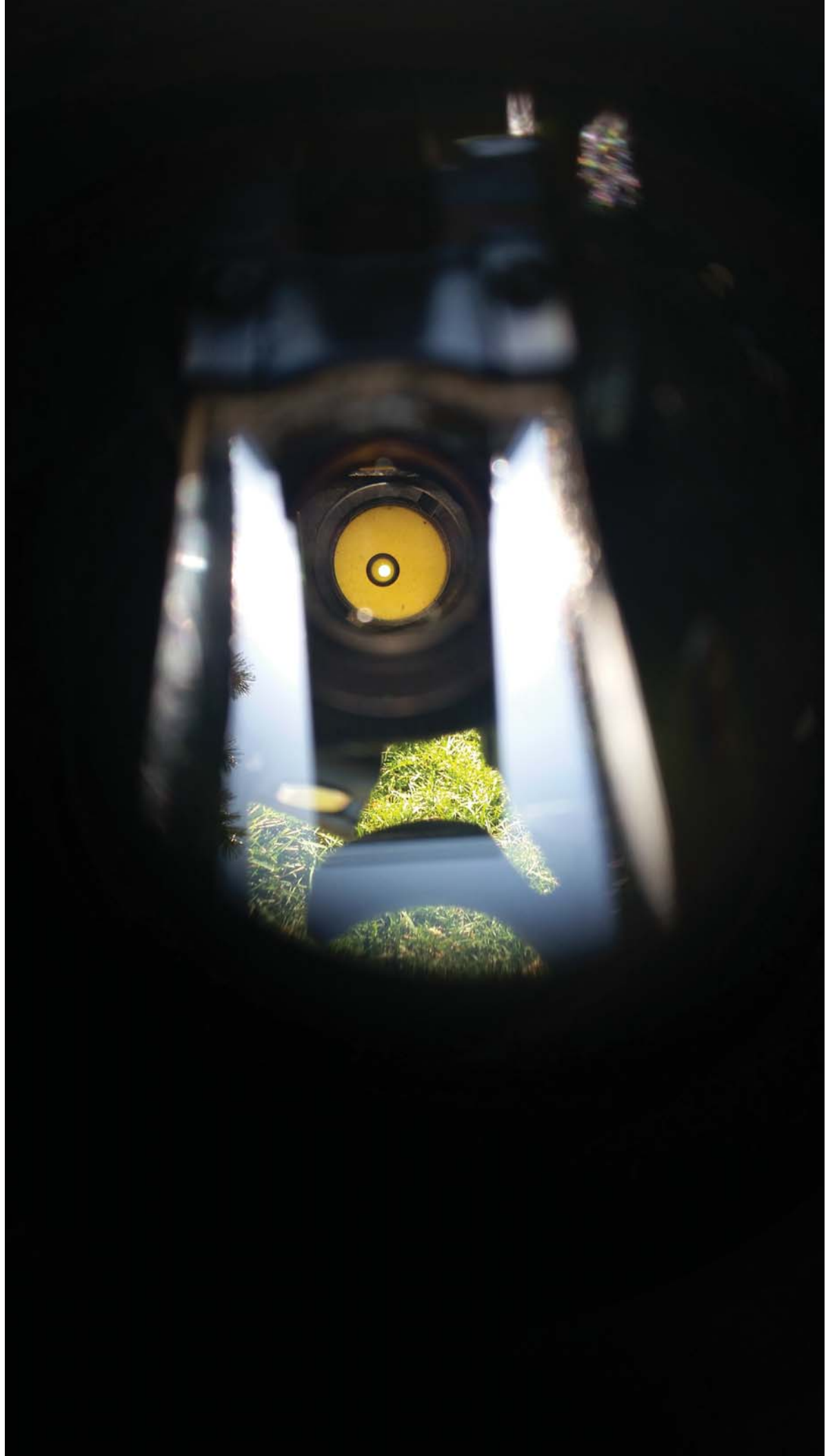












RESTRICTED  
R-6404 A

RESTRICTED  
74 R-6402 A

RESTRICTED  
R-6406 A

RESTRICTED  
R-6407

GREAT SALT LAKE

GREAT SALT LAKE

GREAT SALT LAKE

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Pilot Safety  
Through  
Better Training



