HANDBOOK OF

OPERATING INSTRUCTIONS

FOR

COMPUTER - AIR NAVIGATION, CELESTIAL AZIMUTH
AIR FORCE TYPES CP-300/U, CPU-50A/P

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COMPUTER - AIR NAVIGATION, CELESTIAL AZIMUTH
AF TYPES CP-300/U, CPU-50A/P

1. DESCRIPTION. The Celestial Computer gives positions of stars included in both the American and British Almanacs and may be used for identifying or locating stars. It consists of a star base with the Northern Sky on one side of the base and the Southern Sky on the other side of the base, An East - West Longitude Scale, eighteen (18) removable discs with a polar stereographic grid projection on the sphere with designed latitude in increments of 10^{o}, a set of instructions and a plastic case.

2. IDENTIFICATION OF CELESTIAL BODY.

NOTE

For use of the CPU-50A/P as a star finder where GAM-77 field-of-view is not required, remove rivet from large overlay (not computer body) and discard small overlay.

Knowing the GHA (ARIES) and the dead reckoning latitude and longitude, you can obtain the following:

1. LHA (ARIES)
2. Z_n (Celestial Body)
3. h_c (Celestial Body)
4. SHA (Celestial Body)
5. Declination (Celestial Body)
6. LHA (Celestial Body)

NOTE

Whenever any of the above terms are used in the following instructions, it is to be assumed that they reference a celestial body unless otherwise stated.

3. INSTRUCTIONS FOR USE WITH GAM-77. The astrotracker field-of-view computer used to determine optimum stars for utilization by the KS-120 astrotracker of the GAM 77 missile.

Step No. 1 -- Preliminary celestial data (star azimuth and altitude) is determined by utilizing Star Finding Portion of the Computer.

Step No. 2 -- Each of the selected stars is located on the base plate of the computer with soft pencil or crayon.

Step No. 3 -- Rotate overlay until arrowhead inscribed on it intersects true heading (azimuth lines) on latitude template grid.

Step No. 4 -- The following information is determined visually for each star:

1. The star can not be observed by either astrotracker.
2. The star can be observed by one astrotracker.
3. The star can be observed by both astrotrackers.

Sample Problem:

Date: 9-18-59. Altitude: 40, 000 feet.
Time: 0400 GMT Ground Speed: 460 knots
Present Position: Latitude -- 34 degrees, 18 minutes North.
Longitude -- 118 degrees, 26 minutes West.
A/C True Heading -- 067 degrees.
GHAΥ -- 56 degrees, 20 minutes. LHAΥ -- 297 degrees, 54 minutes.

Step No. 1 -- Utilizing the Star Finder, the following stars are tentatively selected:

NAME	AZIMUTH (^{O})	ALTITUDE
1. Hamal	068	11
2. Fomalhaut	139	12
3. Altair	182	63
4. Antares	226	12
5. Vega	291	74
6. Dubhe	339	14

Step No. 2 -- Locate the six (6) stars on the base plate

Step No. 3 -- Rotate the top plate to the aircraft's true heading.

Step No. 4 -- The following information is determined by visual inspection:

Star No. 1 -- R. B. --001 degrees, Altitude--11 degrees visible to both astrotrackers.
Star No. 2 -- R. B. --072 degrees, Altitude--12 degrees visible only to astrotracker No. 2.
Star No. 3 -- R. B. --115 degrees, Altitude--63 degrees visible to both astrotrackers.
Star No. 4 -- Is not visible to either astrotracker.
Star No. 5 -- R. B. --224 degrees, Altitude--74 degrees visible to both astrotrackers.
Star No. 6 -- R. B. --272 degrees, Altitude--14 degrees visible only to astrotracker No. 1.

Conclusions:

1. Star No. 1 is optimum
2. Star No. 2 is visible to ASM No. 2 only.
3. Star No. 6 is visible to ASM No. 1 only.
4. Stars No. 3 and No. 5 are visible; their high elevation is not conducive to optimum azimuth determination and platform alignment.

4. INSTRUCTIONS FOR USE OF SUN DECLINATION CURVE (Ecliptic)
To Determine Trackability of the Sun

Step No. 1 -- Rotate appropriate azimuth-altitude template to align LHA arrow with LHA of Aries.

Step No. 2 -- Rotate Edwards Overlay until arrowhead inscribed on it intersects true heading on latitude template grid.

Step No. 3 -- Inspect sector of declination curve (ecliptic) for the month. (Interpolate for day.) If the portion of the appropriate sector appears within the clear area or the lightly shaded area of the overlay, the Sun can be tracked.

Sample Problem:

Date 9-9-60 -- Present Position: 35-00N 85-40W--Time:1500 GMT--Acft True Heading: 120° --GHA Aries: 213-40--LHA Aries 128°. Inspection of September segment for portion approximately representing the 9th day reveals the Sun to be within the field of view of both astro trackers. Reference to the altitude/azimuth template incidentally reveals an altitude of slightly over 40 degrees, and a rough azimuth of 120 degrees.

5. INSTRUCTIONS TO PLOT ADDITIONAL CELESTIAL BODIES.

a. Stars, Planets and the Moon are plotted by the following coordinates:

(1) 360° - SHA
(2) Declination

b. The outer edge of the North and South Pole Displays (Moveable Base) **are graduated** in half degree increments to 360° - SHA.

(1) Find SHA of stars in Air Almanac and solve for 360° - SHA.

(2) For Moon and Planets, 360^{o} -SHA = GHA (ARIES) - GHA. (If 360^{o} -SHA is negative in value, add 360^{o} to reverse the sign.) Since the Moon and Planets continually change apparent positions relative to the fixed stars, the positions have to be plotted for a particular time of observation. GHA (ARIES) and GHA are found in the Air Almanac.

c. Draw a line from 360^{o} -SHA (obtained in Step 1 or 2 above) from the outer periphery of the star base to the pole.

d. Obtain the declination of the celestial body from the Air Almanac. Using dividers, measure this value on the altitude scale of any removable disc. Then lay off this distance along the 360^{o} -SHA line using the celestial equator as a starting reference. If the Southern Sky side of the computer is being used, Southern declination will be plotted within the celestial equator circle and Northern declination outside the celestial equator circle and vice versa when the Northern Sky side is used.

e. By reversing this procedure, the declination and SHA of a plotted body may be found.

6. IDENTIFICATION OF A CELESTIAL BODY.

a. Select removable disc nearest the D. R. latitude.

b. To obtain correct latitude:

(1) With proper side up, insert removable disc under cursor by aligning slot in disc with pivot.

(2) Slide disc into position over star base.

(3) Align small horizontal line on removable disc, located adjacent to center line of cursor, with θ^{o} mark on correction scale on cursor. This is the correct position for the designated latitude on the removable disc.

(4) Add or subtract the degree marks on the cursor to the designated latitude to obtain the correct D. R. latitude.

c. For any G. M. T., take the GHA (ARIES) from the Air Almanac and add or subtract the D. R. Longitude to find LHA (ARIES). LHA(ARIES) = GHA (ARIES) $^{+E\ Longitude}_{-W\ Longitude}$. If LHA (ARIES) is negative in value, add 360^{o} to reverse the sign. Rotate removable disc to bring the 0^{o} to 180^{o} Meridian Arrow to LHA (ARIES).

d. For the specified time, the arrow over the LHA (ARIES) is the observer's local meridian. Stars in the visible sky whose altitude range from -10^{o} to $+90^{o}$ are then located within the grid lines of the removable disc.

e. The Altitude and Azimuth of any celestial body within the grid can now be found.

EXAMPLE: Find - Altitude and Azimuth of SPICA.

Given - 21 Mar 61 - D.R. Latitude 40^{o}N
D.R. Longitude 75^{o} 34'W
G.M.T. $7^{h}00^{m}00^{s}$

G.M.T.	$7^{h}00^{m}00^{s}$
GHA (ARIES)	283^{o} 34'
Long	75^{o} 34'W
LHA (ARIES)	208^{o} 00'

Correct Latitude of 45^{o}N disc to 40^{o}. Place 0^{o} to 180^{o} Meridian Arrow to 208^{o}. Read Alt. = 38^{o} and $Z_{n} = 190^{o}$.

f. Alternate method for finding LHA (ARIES). For any given G.M.T., place GHA (ARIES) on inner scale of star base directly over 0^{o} on the outer scale (East-West Longitude Scale). Rotate the removable disc to bring 0^{o} to 180^{o} Meridian Arrow to the D.R. Longitude on the outerscale. The LHA (ARIES) will be found under the 0^{o}-180^{o} Meridian Arrow on the inner scale of the star base.