Installation of Measurements C20-105, C23-101 & C48-101	1-5	
1117	Replace H-11 Center Engine Lower Cap Splice Fasteners with 4340 Fasteners	1-10	
1118	Eliminate Gap on Outboard LOX Anti-Vortex	F, 3-10	
1121	Retune TV Transmitter to Operate under Actual Temperature Environment	2,3	
1122	Modify the Aft Access Platform-Water Deluge Michoud		MSE 1,2
1124	Revise Engine Gimbaling Stimulus Generator Printed Circuit Boards		R-Qual
1125	Add Filters to the Pneumatic Supply Module 65B23111	1-10	MSE 1,2,3
1126	Revise Center Engine Seal Assembly and Installation	3-10	
1127	Modify the Turnbuckle which Fastens the Upper Fairing Assembly to the Lower Fairing Assembly	1-10	

1128	Modify Pneumatic Pressure Test Racks to Relocate Thrust OK Pressure Switch Line		MSE 1,2, MTF 1
1132	Modify the S-IC Thrust Structure Access Platform		R-Qual, MSE, MTF, KSC
1134	Rework all MF Flared Tube Fittings by replacing MF 4039 Spring Washers with Lockwire Per MS 20995	3-10	
1135	Replace the Hastelloy "C" Welded Tube Assemblies and Cres Tube Assemblies with Flared Aluminum Tube Assemblies in the Engine Purge Prefill System	7-10	
1137	Redesign Adapter Bearing Assy for Lightweight Manual Engine Actuator (P/N 65B61069-1 N/H P/N 65B36867)		MILA 1,2,3
1138	Provide Additional Controls for the Forward Stabilization System (FSS).	4-10	R-Test, MTF
1139	Revise Ignition Power Support Assembly M60 Hertz High Voltage Power Supply		MSE 1,2, R-Qual, MTF
1141	Correct GSE Time Data Editor Tape Recorder Incompatibility		MSE 1,2, MTF 1
1142	Revise Actuator Instrumentation and Cabling Documentation to Show Preferred and Substitute Installation	6-15	
1146	Add Protective Covers on Engine Compartment Calorimeters	3-5	
1152	Tighten Tolerance on Sliding Brackets for the 4 1/2" GOX Duct	3-10	
1153	Rework Identification Markings on Umbilical Simulator and Substitute Couplings and Hoses		R-Test, R-Qual, MSE 1,2
1156	Install Lightweight Aluminum LOX Tunnel Bellows	11-15	
1157	Provide Ground Cooling Unit Over-Temperature Indication to Michoud Test Check-Out Control Room		MSE 1,2, R-Test, MTF, R-Qual
1160	Modify 65B12001 Power Supplier to Eliminate a Safety Hazard and Prevent Erratic Operation		MSE 1,2, R-Qual, MTF 1
1161	Install Redesigned Optic Module in Area Contamination Deletion Equipment		MSE 1,2, R-Qual
1162	Provide Additional Hardware Necessary to Static Fire S-IC Stage at MTF	4-15	MTF 1
1163	Replace Helium Flow Control Orifice with Flow Control Nozzle	6-15	

1165	Minimize the Possibility of Installing the LOX Emergency Bubbling System Hardware Improperly	6-15	
1167	Correct the HT-370-7049-2-5 Lifting Eye Weldment Crack Problem		
1185	Allow Usage of Desiccant-Filter Units on S-IC Propellant Tanks		
1196	Modify PCM/DDAS and RDSM Telemetry Assembly	10-15	
1200	Revise Thrust Structure at Station 116 Pos. Toward Fin B	9	
1201	Add Short Circuit Protection for the Battery Charger Control Power Supply		MTF, MSE 1,2
1203	Modify Stage Weighing Equipment 65B33003-1	4-15	
9001	Provide S-IC Ground Support Equipment to S-IC Lightweight Manual Engine Actuator For KSC		MILA 1,2,3
9002-1,-2,-3	To Provide Forward Stabilization System for MTF		MTF 1
9010	Revise Igniter Power Supply & Igniter Substitute J-Box		MTF 1, MSE 1,2
9017	Add Additional Interconnecting Cables to GSE at MTF		MTF
9024	Revise S-IC MAB Patch Distributor Interface		MAB
9032	Refurbish "T" for MTF Facility Checkout	T	MTF 1
9061	Add Electrical Service Panel to the Umbilical Patch Distributor		MTF 1
9069	Change Cables to GSE from Facility Propellant Loading Interface at MTF		MTF
9074	Modify AiResearch Prevalves to Correct Corrosion and Replace Nuts Which Are Susceptible to Cracking	T	
9079	Make Support Equipment Changes Caused by Facility Redesign MTF Static Test Stand 17th and 18th Floor Platforms		MTF
9082	Provide Additional GN_2 Supply Lines on MTF Static Test Stand		MTF
9083	Equipment Installation Provisions for Certain Support Equipment on the MTF Static Test Stand		MTF
9086	Standardize Exploding Bridgewire Firing Unit Output Cable Length	10-15	
9101	MTF Static Test Stand Cabling Changes		MTF 1
9106	Augment the Digital Event Evaluator (DEE) Data Retrieval Capability	1-10	

9114	Revise the Vibration Requirements of all Engine Mounted TVC System Components	1-10	
9116	Delete the AUX GN_2 System at MTF		MTF 1
9117	Replace Stage Fuel and LOX Pre-Pressurization Check Valve in MAB		MAB
9120	Relocate the GOX Flow Valve Tester		MTF
9121	Engine Area Purge System for MTF	4-10	MTF, R-Test
9125	Eliminate Malfunction of the Propellant Measuring System Electronic Checkout Unit		MSE 1,2, R-Test, R-Qual, MTF 1,2
9128	Delete the Forward Umbilical Service Unit (FUSU) at MTF		MTF
9129	Add "Holddown Arm Control Panel" TF 4410018 to the Mechanical Test Control Equipment (MTCE) at MTF		MTF
9139	Convert MTF Ground Equipment Test Sets (GETS) to an Automatic GETS		MTF 1
9141	Add Rollaway Heat Shields Access Panels	3-10	
9169	Modify Fuel Tank Bulkhead Covers to Eliminate Interference		MTF
9180	Replace Aluminum Forward Handling Ring with a Steel Handling Ring on the S-IC-F Stage	F	
9206	Revise F-1 Engine Valve Time	4-15	

APPENDIX F

ENGINEERING CHANGES INITIATED DURING FY 1967

CHANGE NO.	DESCRIPTION	EFFECTIVITY	
		STAGE	GSE
0005 R1	Revise the 60B41223-1 Prevalve Ground Control System	T, F, 1-10	MSE 1, R-Test, R-Qual, MTF 1, MILA 1, MAB
0006	Replace 60B35008 Stress Corrosion Susceptible Servoactuators with 60B84500 Contractor-Designed Servoactuators	1-10	
0030	Delete S-IC Stage Control Sensors	F,1-10	MSE 1,2, R-Test, R-Qual, MTF 1
0046	Add Heater Blanket Assembly to Separation Transducers	1-3	
0055	Add GN_2 Pressure Drain Capability to the S-IC Pneumatic Console		R-Test, MTF, MILA 1,2,3, MAB

0066	Delete Fuel Bubbling System	1-15	MSE 1,2, R-Test, R-Qual, MTF 1, MILA 1,2,3
0076	Redesign Forward Skirt Compartment Hardware to New Prelaunch Environment	1-10	MSE 1,2, R-Test, R-Qual, MTF 1
0084	Modify Pressure Measuring Assembly in S-IC Pneumatic Checkout Racks	MAB	MILA 1,2,3
0085	Telemetry Channel Code Standardization	1-10	
0087	Modify the Engine Thermal Conditioning System Requirements	1-10	MILA 1,2,3, MAB
0091	Redesign Forward Skirt Compartment Hardware to Withstand Post Separation Environment	1-5	
0093	Modify Stage Electrical Cabling to be Compatible with Engine Relocated J-106 Connector	4-15	
0095	Revise the Static Firing Viewing Configuration of the S-IC Stage TV System	3	
0096	Modify the Intertank Umbilical Purge System (N/H P/N 65B80191-1)		MILA 1,2,3, MSFC 1,2, MILA Spares, 1 & 2
0098	Realign Fuel and LOX Loading Servos	1-10	
0099	Revise the LOX Prevalve (20M32010-5 and 021) to Meet Vibration Requirements	1-10	
0100	Revise Longitudinal Acceleration Measurement	3-10	
0101	Change Quick Disconnects in Propellant Tank Pressure Monitor & Control Assy. (65B64146)	1-15	
0102	Revise Winching Fixture Assy Installation Kit, S-IC Propellant Dispersion System		MAB
0103	Delete the Flight Combustion Monitor System	6-10	MSE 1,2, MTF 1
0104	Replace Heat Shield Support Structure Attach Bolts	1, 2	
0105	Increase FUSU (Forward Umbilical Service Unit) Inlet Pressure Capability		MILA 1,2,3
0106	Replace 50M35008 Stress Stage Corrosion Susceptible Servoactuators with 60B84500 Contractor Designed Servoactuators	3-5	
0107	Install Filter Assembly in MOOG Servoactuator Electrical Circuit	5-10	

0108	Modify Cable Insulation for Measurements C-9, C-10 on the F-1 Engine	2-10	
0113	Revise 60B62101 Timer Cards to Filter Out Spurious Gate Signals	1-10	
0114	Add Protective Covers on Engine Compartment Calorimeters	1-2	
0115 (Cancelled)	Provide S-IC Fuel Prevalve Closure	1-15	MSE 1,2, MTF
0116	Modify Fuel Cutoff System	1-10	MSE 1,2, R-Qual, MTF 1
0117	Correct Design Deficiencies in S-IC Umbilicals	1-15	MSE 1, MILA 1,2,3
0119	Revise the Pneumatic Console Vent and Relief Circuitry		R-Test, MTF 1, MILA 1,2,3, MAB
0120	Replace ODOP Transponder	1-10	
0122	Change Ranges of Temperature & Vibration Measurements	1-5	
0123 (Cancelled 12-22-66)	Install Light Weight Aluminum LOX Tunnel Bellows	11-15	
0126	Redesign of Engine Thermal Insulation Part No. 60B64013-1 & -3 and 60B84057-1 & -3	1-10	
0127	Replace PC Cards in LOX & Fuel Loading Electronics	1-10	
0129	Modify Parker Valves to Eliminate Possibility of Contamination thru open Actuator Port	2-10	
0131	Replace NAS1022A Shear Nuts with MBN10F Nuts on the Center Engine Alignment Strut	1-10	
0132	Add Vacuum Seal-Off Valve to Umbilical LOX Line		MILA
0133	Revise Range of Accelerometer Measurement E82-115 & E83-115	1	
0134	Rework 60B76123-1A DC to DC Converter	1-5	
0135	Add a mechanical Relief Valve in the Helium Bottle Gas Storage System	7-15	
0136	Delete the Requirements for the Fin Leading Edge Measurements	1-3	
0137	Transfer of Common Ordnance Items from Contractor Furnished Equipment to GFE	1-10	
0138	Replace Existing Gimbal System Flight Supply Duct & Insulation with a Flexible Hose Duct Assy & Insulation	1-10	