For Pilots  
By Pilots

# apr VFR-100 FLIGHT LOG

Pilot \_\_\_\_\_ Aircraft \_\_\_\_\_ Model \_\_\_\_\_ N \_\_\_\_\_

TAKEOFF TIME \_\_\_\_\_ + ETE ☐ Hrs. \_\_\_\_\_ Min. \_\_\_\_\_ = ETA

## CLIMB / CRUISE DATA ★

| CLIMB SETTINGS        | IAS | RPM | MP | CRUISE ALTITUDE | TRUE AIR SPEED ESTIMATED | ACTUAL |
|-----------------------|-----|-----|----|-----------------|--------------------------|--------|
| CRUISE POWER SETTINGS |     |     |    |                 |                          |        |

## ENROUTE FLIGHT LOG

| FIX    | VOR FREQ. | L E G | VOR OBS | Compass Heading | ESTIMATED Enroute | Arrival | ACTUAL Arrival | Gr. Speed |
|--------|-----------|-------|---------|-----------------|-------------------|---------|----------------|-----------|
| Depart |           |       |         |                 |                   |         |                |           |
| TO     |           | 1     |         |                 |                   |         |                |           |
| TO     |           | 2     |         |                 |                   |         |                |           |
| TO     |           | 3     |         |                 |                   |         |                |           |
| TO     |           | 4     |         |                 |                   |         |                |           |
| TO     |           | 5     |         |                 |                   |         |                |           |
| TO     |           | 6     |         |                 |                   |         |                |           |

## FUEL LOG

| CLOSE OUT FLIGHT PLAN |      | TANK   |    | TIME |      | TOTAL |     | TIME |    | TOTAL |      |
|-----------------------|------|--------|----|------|------|-------|-----|------|----|-------|------|
| FUEL                  | GAL. | NUMBER | ON | OFF  | TIME | ON    | OFF | TIME | ON | OFF   | TIME |
| USABLE ★              |      |        |    |      |      |       |     |      |    |       |      |
| REQUIRED ■            |      |        |    |      |      |       |     |      |    |       |      |
| RESERVE               |      |        |    |      |      |       |     |      |    |       |      |
| RESERVE TIME          |      |        |    |      |      |       |     |      |    |       |      |
|                       |      |        |    |      |      |       |     |      |    |       |      |

★ FROM OWNER'S MANUAL ■ FROM PREFLIGHT CALCULATIONS

apco products research, inc. 11201 Hindry Avenue Los Angeles, California 90045  
apr1@flash.net www.apindustries.com Fax: (310) 649-1703

PILOT EQUIPMENT CATALOG \$1.50 COPYRIGHT 2011 PRINTED IN U.S.A.





