MOONSHINE STATUS REPORT
25 March 1963
DOCUMENT NO. 489

STAT

Copy 1 of 5

Number of Pages 21

Performance

System resolution has continued to show improvement (Table I) despite the fact that weather has continued to impair operations. At low altitude, as in ATF-16, the camera is not focussed and boundary layer seeing is relatively poor. At the present operating altitude of about 40000 feet (35000 feet over terrain) severe buffeting is now being experienced, causing excessively frequent caging and allowing the stabilization system insufficient time to settle. It appears that as long as operations continue at the present altitude, maximum resolution will continue to remain in the 140 to 160 1/mm range limited by the system, and by atmospheric and boundary layer turbulence. In ATF-17 with all subsystems except the heading reference functioning, median resolution exceeded 100 lines per mm as predicted.

Retrofits

During this period several retrofit packages have been installed. These include a new control package, a new knuckle with friction reducing tension rod, circuit changes in stabilization, V/h sensor and IMC. Additional retrofit packages presently in work include the following: a scanner with better quality flats for the forward bench, new c-coil with more reliable connectors, new V/h interface package, improved V/h sensor head, new operational control panel with exposure programmer, magnetic recorder signal outputs. Our intention is to install these just prior to the first "hot" flights if these should be scheduled in the near future. However, if these should be scheduled two months or more in the future, we will install them when all are available, scheduling a general cleaning and overhaul for the same period. The camera must also be refocussed for higher altitudes.

SYSTEM 1A

Field Operations

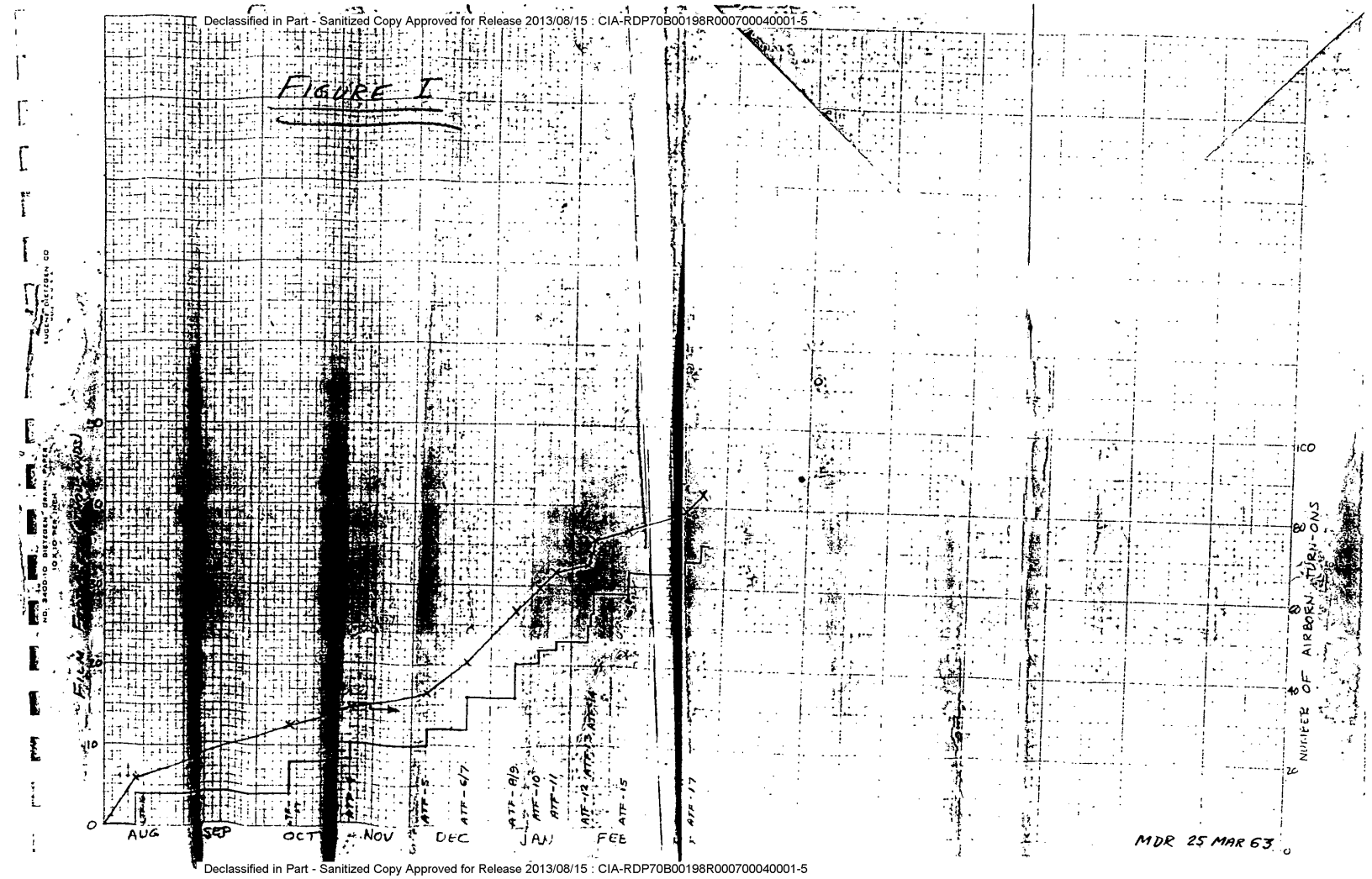
During this period we have continued flight testing in the Area, but these have been limited in altitude-speed for reasons beyond our control. While the primary purpose has been to effect improvement in performance, a secondary objective at the beginning of this period was to provide more practice for the field crew in more operational aspects of their jobs. Accordingly, a series of quick turn-around experiments were designed in which we were able to mount three flights on three successive days. Besides accomplishing our technical objectives, we were thus also able to demonstrate turn around capability comparable to that of the vehicle.

Later flights were deliberately spaced to provide time for retrofit, fine adjustment, and maintenance. So far, we have been able to design all improvements in such a way that substitute packages could be checked out in the laboratory prior to retrofitting in the field. This practice has served to keep the equipment in service with minimum down-time while performance has been steadily improved. Improvements thus demonstrated have also been incorporated into the 1B, and where applicable, into the 1C systems.

Reliability

The performance history is indicated in Figure 1. Reliability continues high. Photographs have been obtained each time the system has been turned on. Only once has it been advisable to postpone a flight due to a malfunction encountered during preflight operations. A failure report summary is included in the Appendix.

Figure I



Performance

System resolution has continued to show improvement (Table I) despite the fact that weather has continued to impair operations. At low altitude, as in ATF-16, the camera is not focussed and boundary layer seeing is relatively poor. At the present operating altitude of about 40000 feet (35000 feet over terrain) severe buffeting is now being experienced, causing excessively frequent caging and allowing the stabilization system insufficient time to settle. It appears that as long as operations continue at the present altitude, maximum resolution will continue to remain in the 140 to 160 l/mm range limited by the system, and by atmospheric and boundary layer turbulence. In ATF-17 with all subsystems except the heading reference functioning, median resolution exceeded 100 lines per mm as predicted.

Retrofits

During this period several retrofit packages have been installed. These include a new control package, a new knuckle with friction reducing tension rod, circuit changes in stabilization, V/h sensor and IMC. Additional retrofit packages presently in work include the following: a scanner with better quality flats for the forward bench, new c-coil with more reliable connectors, new V/h interface package, improved V/h sensor head, new operational control panel with exposure programmer, magnetic recorder signal outputs. Our intention is to install these just prior to the first "hot" flights if these should be scheduled in the near future. However, if these should be scheduled two months or more in the future, we will install them when all are available, scheduling a general cleaning and overhaul for the same period. The camera must also be refocussed for higher altitudes.

TABLE I

ATF	STATUS/REMARKS	MAXIMUM FWD ⊥	MAXIMUM FWD ∥	MAXIMUM AFT ⊥	MAXIMUM AFT ∥	MEDIAN FWD ⊥	MEDIAN FWD ∥	MEDIAN AFT ⊥	MEDIAN AFT ∥	ϕ
8/7		93	92	77	91	65	63	31	54	
8/9		104	123	140	148	65	86	71	68	
10		163	135	129	152	76	75	80	135	
11	ONLY 1 RUN IN CLIMB	–	–	–	–	–	–	–	–	~.75
12	CABINS Y/h, INC PROBLEMS	146	108	110	110	92	67	61	67	~.69
13		88	89	88	88	54	88	49	49	
14		64	107	158	126	56	91	80	71	
15		82	139	153	124	42	53	87	93	
16	LOW TO GET UNDER CLOUD	97	90	115	99	56	65	91	57	
17	35K T/C	140	159	127	120	110	116	86	98	

SHUTTLE STARTED HERE

No shuttle drive, aft scanner on forward metering roller, locked bdy ref, ref Y/h
Aft scan misplaced ↑, locked bdy ref.

Although the direction we have received calls merely for making a 1A camera system operate, and that this extensive program of improvement could justifiably be considered over the present scope, we have continued this activity wherever possible in the belief that the prime interest still lies in ultimate performance, even in this prototype system. We have tried to do as much of this as possible without interfering excessively either in the progress of 1B or 1C, or the operation of 1A.

Heading Reference

More attention must be given to the Heading Reference sub-system. We have yet to run a test in which this system was running properly and it has generally been locked out. With short exposure times, this is not as serious as with long exposure times.

Acceptance

The present contract does not clearly specify an acceptance test. Accordingly we would, at this point, like to define what remaining services and operating subsystems should be provided under this present contract.

First, we must deliver and test an operational control panel with data flash extinction and automatic under-tension (of film) cut-out. Second, we must get the steppers in the data chamber to operate, and must repair the data flash so two images occur as required. Third, we must achieve "125 l/mm photography" on a long, hot flight. These three tasks should satisfy the commitments on 1A.

However, the date of the long, hot flight is uncertain, and (1) we will therefore use the intervening time to further improve the V/h sensor. (2) We may shorten the time constant of that part of the V/h signal which gives IMC. Also, (3) we should try to improve the heading

reference sub-system and (4) reboresight the platform sub-systems. These last four items, are probably necessary to meet 1C objectives, but they do not seem necessary for 1A and can be considered new scope. Similarily, we will complete the magnetic data recorder outputs and the photo-interpretors manual as new scope.

If 1A is to be operationally committed, it may be desireable to remove some test instrumentation leads but the field crew can do this as part of their duties.

Future Plans

Since we believe we are rapidly reaching the performance limits imposed by the present vehicle's operating conditions, and since we have demonstrated rapid turn around capability, we now have less of a feeling of urgency to run frequent flight tests. Since other systems will also require test time, we will schedule flights with decreasing frequency in the immediate future, preferring to utilize the time for more detailed data analysis and for systematic fine tuning. In approximately two weeks we expect to remove the equipment from service to install retrofit kits, and conduct a thorough cleaning and overhaul in preparation for "hot" flights.

V/H Testing

We have been cooperating with the Type II people in their V/H sensor test program, supplying them with a replacement fibre optics collector when theirs was broken and providing a new sensor head and pre-amplifier of current design for inclusion in the test program. This head has a solid rather than fibre optic collector designed to improve the signal to noise ratio.

APPENDIX I

This appendix summarizes failure reports received from the field only:

Number of Failures Reported on Test Equipment	34
Number of Failures Due to Human Error	10
Number of Failures Due to Other Component Failures	3
Number of Prime Failure Reports	8
TOTAL	55

Summary of Prime Failure Reports:

Edge Sensor	3 reports
Air Pax Model 40 Chopper	2
Edge Sensor Modulator	1

The Air Pax Model 40 Chopper has a contact problem inherent in its design and has been replaced with a solid state chopper. The Edge Sensor Modulator was received from the field and studied, but the failure symptoms could not be found in the unit.

Stabilization — 2 reports
Pitch Weight Shifter - Cause Unknown
Time Delay Relay - Design Problem

Data Chamber — 1 report
Data Chamber Clock - Cleaning was required

Shuttles — 2 reports
Voice Coil - Design Problem
Slip Clutch - Wear-Readjustment required

SYSTEM 1B

Status

Assembly status of the more critical items is tabulated in the following section.

Platform & Bridge - Figures 2 and 3

The 1B platform and electronics bridge have been assembled and operated. All subsystems operate and turn in the proper direction. Film has been passed through the system. Only minor realignment of film path was necessary. Corrective work of this nature is scheduled for completion by the end of the month so that final testing and adjustment can commence on schedule April 1.

The modification of the knuckle assembly to incorporate a torsion bar has been completed and installed in the system.

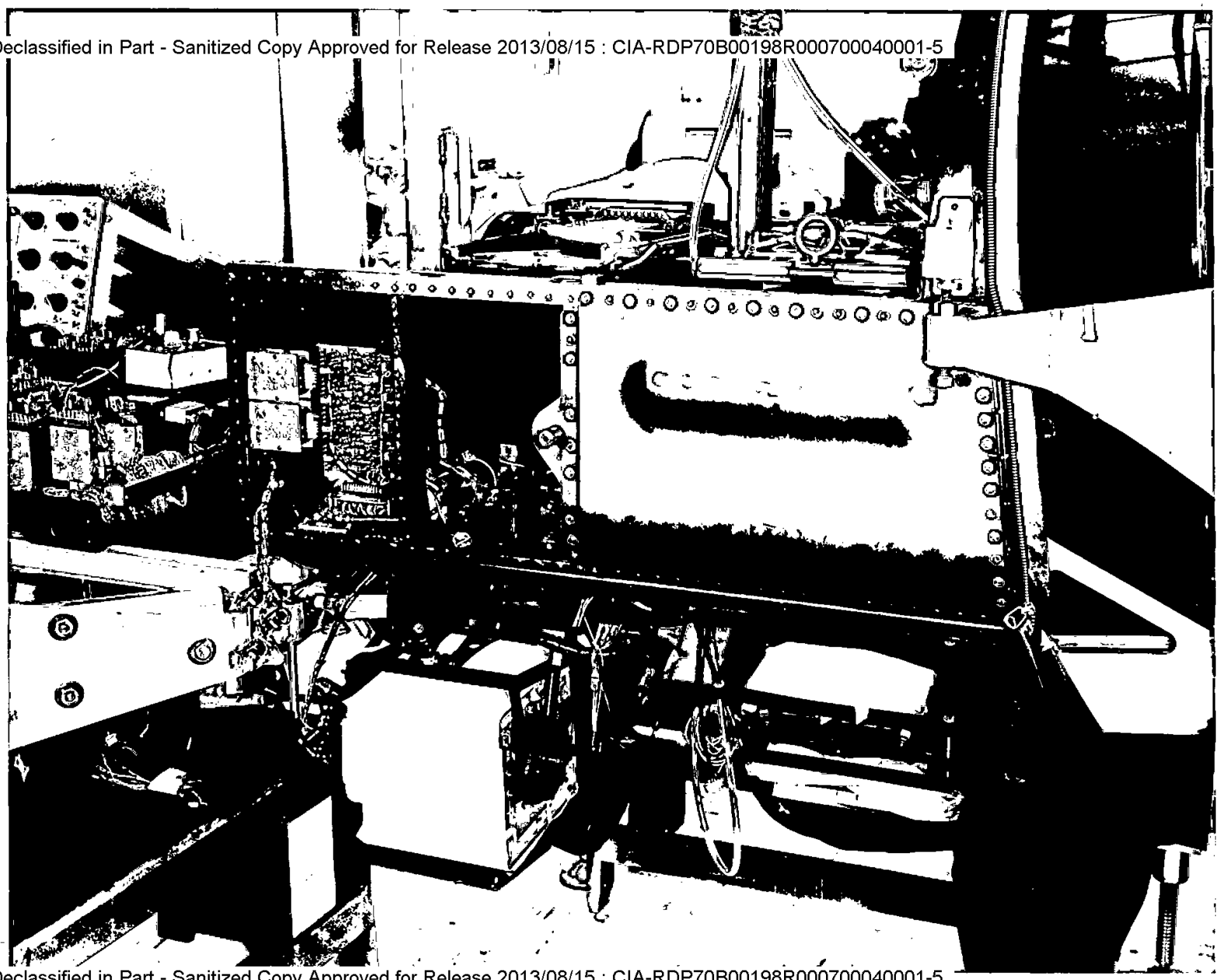
Stabilization

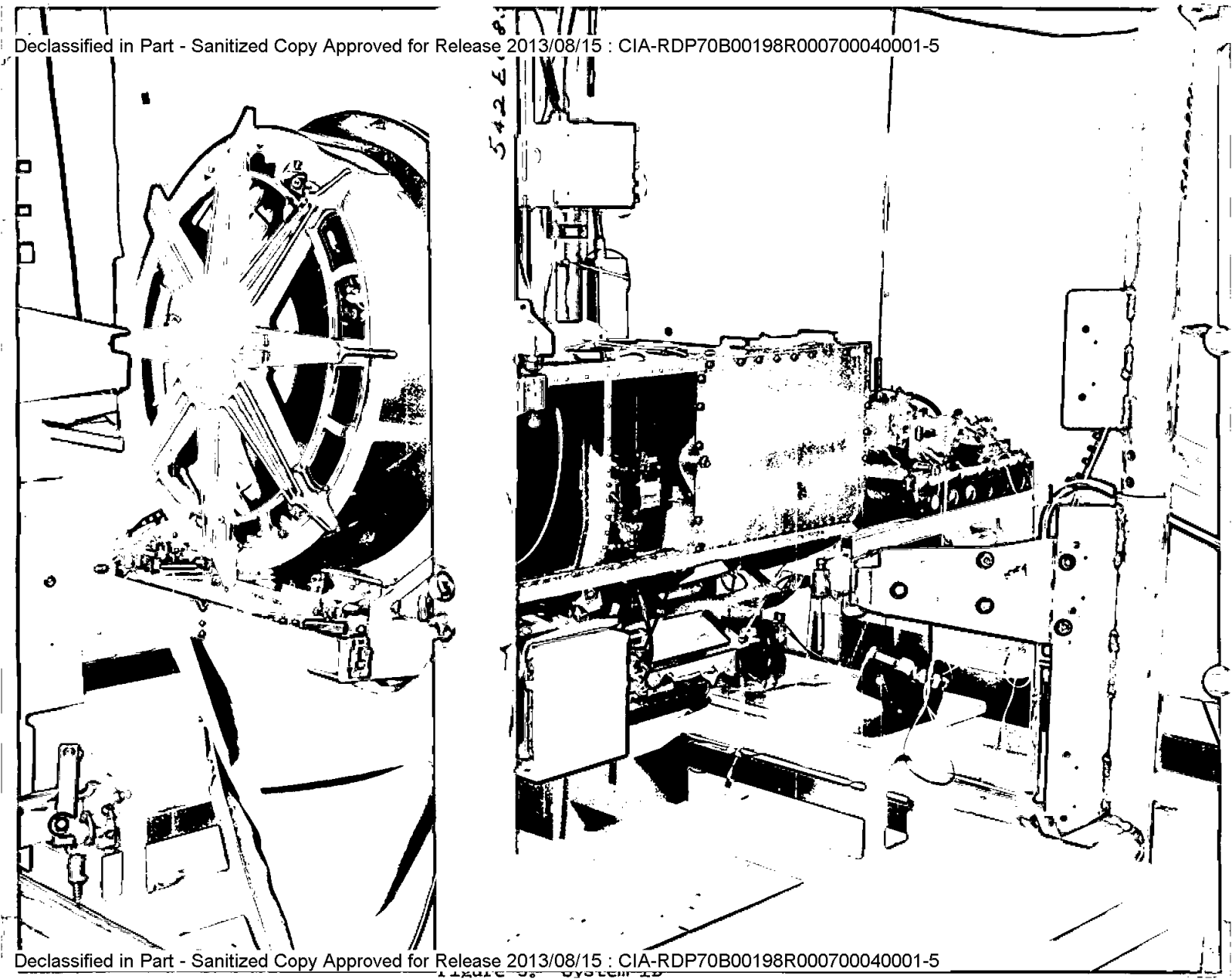
Changes in circuitry proved out on the breadboard and the 1A system are being incorporated in this system also. The gyros in the gyro package have been replaced from stock since the units have had considerable prior use and were getting noisy.

Attitude reference unit is assembled (except for porro mirror) and is being wired.

Frame Assembly

Assembly is nearly complete. Since this assembly is not required until near the end of the process, it has not been rushed and is not behind schedule.





Helium Tanks

The helium tanks loaned to the vehicle manufacturer had to be recalled because the additional tanks that were on order failed to meet specification and the lot was rejected.

Schedule

The schedule previously supplied showed a three week extension of delivery to May 20 reflecting a slippage of the Budd platform, a critical path item. We are attempting to recover a portion of this time by operating on a double shift basis.

SYSTEM 1C

General

Almost all releases have been made for System 1C components. In fact many of the smaller assemblies (over 125) have already been completed. Particular attention is being given to critical path items. Most vendor delivery slippages to date have not affected schedule. However, those that lie on or near the critical path are discussed in detail later. A revised CPM chart is included in the envelope attached to this report.

Platform

Platform delivery continues to slip according to the vendor. Our schedule was designed, based on prior experience with this vendor, to allow a three week slippage on this item. A short time ago we were advised of a 5 working day slippage and, more recently, a 9 working day slippage which would essentially lose this buffer. We are currently negotiating means to try to recover 4 or 5 of these lost days. Progress otherwise is reasonably satisfactory according to the engineer and quality control representative who make periodic inspection trips.

Budd is doing the honeycomb laminating in house this time. They are experiencing some difficulties although not appreciably different than those encountered previously on 1B when they had sub-contracted this work.

Electronic Bridge

The electronic bridge is recognized to be the next most critical item. To reduce drafting effort, and to save time we are using

simplified techniques in the design of the modules. Each module, during the initial design stages, is represented only by a single schematic diagram and a parts list. Finally, when the design is essentially complete, photographs of each side at unit magnification will be made and appropriate call-outs will be added by the drafteman. Several boards have already been constructed in this manner with considerable saving in time and effort.

Shuttles

The complex shuttle assembly could also fall on the critical path if too much slippage is permitted to occur. These assemblies (nearly last to be released) are already being assembled in the clean room. We are experiencing only minor trouble in procurring some of the subcomponents on a satisfactory time schedule. Some delay has been experienced in manufacturing the special drag cup motors for the capstans. (Reference Figure 15, Document 482). The manufacturer had experienced some difficulty at one stage of manufacture but by applying considerable overtime effort he has succeeded in solving that problem.

Optics

Flats sufficient for one scanner have been received and are being assembled.

Aspherizing of the second corrector is continuing; however, the image quality is not yet within specification. In work of this nature it is extremely difficult to predict precisely when satisfactory performance will be obtained. Since all the mechanical parts for the benches are on hand and are assembled, the Optical Group is concentrating on this problem.

Synchronization

A magnetic track of sufficient accuracy for scanner synchronization has been generated. It can be improved so that only one pickup head is required, but this can be done later.

Completed Assemblies

Approximately 125 subassemblies for type 1C have been completed. Photographs of some of the major subassemblies are included in the envelope at the end of the report.

SYSTEM 1D

The only items being worked on for 1D are the set of three refracting optical elements authorized previously. Work on these elements has stopped until the elements for System 1C are complete.

We have prepared a schedule from which we can determine the order in which releases must be made to assure shortest possible delivery of a fourth camera system. Since critical glass blanks are on hand and the correctors are well along in manufacturing, an eight and a half month cycle is indicated. This means that the time has just passed for an early December delivery. An order must be given by mid-April for delivery in this calendar year.

WINDOW STATUS REPORT

Three 14 x 20 vacuum window assemblies constructed during this period. Of these, the first two were plate glass units built for the purpose of checking mount fit, assembly procedures, etc. The first of these units, complete with mount is shown in Figure 4. The third unit built is a non-optical window using coated quartz and plate glass. It appears to be leak tight, although resealing of the tube to block and bellows to foil joints was required. This window will be used for outgassing tests at present and possible thermal tests in the future.

Two tight 7 x 10 windows were recently built as indicated in the last progress report. After cycling the first of these successfully 12 times, thermal cycling was initiated on the second. After cycling the second unit 14 times, cracks began to develop in the aluminum which was jointed to the quartz. It was felt that this might be a fatigue phenomena associated with strain hardening of the aluminum upon extended thermal cycling and that periodic annealing might eliminate this effect. Small test samples of aluminum ultrasonically welded to quartz were made and one was annealed at 650°F after every third cycle while the other was not. After 35 cycles the sample which had been periodically annealed showed no cracking of the aluminum, while the other exhibited both actual and incipient cracking.

Consultation with [redacted] STAT was initiated on this subject. [redacted] STAT pointed out that in the case of high cycle, low stress fatigue, the life of the metal part varies inversely as the square of the strain amplitude and calculated that for the strain to which our

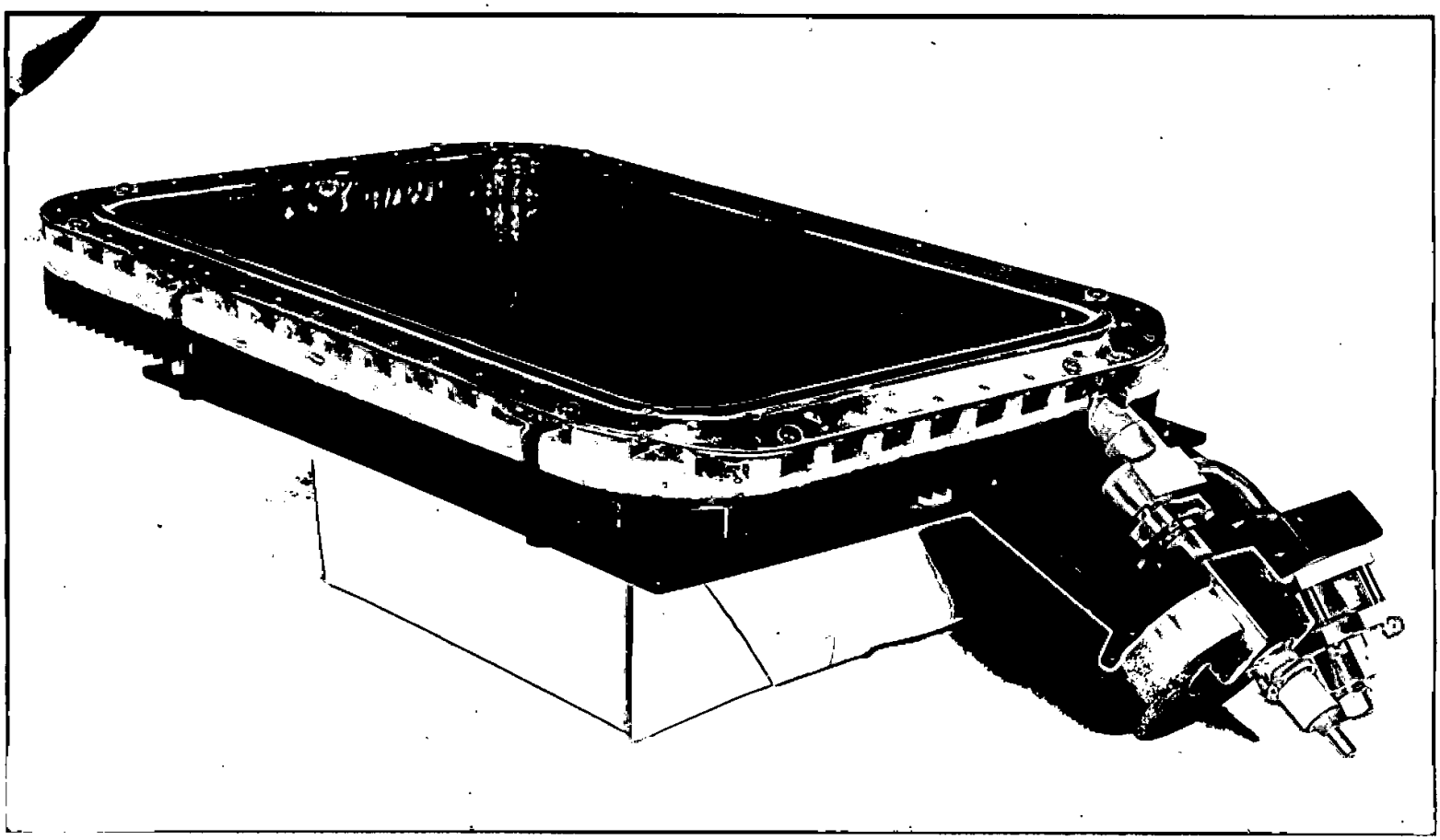
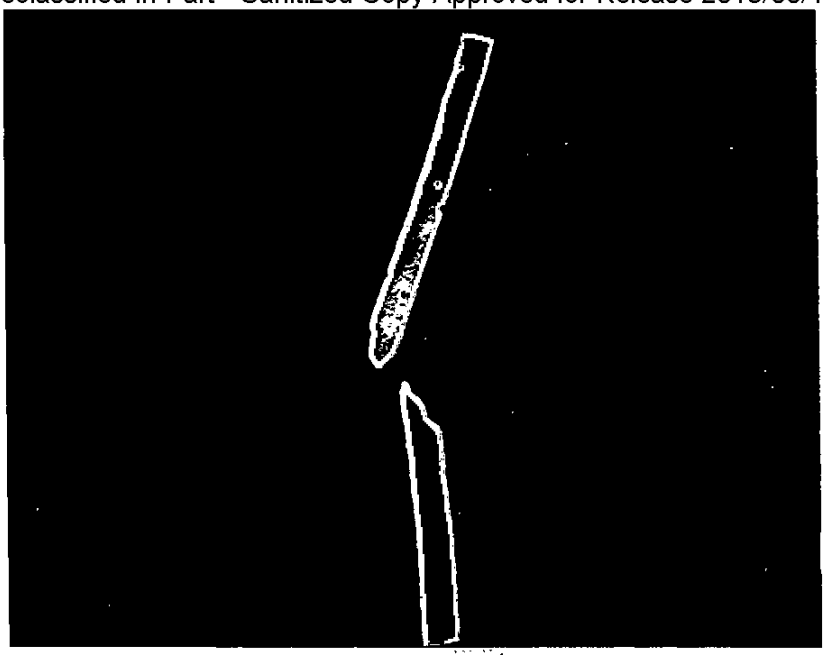


Figure 4.

aluminum is subjected the life should be of the order of several thousand cycles before this type of fatigue could be expected. Further investigations were undertaken and indicated that the cracking, rather than being of a fatigue nature, or due to progressive plastic deformation (high strain, low cycle fatigue) and characterized by necking, is due to high temperature creep. This is demonstrated in the photomicrographs showing metallurgical cross-sections of the aluminum. (Fig. 5). Consultation with [redacted] STAT who has done extensive work in creep of high purity aluminum alloys has been initiated.

An improved design for a non-vacuum window, based on eliminating helium from the gap, has been reported previously. Further analytical investigations and redesign indicate that it is feasible to convert a vacuum window configuration into such a non-vacuum unit by substitution of a pressure regulation system in place of the vac-ion pump and valve, and some spacer changes. This gives the possibility of converting a leaky vacuum window into such a configuration. A model of this concept has been made and is now being prepared for environmental tests.



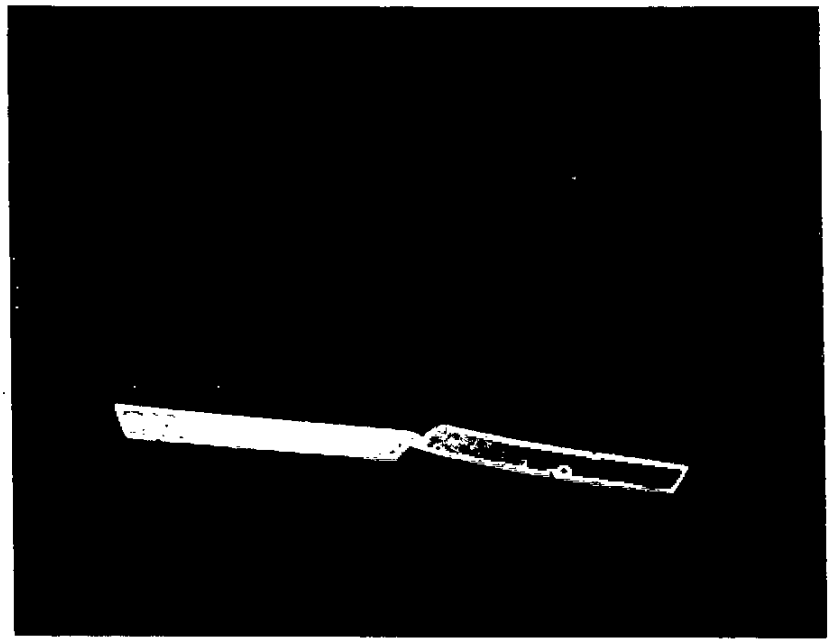


Figure 5

GENERAL

1. Manpower

The number of personnel employed on the project has remained essentially constant. The notable changes are that the drafting effort has reduced sufficiently to release two people. One field engineer was terminated.

There has been an improvement in recruiting personnel for the field. Three persons are in training for field activities by working on the assembly of System 1B. Two of these are Perkin-Elmer employees, one of whom has been working on the project for some time.

A report covering the composition of field staging and recovery crews is in preparation and will be submitted shortly. Also included in this report are lists of materials required for "Fly Away Kits".

2. Project Control

In an effort to control costs better, the entire project is being reestimated on the modified PERT cost basis. This rather considerable activity will be completed in approximately three weeks.