0139	Replace Range Safety Hybrid Ring and Telemetry	1-10	
0140	Improve EDS Reliability	2-15	
0141	Corrective Action on LOX Seal Purge Regulator 60B37476-1 Failure	1-15	
0143	Acceptance Static Firing Incentive Revision	3-10	
0144	Reassign Telemetry Channels Fuel Slosh Measurements	1-4	
0145	Delete Instrument Unit Programmed Center Engine Cutoff & Provide LOX Depletion with Fuel-Depletion (Back-Up) for Center Engine	2	
0146	Reassign Telemetry Channel for Forward Skirt Pressure Measurements	3-5	
0147	Modify 60B51047-5 and -7 Pneumatic Check Valves	1-15	
0149	Change Lubricants on the Forward & Aft Umbilical Carrier to Ensure LOX Compatibility		MILA 1
0150	Modify Parker Valves to Eliminate Stress Corrosion of Actuator Housing	1-15	
0152	Eliminate Stress Corrosion in TVC System Filter Manifold Housings	1-15	
0153	Deletion of Instrumentation No Longer Required	8-15	
0154	Modify RDSM (Remote Digital Sub-Multiplexer) Power Supply	3-15	
0155	Revise Paint Marking on S-IC Stage	F, 1-15	
0156	Revise the Splice Configuration of the Upper and Lower Thrust Ring Caps	T, F, 1-15	
0157	Replace Existing Gimbal System Flight Supply Duct & Insulation with a Flexible Duct Assy & Insulation	2-15	
0158	Revise Fuel Density Temperature Measurement Range	1-15	
0159	Replace Sensor Couplings in Aft Umbilical Carriers #1, #2, & #3		MILA 1, 2, 3
0160	Replace Hydraulic Coupling in Aft No. 2 Umbilical Carrier and Vehicle Plate	T, F, 1-15	
0161	Refurbish S-IC-F Fins & Fairings to a Flight Configuration	TBD	
0162 R1	Paint Exterior of 60B84500 Servoactuators per MIL-C-22751A	3-15	

0163	Modify LOX/Fuel & Drain Valve Actuation Characteristics		MTF, MILA 1,2,3
0164	Modify Engine Prevalve Cutoff & Incorporate Redundant Engine Stop Solenoid Circuits	1-15	MSE 1, 2, MTO 1
0166	Provide Additional Handling Equipment for MILA		MILA
0168	Delete the Base Heat Shield Vapor Barrier	1-15	
0171	Replace 65B23310-1, -3 and -7 Regulators in the S-IC Pneumatic Console		R-Test, MTF 1, MILA 1,2,3, MAB
0172	Incorporate New Insulating Material for Heat Shield Panels	10-15	
0173	Modify Filter Manifold Delta Pressure Transducer	1-15	
0174	Add Instrumentation to S-IC Pneumatic Console, Forward Umbilical Service Unit & S-IC Umbilicals		MILA 1
0175	Modify Holddown Pad Anti-Friction Plate (29-42550-1)		KSC, General
0177	Adjust LOX Tank Vent and Relief Valves to Eliminate Leakage	1-5	MAB
0178	Change N.C. Solenoid Valve to N.O. in LOX Bubbling Module of S-IC Pneumatic Console		MTF, MILA 1,2,3, MAB
0179	Document Procedures to Avoid Interference with Rocketdyne Thermal Bracketry & Insulators	1-15	
0180	Suppress Stage Electrical Transients	1-15	
0181 Cancelled	Modify PCM/DDAS & RDSM Telemetry Assembly	11-15	
0182	Redesign Ambient Gas Temperature Transducer	1-5	
0183	Modify Fuel Anti-Vortex Assembly	3-15	
0184	Replace Flame Arrester 65B80172-1 in S-IC No. 2 Aft Umbilical	F, 1-15	
0185	Revise Engine Fairing to Stage Attachments to Eliminate Susceptibility to Stress Corrosion	1-15	
0186	Revise Insulation Used on the Actuator Support Strut	1-15	
0187	Halogen Leak Test of LOX & Fuel (Low) Pressurization Systems	3-10	MSE 1,2
0188	Revise LOX Depletion Cutoff Timer Settings of Outboard Sensors, 118A1, 118A2, 118A3, 118A4 and Inboard Sensor 11A5	1-2	

0189	Delete the "Internal Timer" Telemetry Measurements from the Range Safety Decoder	1-15	MSE, MTF
0190	Requalify Flight Batteries (60B59803-1 and -3) to New Wet Stand Time	TBD-15	
0191	Revise S-IC Pneumatic Checkout Rack No. 4 Thrust OK Pressure Switch Checkout Circuit		MILA 1,2,3, MAB
0192	Revise 65B24326 Prevalve Ground Control System (PGCS)		MILA 1,2,3
0193	Replace MBR 37496-7 and -8 Relays in Stage Electrical Distributor Respectively with MBR 37496-9 and -10 Relays	1-15	
0195	Revise S-IC Stage Calorimeter Installation to Allow Total Incorporation of Rocketdyne ECP #NA-F1-482	2-5	
0196	Revise Pneumatic Checkout Racks 1,2 & 4		MILA 1,2,3, MAB
0197	Rework 60B74600-1B TV Transmitter 78 KC Ripple Appearing on Transmitter Output	2-3	
0198	Deletion of S-IC-F Pressurization Tunnel Purge System & Associated Fluid Umbilical Couplings of S-IC-F, S-IC-1 and on	1-15	MSE 1,2, MTF 1
0199	Eliminate Gap on Outboard LOX Anti-Vortex T, Devices	1-2	
0200	Interchange Telemetry Channels for Range Safety Receiver Measurements K-121, -128 and K125-120	1-3	
0201	Modify Visual Instrumentation Distributor to Prevent Resetting of Film Camera Timer	2,3	
0202	Modify LOX Tank Bulkhead Covers to Prevent Damage to Stage Components		KSC, General, MTF
0204	Rework Intertank Umbilical Purge System to Replace (65B23310-9) Regulators		MILA, 1,2,3
0205	Modify S-IC Aft Umbilical Carriers/Tail Service Mast (TSM) to Provide Additional Retract Travel Capability		MILA 1,2,3
0207	Add Thermal Protection to Forward Skirt Structure	1-2	
0209	Install Dessicant Filter Material Media Research and Testing	F,3	
0210	Add Automatic Closing of Prevalves to the Abort Sequence at KSC	1-15	
0211	Correct Design Deficiencies in S-IC Umbilicals		MILA 1,2,3
0212	Provide Redundant "Carrier Retracted" Switch and Circuit on S-IC Intertank Reconnect Assembly		MILA 1,2,3

0213	Rework the S-IC Aft Umbilical Plates and Aft Ground Carriers to Provide an Emergency Disconnect Mode		MILA 1,2,3
0214	Relocate the Helium Bottle Fill Module Isolation Valve		MILA 1,2,3, MAB
0215	Replace 20M02008 Helium Bottles with 60B Bottles in S-IC Stage	3	
0218	Provide Thrust Not OK Umbilical Measurements	2-15	
0219	Protect Engine Interface Connector from Excessive Moisture	1-15	
0220	Modify Ground Equipment to Correct Pressure Transducer Leakage		MSE 1,2
0221	Qualify NOPCO Lockfoam for optional Use in S-IC Electrical Distributors	2	Cancelled 4-26-67
0222	Modify 60B41005 LOX Interconnect Valves by Replacing Valve Shaft with New Shafts	2-10	
0223	Revise Motion Targets on S-IC Stage	4-15	MSE 1,2,3
0224	Revise Intertank Paint Pattern	1-15	
0225	Modify 65B23531 Manual Ball Valve Position Travel Stops		MTF, MILA 1,2,3, MAB
0226	Revise Specification for LOX Vent and Relief Valve	1-15	
0227	Revise Rocketdyne Static Test Instrument Provisions		MSE 1,2, MILA 1,2,3
0229	Modify Position Indicator Switches in 65B23278 GSE Solenoid Valve		MSE 1,2, MTO 1, MILA 1,2,3
0230	Revise S-IC Flight Heat Shield to Replace Ceramic Coating with Thermal Blankets		
0231	Engine Hydraulic System Preservation for Stage Shipment and Storage	3-15	
0232	Relocation of D103-120 Pressure Measurement to Inside of the Pressurization Tunnel	1-3	
0233	Revise Dimensional Control on the Outboard Engine Attach Points	10-15	
0234 Cancelled	Replace Hi-Lok Pins with Bolts on Propellant Bracket Bulkhead Assembly	1-15	
0235	Revise Power Transfer Switches	F, 1-15	
0237	Change of "O" Ring Seals in 60B51441 GOX Flow Control Valve	TBD	

0239	Modify Connector Hex Nut Lockwire Hole (Cancelled 6-14-67)	2-5	
0240	Relocate S-IC Stage Vibration Measurement Instrumentation	2-3	
0241	Install Connector Clamp for LOX Tank Ullage Temperature Measurements	1-3	
0242	Modify S-IC Pneumatic Console to Provide Pressure Calibration Source in Mobile Launcher Room		MILA, MAB
0243	Provide Rigid Attachment Face in base Airscoop Seal Assembly	1-15	
0244	Modify the LOX Dome Purge Module of the S-IC Pneumatic Console		MTF 1, MILA 1, 2, 3, MAB
0245	Replace FV-744-3S-SF (Methode) Connectors with MBC 455 Connectors in S-IC Electrical Distributors	4-15	
0246	Modify the GN_2 Primary Regulation Circuit of the S-IC Pneumatic Console		
0247	Realign LOX and Fuel Loading Electronics	2-15	
0249	Redesign Aft Umbilical Carrier #1, 2 and 3 Ball Valve Actuator Arm		MILA
0808 R1	Revise Edge for Withdraw Mechanism Arm of Umbilical Carrier		MILA 1, 2, 3, KSC General, 1 & 2, MSE 1 & 2
0815 R1	Modify Fuel & LOX Tank Bulkhead Covers to Eliminate Interference		KSC General
0817 R1	Add Reference Designator (Spare to Pneumatic Checkout Rack No. 1)		MILA 1, 2, 3
0820 R1	Correct Polarity of Pin Connectors of Electrical Cable 60B55851-1	1, 2	
0821 R1	Revise Thrust Structure Hardware Where Handling and Weighing Fitting are Removed	1-5	
0822 R1	Revise Electrical Cable & Fuel Bubbling Tube Installation in Thrust Structure to Eliminate Interference with Internal Access Equipment	1-3	
0823 R1	Show all Areas of the Coupling Assembly Where Lubrication is Required		MILA 1, 2, 3, MSE 1 & 2
0824 R1	Revise Servoactuator Jacks to Conform to Documentation		KSC General

0826 R1	Install Electrical Bonding Straps on the Engine Fairing at Fins A & C and Correct Installation EO	1-15	
0827 R1	Revise Environmental Control System Duct Installation to Eliminate Interference with the GSE Internal Access Equipment	1-15	
0828 R1	Eliminate Interference between the Hi-LOK Fasteners on the S-IC-1 Stage & Arms on the Intertank Reconnect Assembly 65B80191		MILA 1, 2, 3 MSE 1, 2
0829 R1	Rework the 65B23896-1 GN_2 Tester to Allow Proper Checkout of Two Solenoid Valves in the S-IC Pneumatic Console		MILA 1, 2, 3, MAB
0831 R1	Revise Phase of Liquid Level Sync Signal	1-15	
0832 R1	Correct Bolt Requirements for Installation of the Heat Shield Panels	1-15	
0835 R1	Revise 60B51950 Retrofit Drawing (ECP 0147) to Correct Drawing Error	1-2	
0836 R1	Miscellaneous Changes Dealing with the Pneumatic Console 65B23654		MILA 1, 2, 3, MAB
0837 R1	Miscellaneous Change to the Engine Fairings	1-15	
0838 R1	Modify the Base Heat Shield Panel Installation to Allow the Proper Alignment of the Panels and the Structure	1-15	
0839 R1	Correct the Standard Hardware Requirements for the Installation of the Base Air Scoops	1-15	
0840 R1	Rotate the 65B23531-3 7 Manual Ball Valve 90° in Order to Correct the Installation		MILA 1, 2, 3
0842 R1	Lengthen Cable 120W208 (P-15), (P-16), for the 502 to Allow Them to Mate with (J1) on Transducer per Cable Installation Drawing	1-3	
0843 R2	Modify Torque Callouts on Thruster Installation	2	
0845 R1	Modify the EGS to Eliminate Interference with the Forward Skirt Internal Access Equipment	2	
0848	Replace Pressure Gage (65B23271-23) in the Forward Umbilical Service Unit		KSC, 1-2
0850	Change the LOX and Fuel Tank Standby Pressurization Fittings	1-3	
0851	Modify Forward Skirt Structure to Eliminate an Overstressed Condition that will exist during vehicle Lift-Off	1-15	

0855 R1	Modify Bolt Installation Callout on E016-60B18054-9 to Allow the Installation of the Light Base Air Scoops	1-15	
0856 R1	Modify Lockwire Callout on Insulation Installation (60B68005)	1-2	
0857 R1	Modify the Ring Assembly Interface in the Forward Skirt to Allow the Use of Oversize Hi-Lok Fasteners	1-2	
0858 R1	Modify the Base Heat Shield Installation Drawing to Show the Installation of 10 Nutplates that were not shown on the Original Drawings	1-15	
0859 R1	Revise the F-1 Engine Actuator Bolt Installation Drawing to Properly Locate and Install the 60B21323-1A & 2A Bolts	1-15	
0860 R1	Eliminate Cadmium Plated Washers and Fasteners on the Fin Assemblies E024-60B300000-1m, 60B300006-1 and 60B300007-1	1-15	
0862 R1	Modify Bolt Length Callout on Engine Fairing Installation	1-10	
0864 R1	Modify Fastener Callout on the Pneumatic Console		MILA 1,2,3, MAB
0865 R1	Modify Engine Insulation Blanket	1-5	
1118	Eliminate Gap on Outboard LOX Anti-Vortex	3-10	
1121	Retune TV Transmitter to Operate Under Actual Temperature Environment		MSE 1,2
1122	Modify the Aft Access Platform Water Deluge Michoud		MSE 1,2
1124	Revise Engine Gimbaling Stimulus Generator PC-Boards		R-Qual
1125	Add Filters to the Pneumatic Supply Module 65B23111	1-10	MSE 1,2,3
1126	Revise Center Engine Seal Assembly and Installation	3-10	
1127	Modify the Turnbuckle which Fastens the Upper Fairing Assembly to the Lower Fairing Assembly	1-10	
1128	Modify Pneumatic Pressure Test Racks to Relocate Thrust OK Pressure Switch Line		MSE 1,2, MTF 1
1131	Provide Forging Replacement for Unit 116 Machined Tunnel Filter	13-15	
1132	Modify the S-IC Thrust Structure Access Platform		R-Qual, MSE, MTF, KSC
1133	Modify the S-IC Aft Access Platform and the Forward Access Platform		MSE 1,2, R-Qual

1134	Rework all MF Flared Tube Fittings by Replacing MF4039 Spring Washers with Lockwire Per MS20995	3-10	
1135	Replace the Hastelloy "C" Welded Tube Assemblies in the Engine Purge and Prefill Systems	7-10	
1137	Redesign Adapter Bearing Assy for Lightweight Manual Engine Actuator (P/N 65B61069-1 N/H P/N 65B36867)		MILA 1,2,3
1138	Provide Additional Controls for the Forward Stabilization System (FSS)	4-10	R-Test, MTF
1139	Revise Ignition Power Support Assembly M60 Hertz High Voltage Power Supply		MSE 1,2, R-Qual, MTF
1141	Correct GSE Time Data Editor Tape Recorder Incompatibility		MSE 1,2, MTF 1
1142	Revise Actuator Instrumentation and Cabling Documentation to Show Preferred and Substitute Installation	6-15	
1145 (Cancelled 10-14-66)	Eliminate the Upper Cantilever Ring Baffles in the Fuel and Oxidizer Tanks	8-15	
1146	Add Protective Covers on Engine Compartment Calorimeters	3-5	
1152	Tighten Tolerance on Sliding Brackets for the 4 1/2" GOX Duct	3-10	
1153	Rework Identification Markings on Umbilical Simulator and Substitute Couplings and Hoses		R-Test, R-Qual, MSE 1,2
1156	Install Lightweight Aluminum LOX Tunnel Bellows	10-15	
1157	Provide Ground Cooling Unit Over-Temperature Indication to Michoud Test Check-Out Control Room		MSE 1,2, R-Test, MTO, R-Qual
1159	Rework Manual Ball Valves in Pneumatic Pressure Test Racks 5, 6, 7, 8 & 9		MSE 1,2
1160	Modify 65B12001 Power Supplier to Eliminate a Safety Hazard and Prevent Erratic Operation		MSE 1,2, R-Qual, MTF 1
1161	Install Redesigned Optic Module in Area Contamination Deletion Equipment		MSE 1,2, R-Qual
1162	Provide Additional Hardware Necessary to Static Fire S-IC Stage at MTF	4-15	MTF 1
1163	Replace Helium Flow Control Orifice with Flow Control Nozzle	6-15	
1165	Minimize the possibility of installing the LOX Emergency Bubbling System Hardware Improperly	6-15	

1167	Correct the HT-370-7049-2-5 Lifting Eye Weldment Crack Problem		
1168	Proof Load Forward Handling Ring Crack		
1170	Add Reference Designator Marking to Vehicle Umbilical Plate	3-15	
1171	Deletion of SK-10-1596 Measurement "A" Mounting Provision	3-15	
1174	Add Auto-Transformers to the GSE Stage Power Distributor		MTF
1175	Minimize Solenoid Valves Contamination	8-15	
1178	Provide Manual Control for LOX and Fuel Vent Valve		MTF
1179	Redesign the forward Stabilization System Stabilization Brackets		
1180	Modify Horizontal Thrust Structure Platform to Eliminate Interference with S-IC Stage		
1181	Correct Design Deficiencies in and Release Class I Documentation for S-IC Manual Engine Actuators		MTF 1, MSE 1,2
1183	Provide Additional Guard Rails on F-1 Engine Test Stands		
1184	Provide Fuse Protection for the 28V Wiring in the Patch Distributors and Pneumatic Equipment		MSE 1,2, MTF 1
1185	Allow Usage of Dessicant Filter Units on S-IC Propellant Tanks		MSE
1187	Provide Measuring Capability for Forward Skirt Environmental Control System Air Flow		MSE 1,2
1188	Modify S-IC Stage Ground Hydraulic System at MTF		MTF
1192 (Cancelled)	Change Flange Face Requirements to Reduce Leakage Problem	2	
1195	Replace A.C. Relays in the 60 Hertz High Voltage Power Supply		MTF
1196	Modify PCM/DDAS and RDSM Telemetry Assembly	10-15	
1197	Static Test Heat Shield Panel Flatness Requirements	7-15	
1198	Rework of Terminal Countdown Sequencer Patchboard - MTF		MTF 1
1199	Modify the Michoud Stage TCV Hydraulic Power Supply Units		MSE 1,2

1200	Revise Thrust Structure at Station 116 POS Toward Fin B	9	
1201	Add Short Circuit Protection for the Battery Charger Control Power Supply		MTF, MSE 1,2
1202	Modify MTF Interconnect Piping and Umbilical Substitutes		MTF 1, MSE 1,2
1203	Modify Stage Weighing Equipment 65B33003-1	2	
1204	Modify T/M Calibrator Assembly 50M12011-3		
1205	Provide New Lifting Eye Weldments on all Forward Handling Rings		MTF 1
1206	Proof Load S-IC Lifting Link 65B61098 and Rotating Brace Assembly 65B61097		
1207	Eliminate the Flame Curtain Refurbish Requirements	4-15	
1208	Revise MTF Fuel and LOX Auxiliary Pressurization Capabilities	4-15	
1209	Revise LOX Tank Low Pressure Vent Switch Setting	4-10	
1210	Delete Flowmeter Assembly 65B230321 and Flow Indicator (65B23090-3) from MSE I & II		MSE 1,2
1211	Install Calibration Valves on Non-Flight Checkout Instrumentation		MSE 1,2
1212	Revise S-IC Stage Protective Cover Documentation	4-15	
1213	Combustion Chamber Pressure Measurement Telemetry Channel Change	4-15	
1216	Change Meters in Mechanical Test Control Equipment (MTCE) to be compatible with Stage Pressure Transducers		MTF
1218	Replace 400 H_2 Oscillator in Ignition Sequencer		MTF
1219	Revision to stage handling equipment		MAB
9101	MTF Static Test Stand Cabling Changes	MTF 1	
9103 (Cancelled 1-11-67)	Additional Boeing Furnished Hardware required for the Rocketdyne F-1 Engine Mockup		
9106	Augment the Digital Event Evaluator (DEE) Data Retrieval Capability	1-10	
9114	Revise the Vibration Requirements of all Engine Mounted TVC System Components	1-10	

9116	Delete the AUX GN_2 System at MTF		MTF 1
9117	Replace Stage Fuel and Lox Pre-Pressurization Check Valve in MAB		MAB
9120	Relocate the GOX Flow Valve Tester		MTF
9121	Engine Area Purge System for MTF	4-10	MTF, R-Test
9125	Eliminate Malfunction of the Propellant Measuring System Electronic Checkout Unit		MSE 1,2, R-Test, R-Qual, MTF 1,2
9128	Delete the Forward Umbilical Service Unit (FUSU) at MTF		MTF
9129	Add "Holddown Arm Control Panel" TF 441001B to the Mechanical Test Control Equipment (MTCE) at MTF		MTF
9130	Furnish Hardware for the F-1 Engine Mock-Up EM-1 (FM-10)	2	
9138	Provide Hose and Adapter Assemblies for S-IC, F-1 Engine Fuel Drain at MTF		MTF 1, R-Test
9139	Convert MTF Ground Equipment Test Sets (GETS) to an Automatic GETS		MTF 1
9141	Add Rollaway Heat Shield Access Panels	3-10	
9169	Modify Fuel Tank Bulkhead Covers to Eliminate Interference		MTF 1
9199	Implement Vibration Safety Cutoff System at MTF	4-15	
9202	Provide for Installation of GFE Second Hydraulic Power Supply Unit and Associated Equipment at MTF		MTF
9206	Revise F-1 Engine Valve Time	4-15	
9209	Implement Automatic Turbopump Malfunction Cutoff System		MTF
9217	Replacement of Oxidizer Pump Primary Oxidizer Seal in F-1 Engine	5-6	

APPENDIX G

MTF SYSTEMS TEST DOCUMENT STATUS

DOCUMENT NUMBER	DOCUMENT TITLE	STATUS
D5-11064-3	Planned Event Recording Procedures for Launch Systems Branch Records System , Huntsville and MTF	Cancelled
D5-11397	NASA/Boeing/Support Contractor Interface Responsibilities at Mississippi Test Facility (Sustained Operations Phase)	Completed

D5-11765	Index - S-IC Activation, Testing and Quality Control Procedures for MTO	Completed
D5-11769	Index of S-IC Test Requirements for MTO	Completed
D5-11776	S-IC Stage/GSE/Test Stand Interconnect	Cancelled
D5-11789-xxx	S-IC Static Test Acceptance Operations and Sequence Plan	In Work (One Per Stage)
D5-11791	S-IC MSE/GFE/Facility Sub-System and System C/O Plan - MTF	Cancelled
D5-11792	S-IC Pre-Firing C/O and Post-Firing Evaluation Procedures	Cancelled
D5-11793	MTF Receival, Receival Inspection and Shipping Procedures for S-IC Activation and Operation	Completed
D5-11794	S-IC Static Firing Countdown	Cancelled
D5-11797	S-IC Handling and Transportation Procedures - MTF	Completed
D5-11805	Computer Program Requirements for S-IC Static Test Analysis	Cancelled
D5-11809	Plan for Data Handling, Reporting and Evaluation	Cancelled
D5-11813	MSE Activation Reports - MTF	Cancelled
D5-11817	S-IC Static Firing Quick Look Reports	Cancelled
D5-11818	S-IC Stage Summary Data Reports	Cancelled
D5-11826	Systems Test - Mississippi Test Operations - Safety Plan	Completed
D5-11900-2	Definition of Government Furnished Support Services for Boeing/MSFC-MTF	Completed (Released as IN-I-V-S-IC-65-12)
D5-12288	Work Specification - Activation of S-IC Complex at MTF	Completed (Released as IN-I-V-S-IC-65-15)
D5-12289	Work Specification - Operation and Maintenance of S-IC Complex at the MTF	Cancelled
D5-12290	Facilities Requirements - MTF	Cancelled
D5-12291	MSE Installation Plan for MTF	Completed
D5-12291-1	Labor Interface Summary	Completed
D5-12292	Test Operations Concepts - MTO	Cancelled
D5-12300-8	MTO Management Plan	Cancelled

D5-13033	S-IC Test Measurement Program	Cancelled
D5-13034	S-IC Special Test Plan	In Work
D5-13036	S-IC Stage/GSE/Facility Interface and Configuration Control Plan - MTF	Completed
D5-13039	S-IC Static Test Data Requirements	Cancelled
D5-13127-1	Facility Activation Program Plan, S-IC Complex - MTF	Completed
D5-13146	S-IC Facilities Activation Quality Assurance Plan - MTF	Cancelled
D5-13668	Boeing Maintenance Plan for S-IC Test Complex at MTF	In Work
D5-13691	ST-MTO Proof Load Test/Inspection Program	Completed
D5-13738	S-IC Systems Safety Review/Systems Test - MTF	Completed
D5-13743	Facilities Maintenance Plan - MTF	Cancelled

GLOSSARY

ABCD	Automated Boeing calibration data (computer program for stage test and checkout equipment)
ADR	Automated data reduction
A/SCT	Apollo/Saturn calibration tape
ATG	Activation tests group
ATOLL	Acceptance test or launch language
BAC	Boeing Airplane Company
BATC	Boeing Atlantic Test Center, KSC, Florida
BOD	Beneficial occupancy date
CAM	Change action memo
CAR	Corrective action request
CCB	Configuration Control Board
CCP	Contract change proposal
CDF	Confined detonating fuse
CDR	Critical design review
CEI	Contract end item
CID	Cable interconnect diagram

CLASS I CHANGE:

If an engineering change deviates from the contract and must, therefore, be covered by contract revision, it is Class I. All Class I changes are processed by Engineering Change Proposal. Class I changes are specifically identified as such if one or more of the following is affected: (1) Part I CEI Specifications; (2) Contract price or fee and contract guarantees, delivery, or test schedules; (3) Changes to Part II CEI Specifications if any or the following are affected - interchangeability, electrical interference, present adjustments, interfaces, computer programs, change in vendors, retrofit, requalification testing, and any change affecting high energy nuclear radiation sources.

CLASS II CHANGE:

All changes that are not Class I.

C/O	Checkout
CPFF	Cost plus fixed fee (contract)
CPIF	Cost plus incentive fee (contract)
CRT	Cathode ray tube
CSM	Central Stores Michoud
CY	Calendar year
DAF	Data Acquisition Facility
DDAS	Digital data acquisition system
DEE	Digital events evaluator
DI/DO	Discrete in/discrete out
DRD	Document requirements description
DRL	Document requirements list
DTS	Data transmission system
EAMR	Engineering Advance Material Releases
EAPL	Engineering assembly parts list
ECM	Engineering change memorandum
ECP	Engineering change proposal
ECPR	Engineering change proposal requirements
ECS	Environmental control system
EDS	Emergency detection system
E/E	Electrical/electronic
EITP	End item test plan
EMC	Electromagnetic compatibility
EMO	Equipment management organization
EMPL	Engineering master parts list
EO	Engineering order
EPRR	Engineering parts release record

EQA	Equipment quality analysis
ERS	Experience retention study, also Equipment record system
FACI	First article configuration inspection
FLSC	Flexible linear shaped charge
FM	Frequency modulated (modulation)
FY	Fiscal year
GETS	Ground electronics test set
GFE	Government furnished equipment
GFP	Government furnished property
GN_2	Gaseous nitrogen
GOX	Gaseous oxygen
gpm	Gallons per minute
GSE	Ground support equipment
HLS	Hydraulic load simulator (MAB)
HPA	High pressure air
HPG	High pressure gas
HPIW	High pressure industrial water
HPSU	Hydraulic power supply unit
H. S. S.	High Speed Steel
HTO	Huntsville Test Operations (Boeing Systems Test organization responsible for Huntsville test activities)
ICD	Interface control documentation
ICE	Instrument calibration equipment
IDEP	Interservice Data Exchange Program
IRN	Interface Revision Notice
ITGE	Integrated telemetry ground equipment
JOD	Joint occupancy date
KSC	Kennedy Space Center, Florida
KSI	Kips per square inch
KVA	Kilovolt ampere

LEVELS OF TESTING:

Test Level I Complete Stage
Test Level II Assembly Alignment and Continuity
Test Level III Systems
Test Level IV Subsystems
Test Level V Modules or Components
Test Level VI Parts

LH_2	Liquid hydrogen
LN	Liquid nitrogen
LOX	Liquid oxygen
LSBRS	Launch Systems Branch records system
MAB	Mechanical automation breadboard
MAR	Maintenance Action Revision
MB	NASA/MSFC-Boeing (jointly issued specification, drawing, or part number)
MBR	MSFC/Boeing relay (last letter represents type of part)
MCMRP	Minimum configuration management requirements plan
MCL	Measurement control laboratory
MDS	Malfunction detection system
ME	Manufacturing engineering
MF	Medium Frequency
Michoud	Michoud Assembly Facility, New Orleans, Louisiana
MIG	Mechanical inert gas (welding process)
MRB	Materiel Review Board
MSC	Manned Spaceflight Center, Houston, Texas
MSE	Manufacturer's support equipment (GSE to support manufacturing facility)
MSE I	Manufacturer's support equipment -

this test complex used for PSC and refurbishment of stages.

MSE II	Manufacturer's support equipment - this test complex used for PMC of stages.
MSFC	Marshall Space Flight Center, Huntsville, Alabama
MTF	Mississippi Test Facility, Mississippi
MTO	Mississippi Test Operations (Boeing Systems Test organization responsible for MTF activities)
NASA	National Aeronautics and Space Administration
NDT	Nondestructive Test
N/H	Next Higher Part Number
N/HE	Nitrogen/Helium
NPSH	Net positive suction head
OAT	Overall test (procedure)
ODIS	On-line data input system
ODOP	Offset Doppler system
PAM	Pulse amplitude modulated
PAR	Part analysis report
PART I	CEI specifications- set forth "detail design and performance requirements" for S-IC-F, S-IC-1 through S-IC- 10, and all deliverable GSE at KSC.
PART II	CEI specifications - set forth "drawings and test requirements" for S-IC-3 on (does not affect S-IC-F, S-IC-1, S-IC-2, or deliverable GSE)
PCA	Production control area
PCC	Program control center
PCM	Pulse code modulated
PERT	Program evaluation and review technique
PMC	Post-manufacturing checkout
P/N	Part Number
PRR	Production revision record (a class II change)
PSC	Post-static checkout
QC	Quality control
R&D	Research and development
RACS	Remote automatic calibration system
R-ASTR	Astrionics Laboratory, MSFC
RDAM	Reliability Data Analysis Model
RDC	Reliability Data Center
RDSM	Remote Digital Sub-Multiplexer
RF	Radio frequency
RFP	Request for proposal
R-P&VE	Propulsion and Vehicle Engineering (organization), MSFC
RP-1	Fuel (kerosene)
R-QUAL	Quality Laboratory, MSFC
R-TEST	Test Laboratory, MSFC
SCN	Specification Change Notice
SE	Support Equipment
ST - MTF	Systems test - MTF
TCC	Test control center
TIG	Tungsten inert gas (welding process)
T/M	Telemetry
TVC	Thrust Vector Control
UER	Unplanned event record
VAB	Vertical Assembly Building
WAC	Work Authorization Change
Δp	Delta p, differential pressure