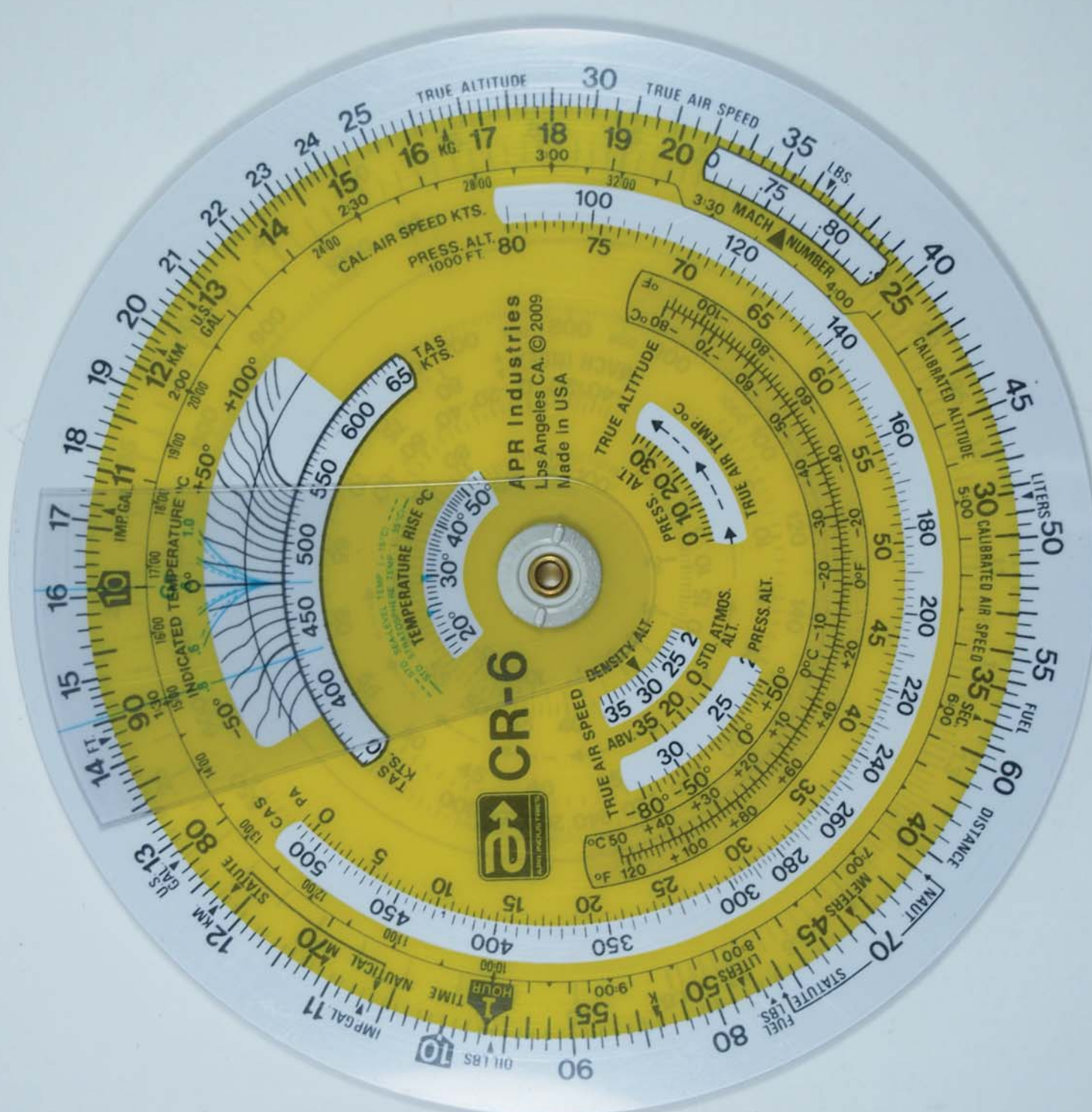
|                                                                                                                                                                                                                                                                                                                                    |                  |                      |       |      |     |             |    |       |     |       |   |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|----------------------|-------|------|-----|-------------|----|-------|-----|-------|---|
| COMPLETE ALL SHADED BOXES PRIOR TO FLIGHT                                                                                                                                                                                                                                                                                          |                  |                      |       |      |     |             |    |       |     |       |   |
| PRESSURE ALTITUDE                                                                                                                                                                                                                                                                                                                  | TEMP °C          | IAS                  | TAS   | RPM  | MP  | FUEL gal/hr |    |       |     |       |   |
|                                                                                                                                                                                                                                                                                                                                    |                  |                      |       |      |     |             |    |       |     |       |   |
|                                                                                                                                                                                                                                                                                                                                    |                  |                      |       |      |     |             |    |       |     |       |   |
|                                                                                                                                                                                                                                                                                                                                    |                  |                      |       |      |     |             |    |       |     |       |   |
|                                                                                                                                                                                                                                                                                                                                    |                  |                      |       |      |     |             |    |       |     |       |   |
| FROM AIM                                                                                                                                                                                                                                                                                                                           |                  | FACILITY INFORMATION |       |      |     |             |    |       |     |       |   |
| FACILITY                                                                                                                                                                                                                                                                                                                           | ELEV.            | GROUND CONTROL       | TOWER | VOR  | FSS | UNICOM      |    |       |     |       |   |
|                                                                                                                                                                                                                                                                                                                                    |                  |                      |       |      |     |             |    |       |     |       |   |
|                                                                                                                                                                                                                                                                                                                                    |                  |                      |       |      |     |             |    |       |     |       |   |
|                                                                                                                                                                                                                                                                                                                                    |                  |                      |       |      |     |             |    |       |     |       |   |
|                                                                                                                                                                                                                                                                                                                                    |                  |                      |       |      |     |             |    |       |     |       |   |
| NAVIGATION PREFLIGHT CALCULATIONS                                                                                                                                                                                                                                                                                                  |                  |                      |       |      |     |             |    |       |     |       |   |
| TAS                                                                                                                                                                                                                                                                                                                                | FUEL CONSUMPTION |                      |       |      |     | gal/hours   |    |       |     |       |   |
