Silver

PROGRAM MANAGEMENT DIRECTIVE
FORM 717 SEE P&P A-58

AC ELECTRONICS
Division of General Motors Corporation

P.M.D. SERIAL NO. 594
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PROGRAM NAME	CONTRACT NO.
APOLLO	NAS 9-10356

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DATE 28 December 1970

RE-ISSUE DATE

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SUBJECT

K-Start Tape Maintenance Procedure

DIRECTIONS

All Apollo K-Start tape maintenance will be carried out in accordance with

EP-DPI-3260-1, "K-Start Tape Maintenance Procedure".

TERMINATION DATA

W. Tschirgi Gigstead	J. Wachholtz M.E. S.K. my acy		PROGRAM DIRECTOR AUTHORIZATION DATE

CLOSE-OUT NOTICE - REMARKS

PROGRAM DIRECTOR - CLOSE OUT

DATE

SUBJECT

K-START TAPE MAINTENANCE PROCEDURE

1.0 PURPOSE

The purpose of the procedure is to show the change cycle for K-Start tapes and to assure adequate checkout of a K-Start tape after it has been changed.

2.0 SCOPE

This procedure applies to modifications of existing K-Start tapes used at NR, GAC and KSC. A new K-Start tape will be generated only as a result of an ECP, and verification of the K-Start tape will be bound by general requirements listed below.

3.0 GENERAL REQUIREMENTS

3.1 Existing K-Start tapes are changed for the following reasons:

3.1.1 To operate with a new flight program.

3.1.2 To reflect changes in test requirements.

3.2 Checkout of a K-Start tape after a change will consist of:

3.2.1 Special analysis with regard to timing requirements.

3.2.2 K-Start tape performance to meet requirements as tested on a G&N system.

3.2.3 Use of a simulation when G&N System Lab tests are not adequate to assure that the K-Start tape meets performance requirements.

3.2.4 Use of spacecraft contractor facilities where 3.2.2 and 3.2.3 above are not adequate to assure that the K-Start tape meets the interface performance requirements.

3.2.5 Field Site coordination for TCP compatibility.

3.3 K-Start tape top flow. Figure I is the K-Start tape top flow presented to give an overview of the K-Start tape activity. Any of the six shown inputs can generate a change to existing requirements and so necessitate a change to a K-Start tape.

4.0 RESPONSIBILITY AND HANDLING

4.1 Evaluate Requirements/Need for Change

Changes will have two natures. Those that are forced because of reassembly of flight programs and those that are required by either the Steering Committees at KSC or the Checkout Coordination Meetings.

4.1.1 Changes Forced by Flight Program Reassembly

Evaluation of these changes consists of the software engineer reviewing the master lead in deck that is used for assembling the K-Start tapes. Changes to the master lead in deck are required and are made if the location of programs in fixed memory which are utilized by the K-Start tapes have been moved. Erasable memory assignments are scanned to determine if the utilization of any erasable memory locations by fixed memory routines will require shifting the locations of the various erasable memory K-Start tape routines.

4.1.2 Required Changes

Changes required by the Steering Committee or through the Coordination Checkout Meetings are documented in the minutes of those meetings and supplied to the lead engineer in charge of the K-Start tape effort. The required change is reviewed with Apollo system personnel with regard to the need for the change and its effect on system operation and software. If the change is undesirable or not possible, the person requesting the change is so informed. If the change is desirable and can be implemented, the lead engineer determines the tapes affected and notifies the software engineer to implement the requested change.

4.2 Tape Checkout

4.2.1 G&N System Test Requirements

The first phase of the testing is principally a software function performed on the card deck from which the K-Start tape is made. This software function consists of checking the VERBS, NOUNS, DATA, etc., on each data card of the K-Start deck and verifying that the sequence of these keycodes, the verb-noun combinations, the number of data keycodes, and other requirements of the G&N computer are satisfied. If any of the pre-stored rules contained in this software program are violated, the listing which is printed out as a result of this program operation will contain an ERROR designation following the line of data on which the error was detected. If no errors are found, a magnetic tape is generated, and the mylar K-Start tape is punched. Finally, the K-Start tape and magnetic tape are read

4.2.1 -continued-

simultaneously and compared. Complete comparison is required before the punched K-Start tape is considered to be software verified. The preceding sequence is used for all K-Start tapes that are punched. This includes tapes made for laboratory testing purposes and for tapes made for use in G&N testing in the field. This is the responsibility of the software engineer producing the tape.

The second phase of testing consists of the software engineer validating the actual K-Start punched tape by using it to manipulate real G&N hardware to the procedure of the TCP. This phase is accomplished by use of the simulated ACE K-Start tape reader which is interfaced with a G&N system. This ACE simulator reads the K-Start tape, formats the keycodes into an uplink bit stream, and enters the information into the G&N computer via the same input interface that the actual ACE system uses. As the keycode information is read from the K-Start tape and entered into the G&N computer, the functions contained in each sequence of keycodes are validated.

A sum check is performed on the information uplinked into erasable memory to insure the program loaded as expected. The K-Start tape is then sequenced to control the test programs and display the results. For G&N level checkout, the operating procedure and expected results are detailed in the G&N Spacecraft Process Specifications ND 1002323, ND 1002325, ND 1002348, ND 1002379 and ND 1002380.

The expected test results for the interface tests are detailed in the documents which originally came out of the Steering Committees or the Coordination Checkout Meetings.

4.2.2 Use of Two-Machine Simulation

When the Learner Lab GSE is inadequate or the desired environment cannot be duplicated, the lead engineer makes arrangements to test the tape on the Two-Machine Simulation facility.

4.2.3 Use of Spacecraft Contractor Facilities

Where the Two-Machine facility is inadequate, the tape will be taken to the appropriate Spacecraft Contractor facility. The software engineer responsible for the tape or Delco site personnel cognizant of the tape will observe the K-Start tape checkout. The results of the checkout will be recorded on the "K-Start Tape Certification and Verification Checklist".

4.2.4 Field Site Coordination

After the Delco/Milwaukee software engineer has verified that the K-Start tape is functioning properly, the engineer or a representative will be sent to the field site where the K-Start tape is to be used.

4.2.4 -continued-

A meeting will be requested with field site representatives of the following organizations:

Delco
MIT
NASA
Spacecraft Contractor Personnel

The listing of the tape will be reviewed with regard to:

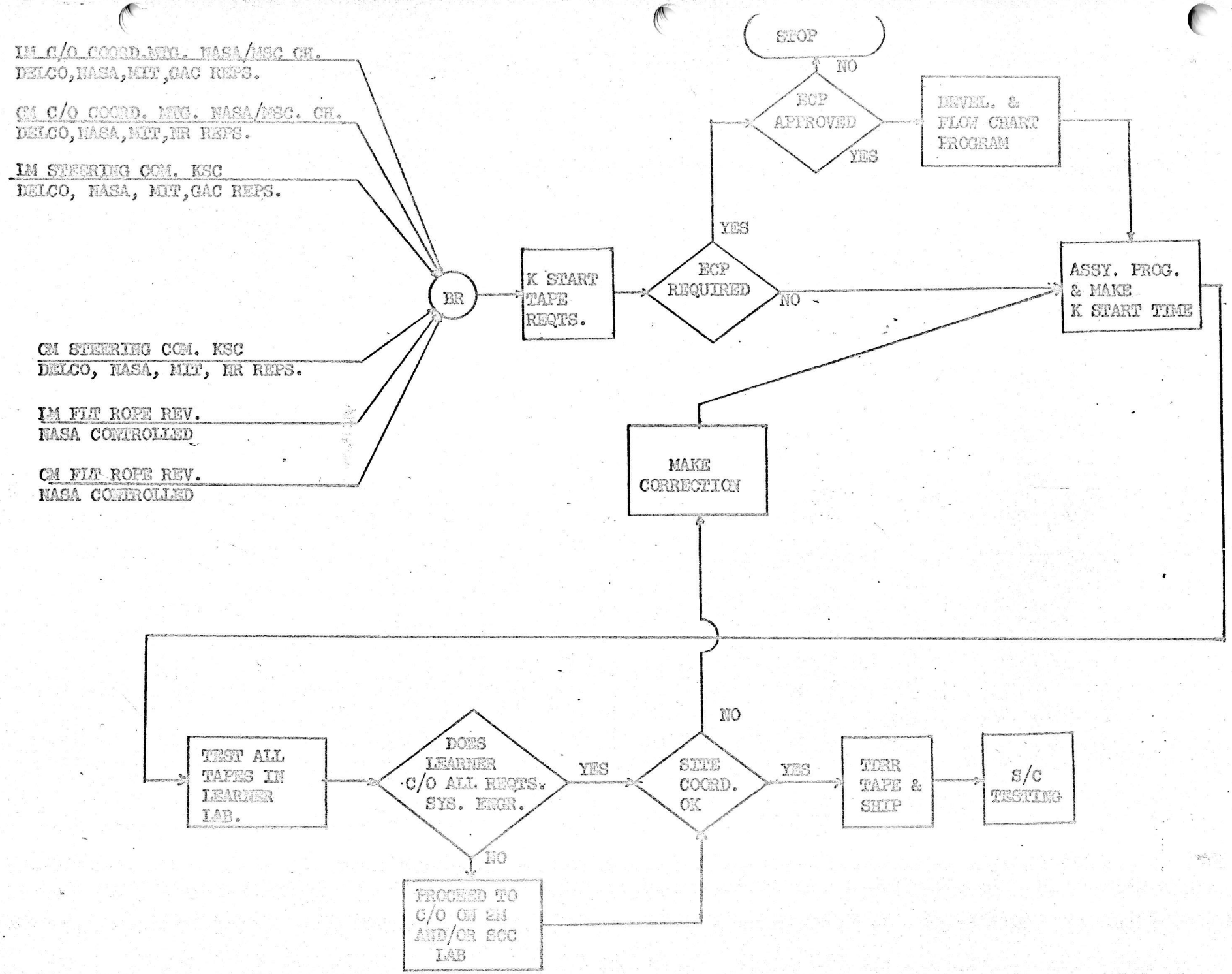
(1) Assembly changes
(2) Program changes
(3) Relocation changes
(4) Procedural requirements or changes to same
(5) Expected test results.

Any changes required or errors detected will result in reassembly of the tape, thorough checkout and re-coordination.

4.2.5 Checklist

A K-Start Tape Certification and Verification Checklist sheet (Attachment 1) is shipped with all K-Start tapes. The checklist is prepared by the responsible software engineer and requires approval of the lead engineer, Group Head and system engineer. This will include review with the software engineer of each tape listing, a discussion of the tests performed, the results obtained and description of waivers. In addition, a sign-off by the Delco field site personnel will be included to indicate their acceptance of the tape.

T. L. Hanley
Technical Director
Apollo, Systems, Instrument Engineering



K START TAPE TOP FLOW DIAGRAM FIG. I

ATTACHMENT 1

DATE _____

K-START TAPE CERTIFICATION AND VERIFICATION CHECKLIST

TAPE NO. _____

TAPE NAME _____

CARD DECK ASSY. DATE _____

The purpose of this checklist is to document the requirements of DPI 32-60-DPI-1 dated 23 December 1970.

		Software Engineer	System & Lead Engineer
TAPE CHECKOUT REQUIREMENTS:	Delco Learner Lab	_____	_____
	Two-Machine	_____	_____
	S/C Contractor Facility	_____	_____

CARD DECK VERIFIED PER SOFTWARE PROGRAM DRA-02, entitled "K-Start Tape Verification" _____

PUNCHED TAPE COMPARISON PERFORMED PER SOFTWARE PROGRAM PTV1 (Standard IBM-360-65 Punched Tape Verification) _____

VERIFICATION DATA

	Date	Location	Program	Ropes or PAC	Initial
G&N Hardware	_____	_____	_____	_____	_____
Two-Machine	_____	_____	_____	_____	_____
S/C Contractor Facility	_____	_____	_____	_____	_____

Remarks/Waivers _____

_____

_____

_____ _____ _____ _____

Software Engineer Date Apollo System Engineer Date

_____ _____ _____ _____

Software Engineer Group Head Date Field Site Engineer Date