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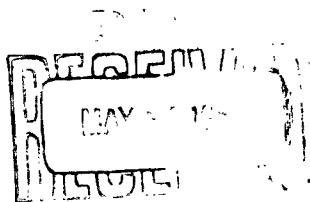
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MEMORANDUM REPORT NO. 1451
JANUARY 1963

ORDVAC PROGRAMS FOR STAR IDENTIFICATION AND
COMPUTATION OF STANDARD COORDINATES

A. Roberta Wooten



RDT & E Project No. 1M2229018215
BALLISTIC RESEARCH LABORATORIES

ABERDEEN PROVING GROUND, MARYLAND

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ARWooten/bj
Aberdeen Proving Ground, Md.
January 1963

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ABSTRACT

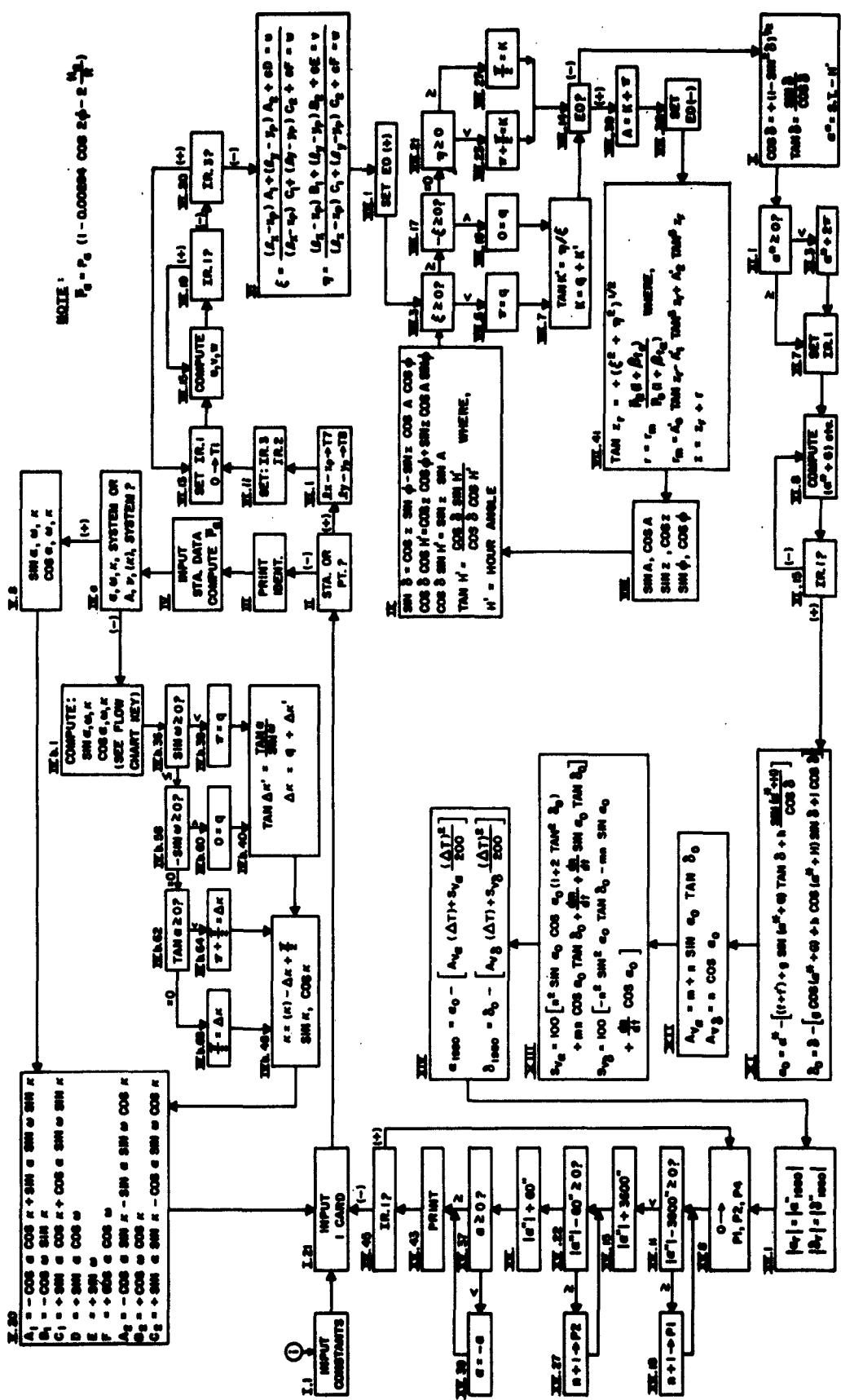
Using the camera orientation elements (α , ω , κ , c , x_p , y_p) derived from several known stars or determined from instruments, the "Star Identification Program" serves to identify all other photographed stars. After proper identification the "Computation of Standard Coordinates Program" is used to compute the coordinates of the control points for the camera orientation described in BRL Report No. 1065, "A General Solution to the Problem of Photogrammetry" by Hellmut H. Schmid.

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1. STAR IDENTIFICATION

1.1 Flow Chart



1.2 Raster

00	0	1	2	3	4	5	6	7	8	9	K	S	N	J	F	L	0	1	2	3	4	5	6	7	8	9	K	S	N	J	F	L
01	IR	IR	IR	IR	IR	IR	IR	IR	IR	IR							TEMPORARY	STORAGE														01
02	AND	CONSTANTS																												03		
04																														05		
06																	CONTROL															07
08																														09		
0K																														08		
0N																	FLOATING ARITH														0J	
0F																														0L		
10																														11		
12																	IR														13	
14																														15		
16																														17		
18																	C + AND Rm													19		
1K																	C AND R'm													18		
1N																	FIXED POINT													1J		
1F																	SIN-COS													1L		
20																	SNE													21		
22																														23		
24																														25		
26																	IBMC														27	
28																														29		
2K																	IBMI														28	
2N																														2J		
2F																	II I2														2L	
30																	IBMR														31	
32																														33		
34																														35		
36																	IBMO														37	
38																														39		
3K																														38		
3N																	ARCTAN														3J	
3F																														3L		
	0	1	2	3	4	5	6	7	8	9	K	S	N	J	F	L	0	1	2	3	4	5	6	7	8	9	K	S	N	J	F	L

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	0	1	2	3	4	5	6	7	8	9	X	S	H	J	F	L	0	1	2	3	4	5	6	7	8	9	X	S	H	J	F	L
40																																
42																																
44																																
46																																
48																																
4K																																
4N																																
4P																																
50	S1																															
52	D1																															
54	P1																															
56	T1																															
58	C1																															
5K	B1																															
5N																																
5P																																
60																																
62																																
64																																
66																																
68																	PROGRAM															
6K																																
6N																																
6P																																
70																																
72																	(UNUSED)															
74																																
76																																
78																																
7K																	740-LLL UNUSED															
7N																																
7P																																

1.3 Flow Chart Key

1, PROGRAM, REFRACTION, AND PRECESSION CONSTANTS

C1	+ .2617993878 + 00	r/h
C2	+ .4363323130 - 02	r/m
C3	+ .7272205217 - 04	r/s
C4	+ .1745329252 - 01	r/o
C5	+ .2908882087 - 03	r'
C6	+ .4848136811 - 05	r"
C7	+ .1000000000 + 01	1.0
C8	+ .2000000000 + 03	200.0
C9	+ .7600000000 + 03	pressure
C10	+ .0000000000 + 00	temperature
C11	+ .3665000000 - 02	B
C12	+ .6370000000 + 07	R
C13	+ .2913756581 - 03	A'0
C14	+ .3227865000 - 06	A'1
C15	+ .1022500000 - 08	A'2
C16	+ .3600000000 + 04	unused
C17	+ .3600000000 + 04	
C18	+ .6000000000 + 02	
C19	+ .2640000000 - 02	C
C20	+ .3073270000 + 01	m ^s
C21	+ .1336170000 + 01	n ^s
C22	+ .1860000000 - 04	dm/dt ^s
C23	- .8500000000 - 04	dn/dt"
C24	+ .1570796327 - 01	r/grad
C25	+ .1570796327 - 01	$\pi/2$
C26	+ .1000000000 + 03	100.0

- I, 1 Input Constants
 I, 21 Input first data card
 II If signal is minus go to Box III (station data), if plus go to Box VI (point data).
 III Print identification
 IV Input station data (cards 2-12)
 COMPUTE; [1] $\overline{P}_a^* = P_a \left(1 - .00264 \cos 2\phi - 2 \frac{H_a}{R}\right)$
 IVa If signal is plus go to Box V.8 (using the α , ω , K - system), if minus go to Box IVb (convert A , v , (K) - system to α , ω , K - system)
 IVb [2] Given A , v , (K). Convert to α , ω , K system by the following formulas:

$$\begin{aligned} K &= A - \pi \\ \tan K &= \frac{\sin K}{\cos K} \\ \cotan K &= \frac{1}{\tan K} \\ \tan v &= \frac{\sin v}{\cos v} \\ \sin \omega &= \sin v \sin K \\ \cos \omega &= + (1 - \sin^2 \omega)^{1/2} \\ \tan \omega &= \frac{\sin \omega}{\cos \omega}; \omega \text{ can only be } 0^\circ \text{ to } \pm 90^\circ \\ \sin \alpha &= \tan \omega \cotan K \\ \cos \alpha &= \frac{\cos v}{\cos \omega} \\ \tan \alpha &= \frac{\sin \alpha}{\cos \alpha} \\ \tan \Delta K &= \frac{\tan \alpha}{\sin \omega} \text{ (check for quadrant)} \\ K &= (K) - \Delta K + \frac{\pi}{2} \end{aligned}$$

V.8 [3] Compute the following auxiliaries:

$$\begin{aligned} A_1 &= - \cos \alpha \cos K + \sin \alpha \sin \omega \sin K \\ B_1 &= - \cos \omega \sin K \\ C_1 &= + \sin \alpha \cos K + \cos \alpha \sin \omega \sin K \end{aligned}$$

* [] Reference page (66).

$$\begin{aligned}
 D &= + \sin \alpha \cos \omega \\
 E &= + \sin \omega \\
 F &= + \cos \alpha \cos \omega \\
 A_2 &= - \cos \alpha \sin \kappa - \sin \alpha \sin \omega \cos \kappa \\
 B_2 &= + \cos \omega \cos \kappa \\
 C_2 &= + \sin \alpha \sin \kappa - \cos \alpha \sin \omega \cos \kappa
 \end{aligned}$$

VI [3] Compute:

$$\xi = \frac{(z_x - x_p) A_1 + (z_y - y_p) A_2 + c D}{(z_x - x_p) C_1 + (z_y - y_p) C_2 + c F} = u$$

$$\eta = \frac{(z_x - x_p) B_1 + (z_y - y_p) B_2 + c E}{(z_x - x_p) C_1 + (z_y - y_p) C_2 + c F} = v$$

VII [3]

1. $\tan K' = \frac{\eta}{\xi}$; (check for quadrant: $K = q + K'$); $A = K + \pi$
2. $\tan z_r = (\xi^2 + \eta^2)^{1/2}$

[1]

3. $r = r_m \frac{\bar{P}_a (1 + \beta t_o)}{\bar{P}_o (1 + \beta t_a)}$ where,

$$r_m = A'_o \tan z_r - A'_1 \tan z_r + A'_2 \tan z_r$$

$$4. z = z_r + r$$

VIII Compute: $\sin A, \cos A; \sin z, \cos z; \sin \phi, \cos \phi$

IX [4]

1. $\sin \delta = \cos z \sin \phi - \sin z \cos A \cos \phi$
2. $\cos \delta \cos H' = \cos z \cos \phi + \sin z \cos A \sin \phi$
3. $\cos \delta \sin H' = \sin z \sin A$
4. $\tan H' = \frac{\cos \delta \sin H'}{\cos \delta \cos H'}$, (check for quadrant)

X [4]

1. $\cos \delta = + (1 - \sin^2 \delta)^{1/2}; \tan \delta = \frac{\sin \delta}{\cos \delta}$, (δ can only be 0° to $\pm 90^\circ$)
2. $\alpha^* (\text{R.A.}) = \text{S.T. } -H'$ (if α^* is minus add 2π)

$$\text{XI [4]} \quad 1. \alpha_o = \alpha^* - \left[(f+f') + g \sin (\alpha^* + G) \tan \delta + \frac{h \sin (\alpha^* + H)}{\cos \delta} \right]$$

$$2. \delta_o = \delta - \left[g \cos (\alpha^* + G) + h \cos (\alpha^* + H) \sin \delta + i \cos \delta \right]$$

$$\text{XII [4]} \quad 1. \text{Ann. Var in R.A.} = m + n \sin \alpha_o \tan \delta_o$$

$$2. \text{Ann. Var in Decl.} = n \cos \alpha_o$$

$$\text{XIII [4]} \quad 1. \text{Sec. Var. in R.A.} = 100 \left[n^2 \sin \alpha_o \cos \alpha_o (1 + 2 \tan^2 \delta_o) \right.$$

$$\left. + mn \cos \alpha_o \tan \delta_o + \frac{dm}{dt} + \frac{dn}{dt} \sin \alpha_o \tan \delta_o \right]$$

$$2. \text{Sec. Var. in Decl.} = 100 \left[-n^2 \sin^2 \alpha_o \tan \delta_o - mn \sin \alpha_o + \frac{dn}{dt} \cos \alpha_o \right]$$

$$\text{XIV [4]} \quad 1. \alpha_{1950} = \alpha_o - \left[A_{V_\alpha} (\Delta T) + S_{V_\alpha} \frac{(\Delta T)^2}{200} \right]$$

$$2. \delta_{1950} = \delta_o - \left[A_{V_\delta} (\Delta T) + S_{V_\delta} \frac{(\Delta T)^2}{200} \right]$$

XV Convert and Print (2 cards)

1. R.A. (hours, minutes, seconds)

2. Decl. (degrees, minutes, seconds)

NOTE: Independent Star numbers G, H, g, h, i, (f + f') are taken from the "American Ephemeris and Nautical Almanac".

1.4 The Code [6]

"The One Address Floating Binary (OAFB) Code" devised by Lloyd Campbell, Computing Laboratory, was applied to this problem. Instructions on the use of the code may be found in BRL Report No. 997, October 1956, "Programming and Coding for Ordvac", by Tadeusz Leser and Michael Romanelli. This code has an internal computing capacity of 9 decimal digits.

1.4.1 Program

SEQUENCE	CODE	ADDRESS	ORDER	INDEX	DESCRIPTION
I.1	K40600	600	+ I.1		
.2	N00040		U OFB		Enter OFB
.3	K805K0		f+ B1		
.4	6002FS	601	fM I1		Set Format S10 - S2
.5	K805K1		f+ B2		
.6	6002FN	602	fM I2		
.7	0005K4		f+ W1		
.8	SN0262	603	U* IBMC		
.9	441003		ISA		
.10	000582	604	f+ C3	1	
.11	681593		fx C20	1	
.12	101593	605	fM C20	1	Read in constants
.13	I01604		IfC' I.10		
.14	000585	606	f+ C6	1	
.15	680596		fx C23		
.16	100596	607	fM C23		
.17	K805K2		f+ B3		
.18	6002FS	608	fM I1		Set Format S8 - S2
.19	K805K3		f+ B4		
.20	6002FN	609	fM I2		
I.21	0005K5		f+ W2		Read Parameter
.22	SN0262	60K	U* IBMC		Card
II.1	000563		f+ T4		
.2	4N0671	60S	fC' VI.1		
III.1	0005K5		f+ W2		Print Parameter
.2	SN02FJ	60N	U* IBMR		Card
IV.1	000562		f+ T3		
.2	100531	60J	fM E1		Set E1
.3	442002		ISA	2	
.4	441003	60F	ISA	1	
.5	0005K5		f+ W2		
.6	SN0262	60L	U* IBMC		Read Cards 2 and 3
.7	002564	610	f+ T5	2	+ Z → S30 (not used)
.8	10251J		fM S30	2	In Star Identification
.9	302517		OM S24	2	
.10	001560	611	f+ T1	1	Ø → S24
.11	681583		fx C4	1	Ø → S25 (not used in
.12	FN2517	612	f(+M S24	2	Star Identification)
.13	I01611		IfC' IV.10	1	
.14	I0260F	613	IfC IV.5	2	
.15	442004		ISA	2	
.16	441003	614	ISA	1	
.17	0005K5		f+ W2		
.18	SN0262	615	U* IBMC		
.19	302519		OM S26	2	S.T. → S26
.20	001560	616	f+ T1	1	S.T. → S27 (not used in Star Identification)

SEQUENCE	CODE	ADDRESS	ORDER	INDEX	DESCRIPTION
.21	681580		fx C1	1	
.22	FN2519	617	f(+)M S26	2	G → S28
.23	101616		I ^c C IV.21	1	
.24	102614	618	I ^c C IV.16	2	H → S29
.25	000518		f+ S28		
.26	100502	619	fM S3		G → S3
.27	00051N		f+ S29		
.28	100503	61K	fM S4		H → S4
.29	0005K5		f+ W2		
.30	SN0262	61S	U* IBMC		
.31	000560		f+ T1		
.32	680582	61N	fx C3		
.33	100504		fM S5		
.34	441002	61J	ISA	1	(f+f ⁰) → S5
.35	001561		f+ T2	1	
.36	680585	61F	fx C6		
.37	101505		fM S6	1	g → S6
.38	F0161F	61L	I ^c C IV.36	1	h → S7
.39	0005K5		f+ W2		
.40	SN0262	620	U* IBMC		
.41	000560	621	f+ T1		
.42	000560		f+ T1		Unused
.43	680585	622	fx C6		
.44	100507		fM S8		i → S8
.45	000561	623	f+ T2		
.46	100508		fM S9		τ → S9
.47	000562	624	f+ T3		
.48	100509		fM S10		ΔT → S10
.49	0005K5	625	f+ W2		
.50	SN0262		U* IBMC		
.51	000560	626	f+ T1		
.52	10050K		fM S11		P _a → S11
.53	000561	627	f+ T2		
.54	10050S		fM S12		
.55	000565	628	f+ T6		
.56	10050J		fM S14		H _a → S14
IV.57	NN04S6	629	fU IV.80		
.58	NN04S6		fU IV.80		Transfer to Compute \bar{P}_a
.59	001562	62K	f+ T3	1	
.60	681583		fx C4	1	Unused
.61	FN050N		f(+)M S13		
.62	F0162K	62S	I ^c C IV.59	1	
.63	0005K5		f+ W2		
.64	SN0262	62N	U* IBMC		
.65	441003		ISA		
.66	001560	62J	f+ T1		α or A → S15
.67	680597		fx C24		ω or ν → S16
.68	10150F	62F	fM S15		κ or (κ) → S17

SEQUENCE	CODE	ADDRESS	ORDER	INDEX	DESCRIPTION
.69	10162J	62L	IIC ¹ IV.66	1	
.70	000500		f+ S1		Unused
.71	0005K5	630	f+ W2		
.72	SN0262		U* IRMC		
.73	441003		ISA 1	1	
.74	001560	631	f+ T1	1	
.75	101511		FM S18	1	
.76	101631	632	IIC ¹ IV.74	1	
.77	000598		f+ C25		
.78	N40598	633	f(+) C25		
.79	100514		FM S21		$\pi \rightarrow S21$
IVa.1	000531	634	f+ NL		α, ω, μ system go to V.
.2	2N0730	635	FC ¹ V.8		$\alpha, \omega, (\kappa)$ system go
IVb.1	00050F		f+ S15		to IVb
.2	N40514	636	f(-) S21		
.3	100560		FM T1		K = A- π
.4	000560		f+ T1		
.5	SN0111	637	U* sin-Cos		
.6	100560		FM T1		
.7	000017	638	f+ O17		sin K
.8	100561		FM T2		cos K
.9	000500	639	f+ S1		Unused
.10	00050L		f+ S16		
.11	SN0111	63K	U* sin-Cos		
.12	100562	63S	FM T3		
.13	780017		f: O17		sin v
.14	100563	63W	FM T4		
.15	000017		f+ O17		tan v
.16	100564	63J	FM T5		
.17	000563		f+ T4		cos v
.18	680561	63F	fx T2		
.19	100565		FM T6		tan α
.20	000565		f+ T6		
.21	SN03N0	63L	U* arctan		
.22	000586		f+ C7		
.23	040568	640	f(-) T9		
.24	100568		FM T9		
.25	000568	641	f+ T9		Unused
.26	000568		f+ T9		
.27	SN01J2	642	U* \sqrt{N}		$\cos \omega = +$ $(1-\sin^2\omega)^{1/2}$
.28	100568		FM T9		
.29	000567	643	f+ T8		$\cos \omega \rightarrow T9$
.30	780568	644	f: T9		
.31	100565		FM T6		$\tan \omega \rightarrow T6$
.32	NN0739		fU IVb.71		
.33	NN0739	645	fU IVb.71		
.34	100568	646	FM T9		
.35	000565		f+ T6		Unused

SEQUENCE	CODE	ADDRESS	ORDER	INDEX	DESCRIPTION
IVb.36	000567		f+ T8		
.37	2N0652	647	fC IVb.58		
IVb.38	000514		f+ S21		
.39	100560	648	fM T1		$\pi = q$ (quadrant)
IVb.40	000562		f+ T3		
.41	780567	649	f; T8		
.42	100561	64K	fM T2		$\tan \Delta K' = \frac{\tan \alpha}{\sin \omega}$
.43	100561		fM T2		Unused
IVb.44	000561		f+ T2		
.45	SNO3N0	64S	U* arctan		
.46	N40560		f(+) T1		$\Delta K'$
.47	100561	64N	fM T2		$\Delta K = \Delta K' + q$
IVb.48	000510		f+ S17		
.49	040561	64J	f(-) T2		
.50	N40598		f(+) C25		
.51	100569	64F	fM T10		$K = (K) - \Delta K + \frac{\pi}{2}$
.52	000569		f+ T10		
.53	SNO1L1	64L	U* sin-Cos		
.54	100569		fM T10		
.55	000017	650	f+ O17		sin of angle in T10
.56	10056K		fM T11		
.57	NN065N	651	fU V.20		Cos of angle in T11
IVb.58	240567		f- T8		
.59	2N0654	652	fC IVb.62		
IVb.60	300560		OM T1		
.61	NN0646	653	fU IVb.40		$0 = q$ (quadrant)
IVb.62	000562		f+ T3		
.63	2N0657	654	fC IVb.68		
IVb.64	000598		f+ C25		
.65	N40514	655	f(+) S21		
.66	100561		fM T2		
.67	NN064J	656	fU IVb.48		$\pi + \frac{\pi}{2} = \Delta K$
IVb.68	000598		f+ C25		
.69	100561	657	fM T1		
.70	NN064J		fU IVb.48		
V.1	000500	658	f+ S1		
.2	00150F		f+ S15		
.3	SNO1L1	659	U* sin-Cos		Unused
.4	101565		fM T6		
.5	000017	65K	f+ O17		
.6	101566		fM T7		
.7	000500	658	f+ S1		
V.20	000565		f+ T6		
.21	680567	65N	fx T8		
.22	680569		fx T10		
.23	100570	65J	fM T17		A1 → T17
.24	240566		f- T7		
.25	68056K	65F	fx T11		
.26	FN0570		f(+M T17		
.27	240568	65L	f- T9		*

SEQUENCE	CODE	ADDRESS	ORDER	INDEX	DESCRIPTION
.28	680567	660	fx T10		
.29	100573		fM T20		B1 → T20
.30	000566	661	f+ T7		
.31	680567		fx T8		
.32	680569	662	fx T10		
.33	100576		fM T23		
.34	000565	663	f+ T6		
.35	68056K		fx T11		
.36	FN0576	664	f(+M T25		
.37	000565		f+ T6		C1 → T23
.38	680568	665	fx T9		
.39	100572		fM T20		
.40	000567	666	f+ T8		
.41	100575		fM T22		E → T22
.42	000566	667	f+ T7		
.43	680568		fx T9		
.44	100578	668	fM T25		
.45	240565		f- T6		F → T25
.46	680567	669	fx T8		
.47	68056K		fx T11		
.48	100571	66K	fM T18		
.49	240566		f- T7		
.50	680569	66S	fx T10		
.51	FN0571		f(+M T18		A2 → T18
.52	000568	66N	f+ T9		
.53	68056K		fx T11		
.54	100574	66J	fM T21		
.55	240566		f- T7		B2 → T21
.56	680567	66F	fx T8		
.57	68056K		fx T11		
.58	100577	66L	fM T24		
.59	000565		f+ T6		
.60	680569	670	fx T10		
.61	FN0577		f(+M T24		C2 → T24
.62	NN060K	671	fU I.21		
VI.1	000565		f+ T6		
.2	100545	672	fM P6		
.3	000560		f+ T1		
.4	040512	673	f(-) S19		$(x_p - x_p) \rightarrow T7$
.5	100566		fM T7		
.6	000561	674	f+ T2		
.7	040513		f(-) S20		
.8	100567	675	fM T8		
.9	000511		f+ S18		$(y_p - y_p) \rightarrow T8$
.10	100568	676	fM T9		
VI.11	443003		ISA	3	c → T9
.12	442000	677	ISA	2	
VI.13	441003		ISA	1	
.14	303560	678	OM T1	3	
VI.15	001566		f+ T7	1	

SEQUENCE	CODE	ADDRESS	ORDER	INDEX	DESCRIPTION
.16	682570	679	$f_x T17$	2	
.17	FN3560		$f(+)_M T1$	3	
.18	F82001	67K	IIA	2	
VI.19	L01678		$Ipc VI.15$	1	
VI.20	L036777	67S	$Ipc VI.14$	3	
VI.21	000560		$f+ T1$		
.22	780562	67N	$f_x^* T3$		
.23	100566		$f_M T7$		$\xi \rightarrow T7$
.24	000561	67J	$f+ T2$		
.25	780562		$f_x^* T3$		
.26	100567	67F	$f_M T8$		
VII.1	000586		$f+ T7$		$\eta \rightarrow T8$
.2	100530	67L	$f_M EO$		
VII.3	000566		$f+ T7$		Set EO(+)
.4	LN0686	680	$fC' VII.17$		
VII.5	000514		$f+ S21$		
.6	100560	681	$f_M T1$		
VII.7	000567		$f+ T8$		$\pi \rightarrow T1$
.8	780566	682	$f_x^* T7$		
.9	100561		$f_M T2$		$\tan K' = \frac{\pi}{\xi}$
.10	000561	683	$f+ T3$		
.11	SN03NO		$U^* \arctan$		
.12	N40560	684	$f(+) T1$		
.13	100562		$f_M T3$		$K = q + K'$, where q indicates the quadrant.
VIII.14	000530	685	$f+ EO$		
.15	2N068J		$fC VII.30$		
.16	NN06NO	686	$f_U X.1$		
VIII.17	240566		$f- T7$		
.18	LN0688	687	$fC' VII.21$		
VIII.19	300560		$OM T1$		
.20	LN0681	688	$f_U' VII.7$		
VIII.21	000567		$f+ T8$		
.22	LN0688	689	$fC' VII.27$		
VIII.23	000598		$f+ C25$		
.24	N40514	68K	$f(+) S21$		
.25	100562		$f_M T3$		$K = \pi + \frac{\pi}{2} \rightarrow T3$
.26	NN0685	68S	$f_U VII.14$		
VIII.27	000598		$f+ C25$		
.28	100562	68N	$f_M T3$		
.29	NN0685		$f_U VII.14$		$K = \frac{\pi}{2} \rightarrow T3$
VIII.30	000562	68J	$f+ T3$		
.31	N40514		$f(+) S21$		
.32	100560	68P	$f_M T1$		
.33	000517		$f+ S24$		$A = K + \pi$
.34	100500	68L	$f_M S1$		
.35	000519		$f+ S26$		$\emptyset \rightarrow S1$
.36	100501	690	$f_M S2$		
VIII.37	240586		$f- C7$		$S.T. \rightarrow S2$

SEQUENCE	CODES	ADDRESS	ORDER	INDEX	DESCRIPTION
.38	100550	691	fM NO		
.39	NN0692		fU VII.41		
VII.40	000566	692	f+ T7		
.41	680566	692	fx T7		
.42	100566	693	fM T7		
.43	000567		f+ T8		
.44	680567	694	fx T8		
.45	FN0566		f(+)M T7		
.46	000566	695	f+ T7		
.47	SN01J2		U* \sqrt{N}		$\tan z_r = + (\xi^2 + \eta^2)^{1/2}$
.48	100568	696	fM T9		
.49	NN06K0		fU VII.69		
.50	N40500	697	f(+) S1		
.51	10056F		fM T15		
.52	00056F	698	f+ T15		
.53	SN01L1		U* sin-Cos		
.54	000017	699	f+ O17		
.55	10056F		fM T15		
.56	000592	69K	f+ C19		
.57	68056F		fx T15		
.58	10056F		fM T15		
.59	00050J	69S	f+ S14		Unused
.60	78058S		f $\ddot{\cdot}$ C12		
.61	10056L	69N	fM T16		
.62	FN056L		f(+)M T16		
.63	000586	69J	f+ C7		
.64	04056F		f(-) T15		
.65	04056L	69F	f(-) T16		
.66	68050K		fx S11		
.67	10050K	69L	fM S11		
.68	000568	6K0	f+ T9		
.69	680568		fx T9		
.70	10056K	6K1	fM T11		
.71	680568		fx T9		
.72	10056S	6K2	fM T12		
.73	68058J		fx C14		
.74	10056N		fM T13		
.75	00056K	6K3	f+ T11		r → T11
.76	680568		fx T12		
.77	68058F	6K4	fx C15		
.78	04056N	6K5	f(-) T13		
.79	10056K		fM T11		
.80	000568	6K6	f+ T9		
.81	68058N		fx C13		
.82	FN056K	6K7	f(+)M T11		
.83	00050S		f+ S12		
.84	68058K	6K8	fx C11		
.85	N40586		f(+) C7		

SEQUENCE	CODE	ADDRESS	ORDER	INDEX	DESCRIPTION
.86	680588	6K9	fx C9		
.87	10056S		fM T12		
.88	000589	6KK	f+ C10		
.89	68058K		fx C11		
.90	N40586	6KS	f(+) C7		
.91	68050K		fx S11		
.92	780568	6KN	f+ T12		
.93	68056K		fx T11		
.94	10056K	6KJ	fM T11		
.95	000500		f+ S1		Unused
.96	000568	6KF	f+ T9		
.97	SN03N0		U* arctan		$z \rightarrow T2$
.98	100561	6KL	fM T2		
.99	N456K		f(+) T11		
VIII.1	100561		fM T2		
.2	000500	6S0	f+ T1		
.3	100562	6S1	fM T3	1	
.4	441003		ISA		
.5	001560	6S2	f+ T1		
.6	SN01L1		U* sin-Cos	1	
.7	101563	6S3	fM T4	1	
.8	000017		f+ O17	1	$\sin\text{-Cos } A, z, \phi$
.9	101566	6S4	fM T7	1	
.10	F016S2		IPC VIII.5	1	
IX.1	000500	6S5	f+ S1		Unused
.2	240564		f+ T5		
.3	680566	6S6	fx T7		
.4	680568		fx T9		
.5	100569	6S7	fM T10		
.6	000567		f+ T8		
.7	680565	6S8	fx T6		
.8	FN0569		f(+)M T10		$\sin \delta \rightarrow T10$
.9	000564	6S9	f+ T5		
.10	680566		fx T7		
.11	680565	6SK	fx T6		
.12	100566		fM T11		
.13	000567	6SS	f+ T8		
.14	680568		fx T9		
.15	FN0566	6SN	f(+)M T7		
.16	000564		f+ T5		$\cos \delta \cos H' \rightarrow T7$
.17	680563	6SJ	fx T4		
.18	100567		fM T8		$\cos \delta \sin H' \rightarrow T8$
.19	1N067L	6SF	fU ¹ VII.3		
.20	00056K		f+ T11		
.21	000567	6SL	fM T8		
.22	1N067L		fU ¹ VII.3		Unused
X.1	000569	6N0	f+ T10		
.2	680569		fx T10		
.3	100560	6N1	fM T1		
.4	000586		f+ C7		

SEQUENCE	CODE	ADDRESS	ORDER	INDEX	DESCRIPTION
.5	040560	6N2	f(-) T1		
.6	100560		fM T1		
.7	000560	6N3	f+ T1		
.8	SNO1J2		U* \sqrt{N}		
.9	10056K	6N4	fM T11		
.10	000569		f+ T10		
.11	78056K	6N5	f+ T11		
.12	100568		fM T12		
.13	000568	6N6	f+ T12		
.14	SNO3NO		U* arctan		
.15	10056N		fM T13		
.16	000501	6N7	f+ S2	*	$\delta \rightarrow T13$
.17	040562		f(-) T3		
.18	100562	6N8	fM T3		$\alpha^* = S.T. - H^* \rightarrow T3$
XI.1	000562		f+ T3		
.2	2N06NN	6N9	fc XI.7		
XI.3	000514		f+ S21		
.4	N40514	6NK	f(+) S21		
.5	N40562		f(+) T3		
.6	100562	6NS	fM T3		
XI.7	441002		ISA	1	
XI.8	000562	6NN	f+ T3	1	
.9	N41502	6NJ	f(+) S3	1	
.10	101563		fM T4	1	
.11	001563	6NF	f+ T4		
.12	SNO1L1		U* sin-Cos	1	
.13	101565	6NL	fM T6		
.14	000017		f+ O17		$\sin(\alpha^* + G) \rightarrow T6$
XI.15	101567	6J0	fM T8	1	
.16	I016NN		ifc XI.8	1	$\cos(\alpha^* + G) \rightarrow T8$
.17	NN06J3	6J1	fU XI.21		
.18	000500		f+ S1		
.19	000500	6J2	f+ S1		
.20	000500		f+ S1		Unused
XI.21	000566	6J3	f+ T7	*	
.22	78056K		f: T11		
.23	680506	6J4	fx S7		
.24	100560		fM T1		
.25	000505	6J5	f+ S6		
.26	680565		fx T6		
.27	680568	6J6	fx T12		
.28	FN0560		f(+)M T1		
.29	000504	6J7	f+ S5		
.30	FN0560		f(+)M T1		
.31	000562	6J8	f+ T3		
.32	040560		f(-) T1		
.33	100515	6J9	fM S22		
.34	000505		f+ S6	*	$\alpha_0 \rightarrow S22$
.35	680567	6JK	fx T8		
.36	100567		fM T2		

SEQUENCE	CODE	ADDRESS	ORDER	INDEX	DESCRIPTION
.37	000506	6JS	f+ S7		
.38	680568		fx T9		
.39	680569	6JN	fx T10		
.40	FN0561		f(+)M T2		
.41	000507	6JJ	f+ S8		
.42	68056K		fx T11		
.43	FN0561	6JT	f(+)M T2		
.44	00056N		f+ T13		
.45	040561	6JL	f(-) T2		
.46	100516		fm S23		
XII.1	000515		f+ S23		
.2	SN0111	6F0	UM sin-Cos		
.3	100562	6F1	fm T3		
.4	000017		f+ 017		sin $\alpha_0 \rightarrow T3$
.5	100563	6F2	fm T4		Cos $\alpha_0 \rightarrow T4$
.6	000500		f+ S1		Unused
.7	000516	6F3	f+ S23		
.8	SN0111		UM sin Cos		
.9	780017	6F4	f: 017		
.10	100564		fm T5		
.11	000594	6F5	f+ C21		
.12	680562		fx T3		
.13	680564	6F6	fx T5		
.14	N40593		f(+) C20		
.15	100560	6F7	fm T1		
.16	000594		f+ C21		*
.17	680563	6F8	fx T4		A _v $\alpha \rightarrow T2$
.18	100561		fm T2		
XIII.1	000564	6F9	f+ T5		
.2	680564		fx T5		
.3	100565	6FK	fm T6		
.4	FN0565		f(+)M T6		
.5	000586	6FS	f+ C7		
.6	FN0565		f(+)M T6		
.7	000594	6FN	f+ C21		
.8	680594		fx C21		
.9	680562	6FJ	fx T3		
.10	680563		fx T4		
.11	680565	6FF	fx T6		
.12	100565		fm T6		
.13	000593	6FL	f+ C20		
.14	680594		fx C21		
.15	680563	6LO	fx T4		
.16	680564		fx T5		
.17	FN0565	6LL	f(+)M T6		
.18	000595		f+ C22		
.19	FN0565	6L2	f(+)M T6		
.20	240596		f- C23		
.21	680562	6L3	fx T3		
.22	680564		fx T5		

SEQUENCE	CODE	ADDRESS	ORDER	INDEX	DESCRIPTION
.23	FN0565	6L4	f(+)M T6		
.24	000565		f+ T6		
.25	680599	6L5	fx C26		
.26	100565		fM T6		$s_v \alpha \rightarrow T6$
.27	240594	6L6	f- C21		
.28	680594		fx C21		
.29	100566	6L7	fM T7		
.30	000562		f+ T3		
.31	680562	6L8	fx T3		
.32	680566		fx T7		
.33	680564		fx T5		
.34	100566	6L9	fM T7		
.35	240593	6LK	f- C20		
.36	680594		fx C21		
.37	680562		fx T5		
.38	FN0566	6LS	f(+)M T7		
.39	000596	6LN	f+ C23		
.40	680563		fx T4		
.41	FN0566	6LJ	f(+)M T7		
.42	000566		f+ T7		
.43	680599	6LF	fx C26		
.44	100566		fM T7		$s_v \delta \rightarrow T7$
.45	NN0700	6LL	fU XIV.1		
.46	000500		f+ T1		Unused
XIV.1	000509	700	f+ S10		
.2	680509		fx S10		
.3	780587	701	f $\ddot{\cdot}$ C8		
.4	100562		fM T3		
.5	680565		fx T6		
.6	100565	702	fM T6		
.7	000509		f+ S10		
.8	680560	703	fx T1		
.9	FN0565	704	f(+)M T6		
.10	000515		f+ S22		
.11	040565	705	f(-) T6		
.12	100520		fM D1		$\alpha_{1950} \rightarrow D1$
.13	000562	706	f+ T5		
.14	680566		fx T7		
.15	100566	707	fM T7		
.16	000509		f+ S10		
.17	680561	708	fx T2		
.18	FN0566		f(+)M T7		
.19	000516	709	f+ S23		
.20	040566		f(-) T7		
.21	100521	70K	fM D2		$\delta_{1950} \rightarrow D2$
.22	000500		f+ S1		Unused
XV.1	441002	70S	ISA		
.2	F40520		f $\mid + \mid$ D1	1	
.3	780582	70N	f $\ddot{\cdot}$ C3		
.4	100546		fM P7		$ \alpha'_{1950} \rightarrow P7$

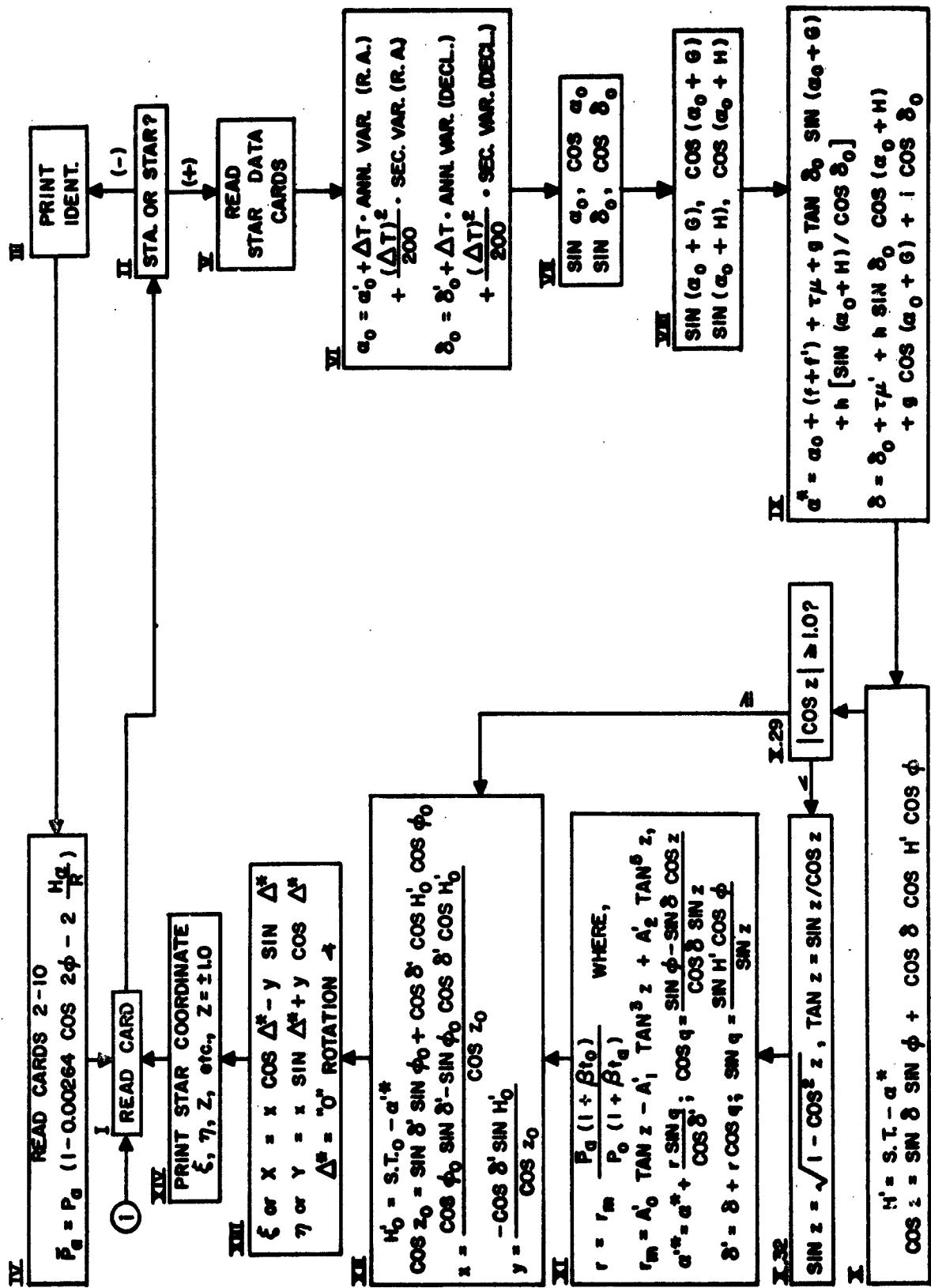
SEQUENCE	CODE	ADDRESS	ORDER	INDEX	DESCRIPTION
.5	F40521	70J	f+ D2		
.6	780585		f; C6		
.7	100547		fM P6		
XV.8	300543	70F	OM P4		
.9	300540		OM P1		
.10	300541	70L	OM P2		
XV.11	001546		f+ P7	1	
.12	04158L	710	f(-) C16	1	
.13	101546		fM P7		
.14	4N0713	711	fC' 64.1	1	
XV.15	N4158L		f(+) C16	1	
.16	101546	712	fM P7	1	
.17	1N0715		fU XV.22		
XV.18	000540	713	f+ P1		
.19	N40586		f(+) C7		
.20	100540	714	fM P1		
.21	NN0710		fU XV.11		
XV.22	001546	715	f+ P7	1	Convert α to hours, minutes, seconds
.23	040591		f(-) C18		and δ to degrees, minutes and seconds.
.24	101546	716	fM P7	1	
.25	2N0718		fC XV.27		
.26	NN071K	717	fU XV.31		
XV.27	000541		f+ P2		
.28	N40586	718	f(+) C7		
.29	100541		fM P2		
.30	1N0715	719	fU XV.22		
XV.31	N40591		f(+) C18		
.32	100542	71K	fM P3		
.33	000543		f+ P4		
.34	N40586	71S	f(+) C7		
.35	100543		fM P4		
.36	300544	71N	OM P5		
XV.37	001520		f+ D1	*	
.38	2N0720	71J	fC XV.43	1	
XV.39	442003		ISA	2	
XV.40	642540	71F	f- P1	2	Test for $-\alpha$ or $-\delta$.
.41	102540		fM P1	2	
.42	10271F	71L	fC' XV.40	2	
XV.43	000720		f+ W4		
.44	SN02FJ	720	U* IBMR		Print
XV.45	10170F	721	fC' XV.8		
.46	NN060K		fU I.21	1	Next Case
V.8	441003		ISA	1	
.9	442000	730	ISA	2	
.10	00250F		f+ S15		
.11	SN01L1	731	U* sin-cos	2	
.12	101565		fM T6		
.13	000017	732	f+ O17	1	
.14	101566		fM T7	1	
.15	F81001	733	IIA	1	

SEQUENCE	CODE	ADDRESS	ORDER	INDEX	DESCRIPTION
.16	F82001	734	IIA	2	
.17	F01731		IIC V.10	1	
.18	NN065N		IU V.20		
.19	NN065N	735	IU V.20		
VIIa.1	000561	736	f+ T2		
.2	SM03N0		U* arctan		
.3	100562	737	TM T3		
.4	N40560		f(+)- T1		Unused
.5	100562		TM T3		
.6	NN0685	738	IU VII.14		
IVb.71	000560	739	f+ T1		
.72	780561		f; T2		
.73	100560	73K	TM T1		
.74	000586		f+ C7		$\tan K \rightarrow T1$
.75	780560		f; T1		
.76	680565	73S	fx T6		
.77	100565		TM T6		
.78	000564	73N	f+ T5		$\sin \alpha \rightarrow T6$
.79	780568		f; T9		
.80	100566	73J	TM T7		$\cos \alpha \rightarrow T7$
.81	000565		f+ T6		
.82	780566	73F	f; T7		
.83	100562		TM T3		
.84	NN0647	73L	IU IVb.36		$\tan \alpha \rightarrow T3$

SEQUENCE	CODE	ADDRESS	ORDER	INDEX	DESCRIPTION
	K20K2K	5K0	B1		
	2K02K2				Format S10 - S2
	N00000	5K1	B2		
	000000				
	820828	5K2	B3		
	280282				Format S8 - S2
	820N00	5K3	B4		
	000000				
	05001K	5K4	W1		
	100580				Input C1 - C26
	060006	5K5	W2		
	100560				Input data and print identification
	060003	5K6	W3		
	100563				Unused
	060006	5K7	W4		
	100540				Print Output Data
	060006	5K8	W5		
	100511				Unused
	800003				
	2004S6				Key Word
IV.80	000517	4S6	f+ S24		
.81	N40517		f(+) S24		
.82	10050F	4S7	fM S15		
.83	10050F		fM S15		
.84	00050F	4S8	f+ S15		
.85	SN01L1		U* sin-cos		
.86	000017	4S9	f+ O17		
.87	10050F		fM S15		
.88	000592	4SK	f+ C19		
.89	68050F		fx S15		
.90	10050F	4SS	fM S15		
.91	00050J		f+ S14		
.92	78058S	4SN	f‡ C12		
.93	10050L		fM S16		
.94	FN050L	4SJ	f(+)M S16		
.95	000586		f+ C7		$\bar{P}_a \rightarrow S11$
.96	04050F	4SF	f(-) S15		
.97	04050L		f(-) S16		
.98	68050K	4SL	fx S11		
.99	10050K		fM S11		
.100	NN062N	4NO	fU IV.63		
.101	NN062N		fU IV.63		

2. COMPUTATION OF STANDARD COORDINATES

2.1 Flow Chart



2.2 Raster

	0	1	2	3	4	5	6	7	8	9	K	S	N	J	F	L	0	1	2	3	4	5	6	7	8	9	K	S	N	J	F	L
00																															01	
02																															03	
04																															05	
06																															07	
08																															09	
0K																															0K	
0N																															0J	
0F																															0L	
10																															11	
12																															13	
14																															15	
16																															17	
18																															19	
1K																															1K	
1N																															1J	
1F																															1L	
20																															21	
22																															23	
24																															25	
26																															27	
28																															29	
2K																															2K	
2N																															2J	
2F																															2L	
30																															31	
32																															33	
34																															35	
36																															37	
38																															39	
3K																															3K	
3N																															3J	
3F																															3L	
	0	1	2	3	4	5	6	7	8	9	K	S	N	J	F	L	0	1	2	3	4	5	6	7	8	9	K	S	N	J	F	L

	0	1	2	3	4	5	6	7	8	9	K	S	H	J	F	L	0	1	2	3	4	5	6	7	8	9	K	S	H	J	F	L
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2.3 Flow Chart Key

i, Program and refraction constants same as Star Identification.

I, II, and III Same as Star Identification

IV Input Station Data (Cards 2-10)

$$\text{COMPUTE: } [1] \bar{P}_a = P_a (1 - .00264 \cos 2\phi - 2 \frac{H_a}{R}) \quad (\bar{P}_a \text{ used in Fox XI})$$

V Input Star Data Cards

$$\text{VI [5]} \alpha_o = \alpha'_o + \Delta T \cdot \text{Annual Variation (R.A.)} + \frac{(\Delta T)^2}{200} \cdot \text{sec. var. (R.A.)}$$

$$\delta_o = \delta'_o + \Delta T \cdot \text{Annual Variation (Decl.)} + \frac{(\Delta T)^2}{200} \cdot \text{sec. var. (Decl.)}$$

VII 1. $\sin \alpha_o, \cos \alpha_o$

2. $\sin \delta_o, \cos \delta_o$

VIII 1. $\sin (\alpha_o + G)^*, \cos (\alpha_o + G)^*$

2. $\sin (\alpha_o + H)^*, \cos (\alpha_o + H)^*$

*If $(\alpha_o + G)$ or $(\alpha_o + H) \geq 24$ hours, the subroutine adjusts the angle.

$$\text{IX [5]} \alpha^* = \alpha_o + (f + f') + \tau \mu + g \tan \delta_o \sin (\alpha_o + G) + h [\sin (\alpha_o + H)/\cos \delta_o]$$

$$\delta = \delta_o + \tau \mu' + h \sin \delta_o \cos (\alpha_o + H) + g \cos (\alpha_o + G) + i \cos \delta_o$$

X [5] $H^* = S.T. - \alpha^*$

$$\cos z = \sin \delta \sin \phi + \cos \delta \cos H^* \cos \phi, \text{ If } |\cos z| \geq 1.0 \text{ go to XII}$$

$$\sin z = (1 - \cos^2 z)^{1/2}$$

$$\tan z = \sin z/\cos z$$

$$\text{XI [1]} r = r_m \frac{\bar{P}_a (1 + \beta t_o)}{\bar{P}_o (1 + \beta t_a)}, \text{ where, } r_m = A'_o \tan z - A'_1 \tan^3 z + A'_2 \tan^5 z$$

$$[4] \alpha'^* = \alpha^* + \frac{r \sin \alpha}{\cos \delta}; \cos q = \frac{\sin \phi - \sin \delta \cos z}{\cos \delta \sin z}$$

$$\delta' = \delta + r \cos q; \sin q = \frac{\sin H^* \cos \phi}{\sin z}$$

$$^{**} \text{XII [4]} \quad H'_0 = S.T._0 - \alpha^* ; \cos z_0 = \sin \delta' \sin \phi_0 + \cos \delta' \cos H'_0 \cos \phi_0$$

$$x = \frac{\cos \phi_0 \sin \delta' - \sin \phi_0 \cos \delta' \cos H'_0}{\cos z_0}$$

$$y = \frac{-\cos \delta' \sin H'_0}{\cos z_0}$$

$$\text{XIII } X = x \cos \Delta^* - y \sin \Delta^*$$

$$Y = x \sin \Delta^* + y \cos \Delta^*$$

when,

$\Delta^* = "0^\circ"$ (rotation angle positive from north to east), north = +x
east = +y

XIV Print card number 2 (Star Coordinate)

ξ , η , Z, wt, Boss no., pt. no., (Input for camera orientation code) where,

Z = ± 1.0 , X is ξ and Y is η .

Option prints:

ξ , η , Z, Boss no. type, point no.

**

In order to refer the Standard Coordinates to an arbitrarily chosen position of origin on the earth, a set of corresponding reference parameters ϕ_0 and S.T.₀ can be introduced. If the Standard Coordinates are to be computed in the local system in which the refraction was computed, the ϕ_0 and S.T.₀ values must be identical to the local values.

2.4 The Code [6]

2.4.1 Program

SEQUENCE	CODE	ADDRESS	ORDER	INDEX	DESCRIPTION
I.1	K40600	600	+ I.1		
.2	N00040		U OfB		Enter OfB
.3	K805K0		f+ B1		
.4	6002FS	601	FM I1		
.5	K805K1		f+ B2		Set Format S10 - S2
.6	6002FN	602	FM I2		
.7	0005K4		f+ W1		
.8	SN0262	603	U* IBMC		
.9	441003	604	ISA	1	
.10	000562		f+ C3		
.11	681593	605	fx C20	1	
.12	101593		fm C20	1	Read in Constants
.13	L01604		IfC' I.10		
.14	000585	606	f+ C6	1	
.15	680596		fx C23		
.16	100596	607	FM C23		
.17	K805K2		f+ B3		
.18	6002FS	608	FM I1		Set Format S8 - S2
.19	K805K3		f+ F4		
.20	6002FN	609	FM I2		
I.21	0005K5		f+ W2		
.22	SN0262	60K	U* IBMC		Read Parameter Card
II.1	000563		f+ T4		
.2	2N0430	60S	FC' VI.1		
III.1	0005K5		f+ W2		
.2	SN02FJ	60N	U* IBMR		Print Parameter Card
IV.1	000562		f+ T5		
.2	100531	60J	FM E1		
.3	442002		ISA	2	
.4	441003	60F	ISA	1	
.5	0005K5		f+ W2		
.6	SN0262	60L	U* IBMC		Read Cards 2 and 3
.7	002564		f+ T5	2	
.6	10251J	610	FM S30	2	± Z → S30
.9	302517	611	OM S24	2	
.10	001560		f+ T1	1	
.11	681583	612	fx C4	1	Ø → S24
.12	FN2517		f(+)-M S24	2	Øo → S25
.13	L01611	613	IfC' IV.10	1	
.14	L0260F		IfC' IV.5	2	
.15	442004	614	ISA	2	
.16	441003		ISA	1	
.17	0005K5	615	f+ W2		
.18	SN0262		U* IBMC		
.19	302519	616	OM S26	2	
.20	001560		f+ T1	1	

SEQUENCE	CODE	ADDRESS	ORDER	INDEX	DESCRIPTION
.21	681580		fx C1	1	S.T. → S26
.22	FN2519	617	f(+M S26	2	S.T.O → S27
.23	I01616		Ipc' IV.21	1	G → S28
.24	I02614	618	Ipc' IV.16	2	H → S29
IV.25	000518		f+ S28		
.26	100502	619	fM S3		G → S3
.27	00051N	61K	f+ S29		
.28	100503		fM S4		H → S4
.29	0005K5	61S	f+ W2		
.30	SN0262		U* IBMC		
.31	000560	61N	f+ T1		
.32	680582		fx C3		
.33	100504	61J	fM S5		
.34	441002		ISA	1	(f + f') → S5
.35	001561	61F	f+ T2		
.36	680585		fx C6	1	
.37	I01505	61L	fM S6	1	g → S6
.38	F0161F		Ipc' IV.36	1	h → S7
.39	0005K5	620	f+ W2		
.40	SN0262		U* IBMC		
.41	000560	621	f+ T1		
.42	000560		f+ T1		Unused
.43	680585	622	fx C6		
.44	100507		fM S8		i → S8
.45	000561	623	f+ T2		
.46	100508		fM S9		τ → S9
.47	000562	624	f+ T3		
.48	100509		fM S10		ΔT → S10
.49	0005K5	625	f+ W2		
.50	SN0262		U* IBMC		
.51	000560	626	f+ T1		
.52	10050K		fM S11		P _a → S11
.53	000561	627	f+ T2		
.54	10050S		fM S12		
.55	000565	628	f+ T6		
.56	10050J		fM S14		H _a → S14
.57	441003		ISA		
.58	30050N	629	OM S13	1	
.59	001562		f+ T3		
.60	681583	62K	fx C4	1	Rotation angle
.61	FN050N		f(+M S13		
.62	F0162K	62S	Ipc' IV.59	1	
.63	NN04S6		fU IV.80		
.64	NN04S6	62N	fU IV.80		Unused
.65					62J - 62L available
.66		62J			
	800003				Key Word
	200430				

SEQUENCE	CODE	ADDRESS	ORDER	INDEX	DESCRIPTION
V.1	000565	430	T+ T6		
.2	100545		TM P6		Pt No.
.3	000564	431	T+ T5		
.4	100544		TM P5		Boss No.
.5	300543		OM P4		
.6	300543	432	OM P4		Unused
.7	00051J	433	f+ S50		
.8	100542		TM P3		+ Z
.9	000560		f+ T1		
.10	680580	434	fx C1		
.11	100520		TM D1		
.12	000561	435	f+ T2		
.13	680581		fx C2		
.14	N40520	436	f(+) D1		α^i_0
.15	100520		TM D1		
.16	000562	437	f+ T3		
.17	680582		fx C3		
.18	N40520	438	f(+) D1		
.19	100520	439	TM D1		
.20	100520		TM D1		Unused
.21	0005K5		f+ W2		
.22	SN0262	43K	U* IBMC		
.23	000560	43S	f+ T1		
.24	680582		fx C3		
.25	100521	43N	TM D2		A _v
.26	000560		f+ T2		α
.27	680582	43J	fx C3		S _v
.28	100522		TM D3		δ
.29	000562	43F	f+ T3		
.30	680582		fx C3		
.31	100523	43L	TM D4		μ
.32	100523		TM D4		Unused
V.33	0005K5	440	f+ W2		
.34	SN0262		U* IBMC		
.35	000560	441	f+ T1		
.36	680583		fx C4		
.37	100524	442	TM D5		
.38	000561		f+ T2		δ^i_0
.39	680584	443	fx C5		
.40	N40524		f(+) D5		
.41	100524	444	TM D5		
.42	000562		f+ T3		
.43	680585	445	fx C6		
.44	N40524		f(+) D5		
.45	100524	446	TM D5		
.46	100524		TM D5		Unused
.47	0005K5	447	f+ W2		
.48	SN0262		U* IBMC		
.49	000560	448	f+ T1		
.50	680585		fx C6		

SEQUENCE	CODE	ADDRESS	ORDER	INDEX	DESCRIPTION
.51	100525	449	fM D6		
.52	000561		f+ T2		$A_v \alpha$
.53	680585	44K	fx C6		
.54	100526		fM D7		$S_v \delta$
.55	000562	44S	f+ T3		
.56	680585		fx C6		
.57	100527	44N	fM D8		μ^*
.58	100527		fM D8		Unused
VI.1	000509	44J	f+ S10		
.2	680509		fx S10		
.3	780587	44F	f+ C8		
.4	100560		fM T1		
.5	680522	44L	fx D5		
.6	100522		fM D5		
.7	000560	450	f+ T1		
.8	680526		fx D7		
.9	100526	451	fM D7		
.10	000509		f+ S10		
.11	680521	452	fx D2		
.12	N40522		f(+) D3		
.13	N40520	453	f(+) D1		
.14	100520		fM D1		$\alpha_o \rightarrow D1$
.15	000509	454	f+ S10		
.16	680525		fx D6		
.17	N40526	455	f(+) D7		
.18	N40524		f(+) D5		
.19	100524	456	fM D5		$\delta_o \rightarrow D5$
.20	100524		fM D5		Unused
VII.1	000520	457	f+ D1		
.2	SNO111		U* sin-cos		
.3	100560	458	fM T1		
.4	000017		f+ O17		$\sin \alpha_o$
.5	100561	459	fM T2		$\cos \alpha_o$
.6	100561		fM T2		Unused
.7	000524	45K	f+ D5		
.8	SNO111		U* sin-cos		
.9	100562	45S	fM T3		
.10	000017		f+ O17		$\sin \delta_o$
.11	100563	45N	fM T4		
.12	000520		f+ D1		$\cos \delta_o$
VIII.1	N40502	45J	f(+) S3		$(\alpha_o + G)$
.2	100564		fM T5		
.3	000564	45P	f+ T5		
.4	SNO111		U* sin-cos		
.5	100564	45L	fM T5		
.6	000017		f+ O17		$\sin (\alpha_o + G)$
.7	100565	460	fM T6		
.8	000520		f+ D1		$\cos (\alpha_o + G)$
.9	N40503	461	f(+) S4		$(\alpha_o + H)$
.10	100566		fM T7		

SEQUENCE	CODE	ADDRESS	ORDER	INDEX	DESCRIPTION
.11	000566	462	f+ T7		
.12	SN0111		U* sin-cos		
.13	100566	463	fM T7		
.14	000017		f+ O17		sin ($\alpha_0 + H$)
.15	100567	464	fM T8		sin ($\alpha_0 + H$)
.16	000562		f+ T3		
IX.1	780563	465	f+ T4		
.2	680564		fx T5		
.3	680505	466	fx S6		
.4	N40520		f(+) D1		
.5	N40504	467	f(+) S5		
.6	100520		fM D1		
.7	000508	468	f+ S9		
.8	680523		fx D4		$\alpha^* \rightarrow D1$
.9	N40520	469	f(+) D1		
.10	100520		fM D1		
.11	000566	46K	f+ T7		
.12	780563		f+ T4		
.13	680506	46S	fx S7		
.14	N40520		f(+) D1		
.15	100520	46N	fM D1		
.16	000508		f+ S9		
.17	680527	46J	fx D8		
.18	N40524		f(+) D5		
.19	100524	46F	fM D5		
.20	000567		f+ T8		
.21	680562	46L	fx T3		
.22	680506		fx S7		$\delta \rightarrow D5$
IX.23	N40524	470	f(+) D5		
.24	100524		fM D5		
.25	000565	471	f+ T6		
.26	680505		fx S6		
.27	N40524	472	f(+) D5		
.28	100524		fM D5		
.29	000563	473	f+ T4		
.30	680507		fx S8		
.31	N40524	474	f(+) D5		
.32	100524		fM D5		
X.0	000524	475	f+ D5		
.1	000519		f+ S26		Unused
.2	040520	476	f(+) D1		$H^* = S.T. - \alpha^*$
.3	100560		fM T1		
.4	000560	477	f+ T1		
.5	SN0111		U* sin-cos		
.6	100560	478	fM T1		sin H*
.7	000017		f+ O17		
.8	100561	479	fM T2		Cos H*
.9	100561		fM T2		Unused
.10	000524	47K	f+ D5		
.11	SN0111		U* sin-cos		

SEQUENCE	CODE	ADDRESS	ORDER	INDEX	DESCRIPTION
.12	100562	47S	fM T3		
.13	000017		f+ 017		sin θ
.14	100563	47N	fM T4		Cos θ
.15	100563		fM T4		Unused
.16	000517		f+ S24		
.17	SN0111	47J	• U* sin-Cos		
.18	100564	47F	fM T5		sin ϕ
.19	000017		f+ 017		
.20	100565	47L	fM T6		Cos ϕ
.21	100565		fM T6		Unused
X.22	000563	480	f+ T4		
.23	680561		fx T2		
.24	680565	481	fx T6		
.25	100566		fM T7		
.26	000562	482	f+ T3		
.27	680564		fx T5		
.28	F10566	483	f (+) M T7		Cos z
X.29	F40566		f (+) T7		
.30	040586	484	f (-) C7		Test: Cos z > 1.0?
.31	4N04J0		fC' XII.1		↓ Go to Box XII
X.32	000566	485	f+ T7		
.33	680566		fx T7		
.34	100567	486	fM T8		
.35	000586		f+ C7		
.36	040567	487	f (-) T8		
.37	100567		fM T8		
.38	000567	488	f+ T8		
.39	SN01J2		U* \sqrt{N}		
.40	100567	489	fM T8		
.41	780566		f+ T7		sin z
.42	100568	48K	fM T9		tan z
.43	NN048N		fU XI.1		Transfer to Box XI
.44	100569		fM T10		
.45	100569	48S	fM T10		↓ Unused
XI.1	000568	48N	f+ T9		
.2	680568		fx T9		
.3	10056K		fM T11		
.4	680568	48J	fx T9		
.5	100568		fM T12		
.6	68058J	48F	fx C14		
.7	10056N	48L	fM T13		
.8	00056K		f+ T11		
XI.9	00056K	490	f+ T11		
.10	68056S		fx T12		
.11	68058F	491	fx C15		
.12	04056N		f (-) T13		
.13	10056K	492	fM T11		
.14	000568		f+ T9		
.15	68058N	493	fx C13		
.16	N4056K		f (+) T11		

SEQUENCE	CODE	ADDRESS	ORDER	INDEX	DESCRIPTION
.17	10056K	494	fM T11		
.18	00050S		f+ S12		
.19	68058K	495	fx C11		
.20	N40586		f(+) C7		
.21	680588	496	fx C9		
.22	10056S		fM T12		
.23	000589	497	f+ C10		
.24	68058K		fx C11		r → T11
.25	N40586	498	f(+) C7		
.26	68050K		fx S11		
.27	78056S	499	f- T12		
.28	68056K		fx T11		
.29	10056K	49K	fM T11	↓	
.30	000567		f+ T8	↑	
.31	680563	49S	fx T4		
.32	10056S		fM T12		
.33	240566	49N	f- T7		
.34	680562		fx T3		Cos q → T12
.35	N40564	49J	f(+) T5		
.36	78056S		f- T12		
.37	10056S	49F	fM T12	✗	
.38	000560		f+ T1	✗	
.39	680565	49L	fx T6		
.40	780567		f- T8		sin q → T13
.41	10056N	4K0	fM T13		
.42	00056K		f+ T11	✗	
.43	68056S		fx T12		
.44	FN0524	4K1	f(+)M D5		8'
.45	NN04NN	4K2	fU XI.55		
.46	NN04NN		fU XI.55	✗	
.47	68056S		fx T12		
.48	FN0524	4K3	f(+)M D5		
.49	NN04NN	4K4	fU XI.55		
.50	NN04NN		fU XI.55		Unused
.51	780567		f- T8		
.52	68056S	4K5	fx T12		
.53	100561		fM T2		
.54	100561	4K6	fM T2	✗	
XIII.1	00050N		f+ S13		
.2	SN01L1	4K7	U* sin-Cos		
.3	100562		fM T3		
.4	000017	4K8	f+ O17		
.5	100563		fM T4		
.6	000562	4K9	f+ T3		
.7	680561		fx T2		
.8	100564	4KK	fM T5		ξ → P1
.9	00056J		f+ T14		
.10	680563	4KS	fx T4		
.11	040564		f(+) T5		
.12	100540	4KN	fM P1	↓	

SEQUENCE	CODE	ADDRESS	ORDER	INDEX	DESCRIPTION
.13	000563	4KJ	f+ T4		
.14	680561		fx T2		
.15	100564	4KF	fM T5		
.16	00056J		f+ T14		η → P2
.17	680562	4KL	fx T3		
.18	N40564		f(+) T5		
XIII.19	100541	4S0	fM P2		
.20	100541		fM P2		↓ Unused
.21	0005K7	4S1	f+ W4		
.22	SN02FJ		U* IBMR		
.23	NN060K	4S2	fU I.21		
.24	NN060K		fU I.21		
.25		4S3			4S3 - 4S5 1s
.26					available
	800003				
	2004S6				Key Word
IV.80	000517	4S6	f+ S14		
.81	N40517		f(+) S14		
.82	10050F	4S7	fM S15		
.83	10050F		fM S15		
.84	00050F	4S8	f+ S15		
.85	SN01L1		U* sin-Cos		
.86	000017	4S9	f+ O17		
.87	10050F		fM S15		
.88	000592	4SK	f+ C19		
.89	68050F		fx S15		Pa → S11
.90	10050F	4SS	fM S15		
.91	00050J		f+ S14		
.92	78058S	4SN	f‡ C12		
.93	10050L		fM T16		
.94	FN050L	4SJ	f(+)M T16		
.95	000586		f+ C7		
.96	04050F	4SF	f(-) T15		
.97	04050L		f(-) T16		
.98	68050K	4SL	fx S11		
.99	10050K		fM S11		
.53	NN060K	4NO	fU I.21		
.54	NN060K		fU I.21		
	800003				
	2004NN				
XI.55	000524	4NN	f+ D5		
.56	SN01L1		U* sin-Cos		
.57	100562	4NJ	fM T5		sin 8°
.58	000017		f+ O17		
.59	100563	4NF	fM T4		
.60	00056K		f+ T11		↑ Cos 8°
.61	68056N	4NL	fx T13		
.62	780563		f‡ T4		
.63	FN0520	4JO	f(+)M D1		
XII.1	00051K		f+ S27	*	α**→ D1

SEQUENCE	CODE	ADDRESS	ORDER	INDEX	DESCRIPTION
	K20R2K				
	2K02K2	5K0	B1		Format S10 - S2
	100000				
	000000	5K1	B2		
	820828				
	280282	5K2	B3		Format S8 - S2
	820100				
	000000	5K3	B4		
	05001K				
	100580	5K4	W1		Input C1 - C26
	060006				
	100560	5K5	W2		Input data and print identification
	060003				
	100563	5K6	W3		Unused
	060006				
	100540	5K7	W4		Print Output data
	060006				
	100511	5K8	W5		Unused
					Option
	800003				
	2004F2				
	000544				
	100543	4F2	f+ P5		Boss number
			fM P4		
	000586				
	N40586	4F3	f+ C7		
			f(+) C7		
	100544				
	NN04K7	4F4	fM P5		Point type
	800001				
	000LLL				

3. DATA

3.1 Format

Each datum number is identified as a field for input and output purposes using standard floating decimal (88-82), coefficient (sign and 8 digits) with exponent (sign and 2 digits). The sign is punched in a separate column using zero or "no punch" for plus and "X" punch for minus.

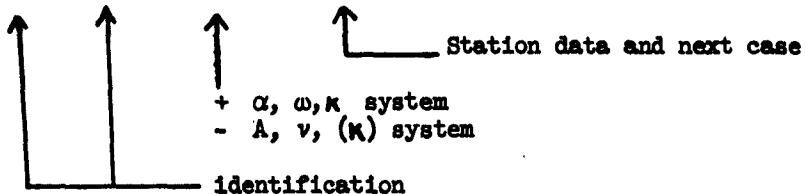
3.2 Input

The first 10 cards of the input for the "Star Identification" and "Computation of Standard Coordinates" for Stars are identical. However, the data on cards 3 and 5 (ϕ_0 and S.T.₀) are not used in the "Star Identification Computation". They are included in order that the first 10 cards of the input data can be used for both "Star Identification" and "Computation of Standard Coordinates". Cards 11 and 12 are additional for Star Identification only. Field 4 must be a non-zero negative number on card 1.

The first 10 cards contain the following information:

Card 1 (Parameter Card)

id. id. ±0.1* -0.1



Card 2

Fields 1-3, ϕ in degrees, minutes and seconds.

Field 4, zero

Field 5, ± Z

Field 6, immaterial

* This signal only applies to "Star Identification" and maybe any non-zero positive or negative number.

Card 3

Fields 1-3, ϕ_0 , in degrees, minutes and seconds.

Fields 4-6, immaterial.

Card 4

Fields 1-3, S.T. in hours, minutes and seconds.

Fields 4-6, immaterial.

Card 5

Fields 1-3, S.T. ϕ_0 , in hours, minutes and seconds.

Fields 4-6 immaterial.

Card 6

Fields 1-3 "G" in hours, minutes and seconds.

Fields 4-6, immaterial.

Card 7

Fields 1-3, "H" in hours, minutes and seconds.

Fields 4-6, immaterial.

Card 8

Field 1 ($f+f'$) in seconds of time.

Fields 2-3 "g" and "h" in seconds of arc.

Fields 4-6, immaterial.

Card 9

Field 1, "i" in seconds of arc.

Field 2, " τ " (part of year).

Field 3, " ΔT " number of years since 1950 (as the information in the Boss Catalogue dates from 1950).

Card 10

Field 1, " P_a " (mm) pressure at station.

Field 2, " t_a " (centigrade) temperature at station.

Fields 3-5, " Δ " angle (rotation angle) in degrees, minutes and seconds.

Field 6, " H_a " (meters) height of station.

Card 11

Fields 1-3, α, ω, κ in grads, or A, v, κ in grads.

Fields 4-6, immaterial.

Card 12

Fields 1-3, x_p , y_p (meters), respectively.

Fields 4-6, immaterial.

Star data for Computation of Standard Coordinates consists of 4 cards from Boss Catalogue as follows:

Card 1

Fields 1-3, R.A. (right ascension) in hours, minutes, and seconds.

Field 4, immaterial.

Fields 5-6, Boss number and point number.

Card 2

Field 1, Annular variation.

Field 2, Secular variation.

Field 3, μ

Field 4, immaterial.

Fields 5-6, Boss number and point number, respectively.

Card 3

Fields 1-3, Declination in degrees, minutes and seconds.

Field 4, immaterial.

Fields 5-6, Boss number and point number, respectively.

Card 4

Field 1, Annular variation.

Field 2, Secular variation.

Field 3, μ^*

Field 4, immaterial.

Fields 5-6, Boss number and point number, respectively.

Point data (measurements) used for Star identification consists of one card per point as follows:

Card 1

Fields 1-2, ℓ_x , ℓ_y (from comparator)

Fields 3-5, immaterial for this program. It is suggested that the Output Cards from the Stereo Comparator code be used for the Input of Star Identification and Camera Orientation.

Field 6, point number.

3.3 Output

1. Star Identification consists of 2 cards. Card 1 contains α (hours, minutes, seconds) and card 2 contains δ (degrees, minutes, seconds). Field 6 contains point number and fields 4-5 are immaterial.
2. Computation of Standard Coordinates consists of 1 card as follows:
 $\xi, \eta, Z = + 1.0, \text{ zero, Boss No. and Point No.}$
3. Option prints:
 $\xi, \eta, Z = + 1.0, \text{ Boss No., type, and point No.}$

A. Roberta Wooten

A. ROBERTA WOOTEN

4. SAMPLES

4.1 Star Identification

4.1.1 Layout ($\mathbf{g}, \emptyset, \mathbf{k}$):

4.1.2 Output:

4-3-3 Import (A; v; (x);):

Outlines

4.2 Computation of Standard Coordinates

2.1 Input:

•222000000	31
•58	02
•56	32
•16	02
•16	02
•1	01
•3	01
•757	01
•682	01
•77353	03
•14	02
•1717	00
•74	02
•14721	02
•19600900	02
•33051000	01
•10000000	02
•76570000	01

4.2.2 Output:

ed33030600	61	22030600	32	13030600	32	-10030600	32	-60030600	32
ed292346	60	-22030600	33	13030600	33	-10030600	33	-60030600	33
ed2842376	61	220306268	33	130306268	34	-100306268	34	-600306268	34

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