| LEG                                                                                                                                                                                                                                                                                                                                | TC               | WIND                 | TH    | VAR  | MH  | CH*         | GS | DIST. | ETE | FUEL  |   |
| 1                                                                                                                                                                                                                                                                                                                                  |                  |                      |       |      |     |             |    |       |     |       |   |
| 2                                                                                                                                                                                                                                                                                                                                  |                  |                      |       |      |     |             |    |       |     |       |   |
| 3                                                                                                                                                                                                                                                                                                                                  |                  |                      |       |      |     |             |    |       |     |       |   |
| 4                                                                                                                                                                                                                                                                                                                                  |                  |                      |       |      |     |             |    |       |     |       |   |
| 5                                                                                                                                                                                                                                                                                                                                  |                  |                      |       |      |     |             |    |       |     |       |   |
| 6                                                                                                                                                                                                                                                                                                                                  |                  |                      |       |      |     |             |    |       |     |       |   |
| 7                                                                                                                                                                                                                                                                                                                                  |                  |                      |       |      |     |             |    |       |     |       |   |
| * OBTAIN CH FROM COMPASS CORRECTION CARD                                                                                                                                                                                                                                                                                           |                  |                      |       |      |     |             |    |       |     | TOTAL | : |
| FLIGHT TIME LOG                                                                                                                                                                                                                                                                                                                    |                  |                      |       |      |     |             |    |       |     |       |   |
| PILOT TIME                                                                                                                                                                                                                                                                                                                         |                  | TACHOMETER           |       | NO.1 |     | NO.2        |    |       |     |       |   |
| 2 ENDED TAXI                                                                                                                                                                                                                                                                                                                       |                  | 2 SHUT DOWN          |       | .    |     | .           |    |       |     |       |   |
| 1 BEGAN TAXI                                                                                                                                                                                                                                                                                                                       |                  | 1 START              |       | .    |     | .           |    |       |     |       |   |
| 3 LOG TIME                                                                                                                                                                                                                                                                                                                         |                  | 3 TACH TIME          |       | .    |     | .           |    |       |     |       |   |
| SECTIONAL CHART MILEAGE SCALE 1:500,000                                                                                                                                                                                                                                                                                            |                  |                      |       |      |     |             |    |       |     |       |   |
| <div style="display: flex; justify-content: space-between;"> <span>Nautical Miles 10</span> <span>0</span> <span>10</span> <span>20</span> <span>30</span> </div> <div style="display: flex; justify-content: space-between;"> <span>Statute Miles 10</span> <span>0</span> <span>10</span> <span>20</span> <span>30</span> </div> |                  |                      |       |      |     |             |    |       |     |       |   |

aero products research, inc.

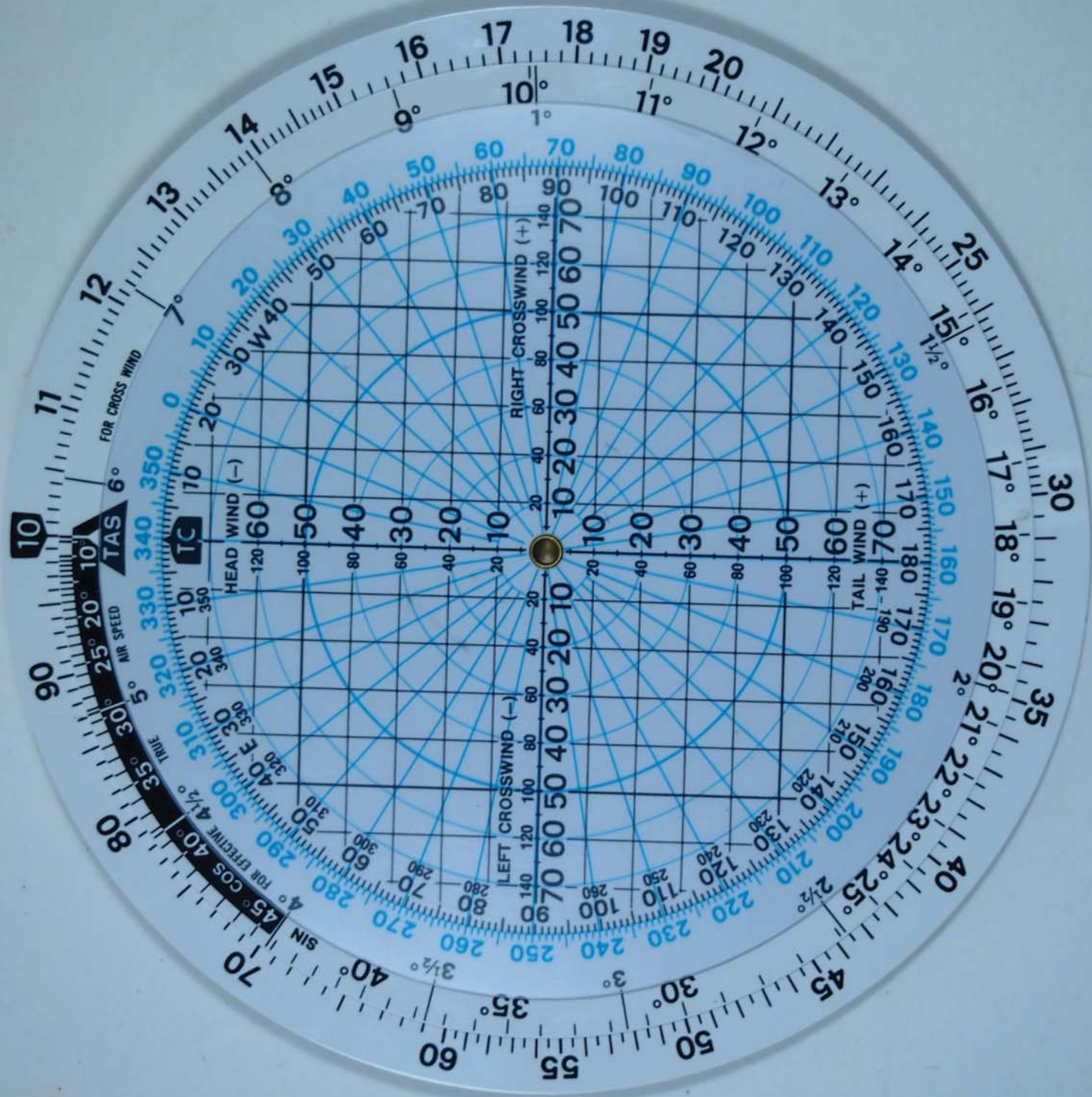
## For Pilots By Pilots













AN N603SK/MA 0811  
- PRE-DEPARTURE ATC CLEARANCE  
SKW4595 DEPART MSP AT 1510Z FL 310  
CRJ7/L TRANSPONDER 7076  
ROUTE KMSP RST9 RST OHHMY ENDEE4  
KMDW  
CLEARED RST9 DEPARTURE RST TRSN\*CLB VIA  
SID EXC MAINT 7000FT  
CLB VIA SID EXC MAINT 7000FT\*EXP 310 10  
MIN AFT DP.DPFRQ 132.97  
XPCT RHY 17\*XPCT RHY 17

Collins

POS

BRT

ACT LEGS 4595 1/3

SEQUENCE

CORDY

AUTO/INHIBIT

154° 20NM

RST

---/FL255

150° 65NM

OHHMY

---/FL310

142° 56NM

UGGLY

3.8° ