

SHARE PROGRAM LIBRARY AGENCY



PROGRAM NUMBER

161001

University of Miami

1365 MEMORIAL DRIVE - CORAL GABLES, FLORIDA
(305) - 284-6257

1 SDA Number (to be filled in by SDA)

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Date of Submittal 1-6-67 New ☒ or Revision ☐

A13-21

2	Submitter's Installation Code								R	S				
3	Program Number or Designation (and Suffix)								R	K	T	4		
4	Submitter's Name.....	B												R
5	Submitter's Department (primarily for internal use)													
6	Author (if different from above).....													
7	Year Completed (last 2 digits) or Status Code													

Ms. Irene Nesbit
Rand Computation Center
The Rand Corporation
1700 Main St.
Santa Monica, CA 90406

1-3

4-8

A22-38

A39-50

A51-67

A68-69

[illegible]

Title
Card
012-68

9	Field of Application	T R A J E C T O R I E S											
10	Primary Subject Code											T	4
11	Secondary Subject Codes	T 3				T 7							
12	Principal Source Language	F Ø R T											4
13	Secondary Source Language												
14	Type of Routine											M	P
15	Machine	3 6 0											
16	Monitor or Operating System Required	F Ø R T											4

B12-26

B27-29

B30-41

B 42-48

B49-55

B56-57

D 36-64

00371

[illegible]

C12-23

C24-39

19 Documents Available (indicate page counts):

Submittal & Attachments...		S	U	REL	ANKS	2
Catalog Cards . . .	21	W	U			
Write-up...						
Listing...						

C40-44

C45-54

NOTE: The SU and Catalog Cards are sent to all installations at announcement time. Obtainable by order card from SDA are: 1) The Documentation (DO) consisting of the SU and WU, 2) the Listing (LS).

20-21 Program Material Avail.																				
20	a. Primary Form.....	C	O	M	P	L	E	T	E	S	Y	S	T	E	M					
		b. Count								c. Medium								I	T	P
21	a. Additional Form																			
		b. Count								c. Medium										

D12-31

D32-39

D40-59

D60-67

22 Search Key

*	A	E	R	Ø	S	P	A	C	E	.	V	E	H	I	C	L	E	.	D	E
S	I	G	N	.	*	T	R	A	J	E	C	T	Ø	R	I	E	S	,	.	.
*	Ø	R	B	I	T	S	,	.	*	R	Ø	C	K	E	T	S

Search
Card
S12-74

Remarks (not to be keypunched) Tape contains 4 files, BCD, (as described in WU).
Listing can be obtained from tape.

User must specify 7-track or 9-track tape.

Abstract (Cards 10-99, Columns 12-72)

ROCKET IV is a FORTRAN IV program which mathematically simulates the flight of aerospace vehicles by numerical integration of their equations of motion. A special-purpose input form enables the user to specify the characteristics of his vehicle and its flight plan, both of which can vary through a wide range of choices, with comparatively little effort. The program requires the use of a FORTRAN compiler, reads input from tape 5, and writes output on tape 6. It occupies about 25,000 words of core.

A complete description of the program and a number of illustrative examples are given in "ROCKET: RAND's Omnibus Calculator of the Kinematics of Earth Trajectories," by Barry W. Boehm, Prentice Hall, 1964.

User must specify 7-track or 9-track tape.

(Please attach additional pages, if necessary)

Pages Attached: Keypunchable Abstract Continuation (AC) _____

Non-Keypunchable Supplement (NK) _____

Signature of Submitter *[Signature]* Date 1-17-67

Signature of Installation Addressee *Paul L. Lohr*

ROCKET PROGRAM (RS RKT4)

ROCKET is a standard FORTRAN IV program. It requires the use of a FORTRAN compiler, reads input from logical unit 5, and writes output on logical unit 6. It should run comfortably in any system.

Page 2 gives the contents of the ROCKET tape. There are two versions of the source program. File 1 contains a COMMON package of program variables in every subroutine; this is needed for correct compilation and execution. File 2 contains the same routines without common packages in any but the main routine. This saves space and improves readability when the source cards are being used for documentation purposes only. File 3 is the input for a problem, and File 4 is the resulting output. This sample should be run first to check for possible transmission errors and to get a feel for the order of input to the program.

The source program on File 1 is liberally sprinkled with comment cards, taking the place of a detailed flow chart. A general flow chart is given on page 3.

Pages 4 and 5 show the ROCKET special-purpose input forms for the sample problem. By comparing these with the sample problem set-up from files 2 and 3, one can see the order in which input is accepted by the program.

Pages 6 and 7 are blank input forms by which the user specifies his inputs to the program.

Pages 8, 9, and 10 contain a list of differences between the FORTRAN IV version and the FORTRAN II version which is currently available as SDA No. 3001.

A complete description of the program and a number of illustrative examples are given in ROCKET: RAND's Omnibus Calculator of Earth Trajectories, by Barry W. Boehm, Prentice Hall, 1964. A list of errata in the book is given on Page 11.

Page 11 also includes a small list of program errata discovered to date. These changes should be made before compiling.

Barry W. Boehm, John Rieber (RS)
May 4, 1967

ROCKET TAPE DESCRIPTION

FILE 1 (BCD)

Cards 00000000 - 12700030: FORTRAN source decks.
Cards 00000030 - 00000640
contain the COMMON package,
which must be inserted in
every subroutine referring
to program variables. Each
FORTRAN deck is sequenced
separately.

FILE 2 (BCD)

Cards 00000000 - 12700030:
(3688 words) FORTRAN source decks similar
to File 1, but the COMMON
package has been deleted from
all but the main routine,
producing greater legibility.
This file is for documentation
purposes only, and should not
be used for compilation. Each
FORTRAN deck is sequenced
separately.

FILE 3 - Sample Problem Input (BCD)

Cards 001 - 015: \$IBJOB card and flight program
subroutine.

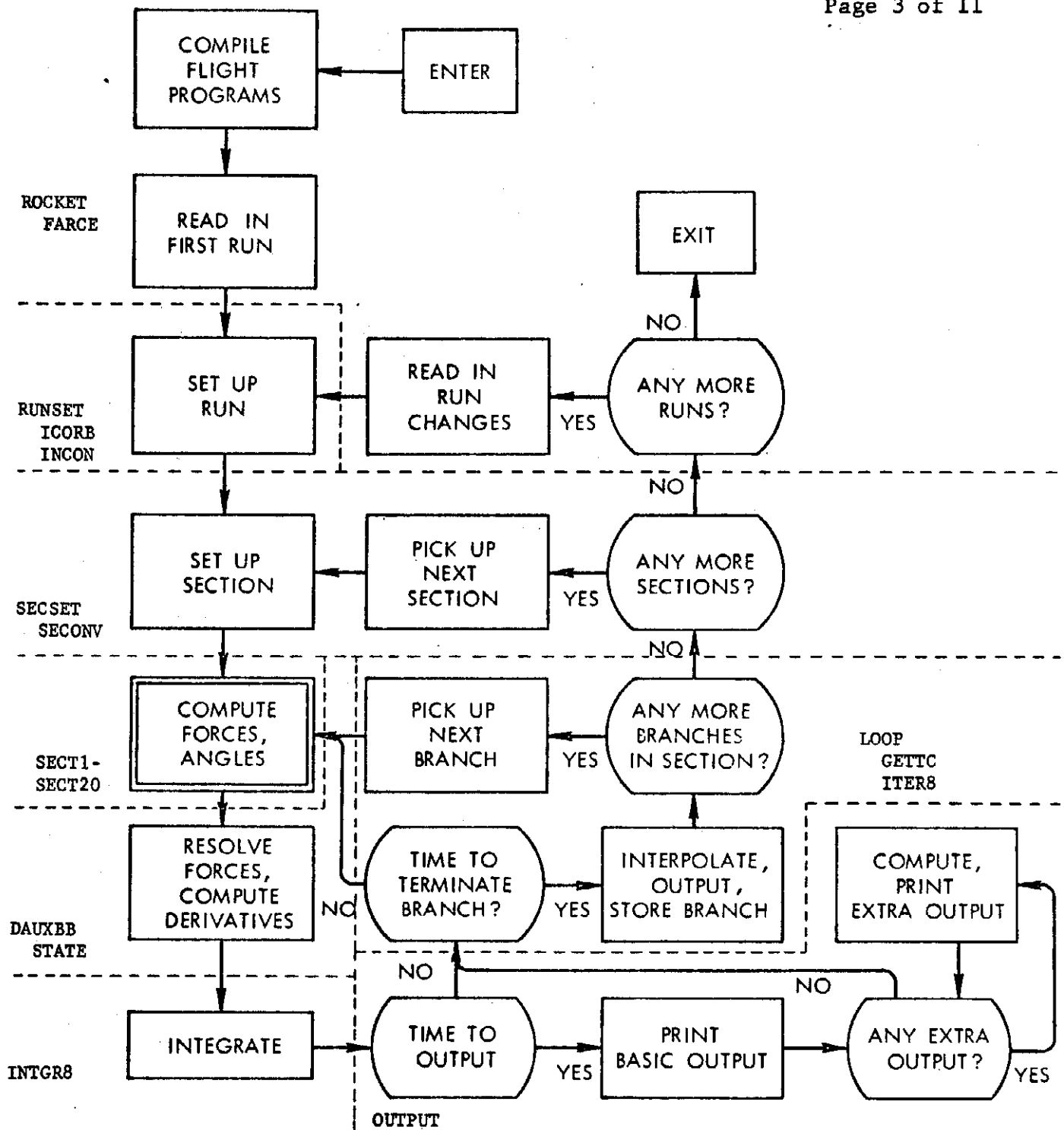
Cards 016 - 112: \$ENTRY card and input data
cards.

Source deck from File 1 goes between cards 015 and 016
for compilation and execution.

FILE 4 - Sample Problem Output (BCD)

132 character line images - BCD, unblocked.
(Standard FORTRAN carriage control.)

Tape is 800 BPI



ROCKET Program Basic Flowchart

ROCKET TRAJECTORY PROGRAM—INPUT FORM

DESCRIPTIVE REMARKS

[illegible]

INITIAL CONDITIONS

4 6		15 17 19		28 30 32		41 43 45		54 56 58		67 69	
0001	SEQUENCE NO.			OBLAT.		ROTAT.		INCON.			
0005	TIME			ALT.		LAT.		LONG.			VEL.
0010	GAMMA			AZIM.		WSI.		LAUNCH LAT.			LAUNCH LONG.
0015	INER. REF. LONG.			ALPHA		BETA		N BODY			
0020	NO. TRACKERS			LAT. T1		LONG. T1		ALT. T1			LAT. T2
0025	LONG. T2			ALT. T2		LAT. T3		LONG. T3			ALT. T3

SECTION CONDITIONS

[illegible]

JETT, WGT.

TILT ANGLE

REF. AREA

THRUST COEF

F. F. COEP

[illegible]

ASNO. COEF.

GUID. CORR

EX. COEF.

[illegible]

MULT. VAL. FLAG.

v1

Y2

22

✓

[illegible]

PRINT INTERVAL

4892.9.9.

TRACKER P. Q.

UNIT P. 9.

GUID. P. 9.

0120	1/1	101	1/1	101
0220	1/1	102	1/1	101
0320				
0420				

SPEC. P. O. 1

SPIC, P. O. 2

WPEC. P. 9. 3

ALT. T.C.

ALT. Y. V.

0125					
0225					
0325					
0425					

THR. TABLE

SEND TABLES

GUIDE TABLE

EX. TABLE

[illegible]

EXTRA INPUTS

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ROCKET TRAJECTORY PROGRAM—INPUT FORM

Page 6 of 11

DESCRIPTIVE REMARKS

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2460														
2470														
2480														
2490														
0000	(A)													

INITIAL CONDITIONS

	4	6	15	17	19	28	30	32	41	43	45	54	56	58	67	69
0001	SEQUENCE NO.					OBLAT.			ROTAT.			INCON.				
0005	TIME					ALT.			LAT.			LONG.			VEL.	
0010	GAMMA					AZIM.			WGT.			LAUNCH LAT.			LAUNCH LONG.	
0015	INER. REF. LONG.					ALPHA			BETA			N BODY				
0020	NO. TRACKERS					LAT. T1			LONG. T1			ALT. T1			LAT. T2	
0025	LONG. T2					ALT. T2			LAT. T3			LONG. T3			ALT. T3	

TERMINATION COND.

TERM V1

SECTION CONDITIONS

TERM V2

TERM V3

TERM V4

0100																
0200																
0300																
0400																

JETT. WGT.

TILT ANGLE

REF. AREA

THRUST COEF

F.F. COEF.

0105																
0205																
0305																
0405																

AERO. COEF.

GUID. COEF.

EX. COEF.

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0210																
0310																
0410																

MULT. VAL. FLAG.

V1

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V3

V4

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0215																
0315																
0415																

PRINT INTERVAL

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TRACKER P.O.

ORBIT P.O.

GUID. P.O.

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0320																
0420																

SPEC. P.O.1

SPEC. P.O.2

SPEC. P.O.3

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ALT. T.V.

0125																
0225																
0325																
0425																

THR. TABLES

AERO. TABLES

GUID. TABLES

EX. TABLES

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0330																
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EXTRA INPUTS

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[illegible]

ROCKET: Differences Between FORTRAN II and FORTRAN IV Versions

A. FORTRAN IV Version Modifications (partially incompatible with FORTRAN II version)

1. Since some systems don't read in blanks as -0., we have programmed ROCKET to ignore all zero entries read in from the input form, be they plus or minus. This can be a little inconvenient, as it means you can't change a non-zero quantity to zero. If you want to do this, put in 10-20, which works just about as well as zero.
2. The MAP-coded fourth-order Adams-Moulton, Runge-Kutta integration routine has been deleted. This means you always use the second-order integration routine, which may give slightly different results. We're working on a FORTRAN version of the fourth-order routine; it should be available soon.
3. Locations B(2440) through B(2459) and B(7001) through B(10000) are no longer available for use. Table storage has been restructured; see the new Table Table (Table 1).

B. FORTRAN IV Version Additions (completely compatible with FORTRAN II Version)

1. More variables have been put into the COMMON package, where you can get at them. See program listing on tape.
2. Three more slots are available for specifying derivatives (X6D, X7D, X8D) and obtaining their integrals (X6, X7, X8).
3. Section and branch numbers are printed as part of the basic output.

4. Termination quantities are now automatically furnished without your having to worry about computing them. Some new ones have been added:

<u>Item No.</u>	<u>Quantity</u>
18	time increment $t - t_s$ since beginning of section (sec)
19	orbital inclination i (deg)
20	bank angle σ_B (deg)
21	inertial attitude angle θ_I (deg)
22	velocity increment $v - v_s$ since beginning of section (ft/sec)
23	weight increment $w - w_s$ since beginning of section (lb).

5. The initial azimuth angle ψ_v is set to 90° if not explicitly specified. This eliminates inadvertent specification of polar trajectories.
6. A general one-dimensioned table lookup subroutine has been provided: `TABLDV(X,Y,NTAB,N)`, where

X = value of independent variable

Y = resulting value of dependent variable

NTAB = number of table in which independent and dependent variable values are stored

N = order of interpolation ($N = 1$ or 2).

Table 1

TABLE TABLE

Table Number	Table Type	N ₁	N ₂	Base Location	N _{DV}	No. of Stages
1	Air Pressure, Density	199		3000	2	1
2	Thrust, Fuel Flow	54		3600	2	3
3	Guidance	49		4100	1	3
4	Guidance	49		4400	1	2
5	Axial Aerodynamics	49		4600	1	3
6	Normal Aerodynamics	49		4900	1	3
7	Arbitrary	49		5200	1	2
8	Arbitrary	49		5400	1	2
9	Arbitrary	24		5650	1	1
10	Arbitrary	49		5700	2	2
11	Arbitrary	149		6000	1	1
12	Arbitrary	99		6300	1	1
13	Arbitrary	49		6500	1	1
14	Arbitrary	24		6600	1	1
15	Arbitrary	24		6650	1	1
16	Axial Aerodynamics	25	10	4600	1	1
17	Normal Aerodynamics	25	10	4900	1	1
18	Arbitrary	25	10	6700	1	1

ROCKET Book Errata: 8-28-66

<u>Page</u>	<u>Line</u>	<u>Is</u>	<u>Should be</u>
34	19	1000	10000
35	20	DH = HEFT - EMV(1)	DH = EMV(1) - HEFT
37	11	EMB(3):	EMV(3):
37	12	0.1	0.00001
62	22	$A_A = q \cdot A_{ref} \cdot C_A$	$A_A = -q \cdot A_{ref} \cdot C_A$
70	23	$A_A = 0.4 \cdot A_{ref} \cdot q$	$A_A = -0.4 \cdot A_{ref} \cdot q$
73		delete last 4 lines	
117	12	$(r_{x_T}^2 - R_T)^2$	$(r_{x_T} - R_T)^2$
150	19, 20	insert between lines 19 and 20: Q, dynamic pressure q (lb/ft ²)	
189		Table storage is cut back in the current model. A revised Table Table is attached.	

ROCKET Tape Errata: 5-4-67 (File 1 locations)

<u>Card No.</u>	<u>Is</u>	<u>Should be</u>
00003290	DØ 13 I=1,7000	DØ 13 I=1,11257
03200670	...,TEX(17)	...,TEX(20)
03201260	...(ENDP(I),I=1,4)...	...(ENDP(L),L=1,4)...
03101450	SLPRES=211.6224	SLPRES=2116.224
05300740	...,EINC,BØMEG,ØMEG,...	...,EINCD,BØMEGD,ØMEGD,...

Notice to Users:

The changes noted on the attached pages were found necessary for one user to make this program operate correctly on a system 360 or 370 computer. The program as changed is running on OS/MVT Rel. 18.6. Whether these changes will make this program operate in your environment is for your determination.

DISCLAIMER

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January 18, 1972

MEMORANDUM FOR THE RECORD

Subject: Changes to Program 360D-16.1.001

The purpose of this memo is to document changes made to the originally-supplied version of the ROCKET program package. The changes made fall in three categories:

- (a) Machine-dependent features (that were not errors on the 7094) (item (1) below)
- (b) Bona fide program errors (item (2) through (5))

It is interesting to note that some (not all) of the programming errors did not in fact cause operational errors on the particular combination of 7094/compiler used by the original program author. When are programs really checked out?

A listing of specific changes is given below:

- (1) The source decks that we received were BCD; they were converted to EBCDIC for our 360.
- (2) The first executable statement in the MAIN program was incorrect—the count was wrong, and on our 360 an addressing error resulted. The corrected form of this statement now reads:

DO 13 I = 1, 9209

Because of the way COMMON was allocated on the 7094, this coding error did not cause an operational error on that machine.

- (3) A problem occurred in subroutine RANGES because of the precision change in transferring from a 36-bit machine to a 32-bit machine. The change made applies to the second executable statement, which now reads:

IF (DELER - 0.0025) 22, 22, 23.

- (4) A variable called CAL was computed in subroutine CALMAL, and supposedly printed in subroutine PAERO. The original program failed to transfer the computed value to PAERO. This error was corrected by adding a labelled common area:

COMMON / COOFS / CAL

to both subroutines CALMAL and PAERO.

- (5) In subroutine CAXMAL an undefined variable NM was used as an argument supposedly specified what type of interpolation was to be used. On the 7094 this variable probably was zero (because memory was cleared by the operating system in most instances), thus forcing linear interpolation even though higher order interpolation may have been specified on the input form. The corrected call statement in CAXMAL now reads

CALL TAB2D (EMACH,ALPHAD,CAX,16,NX).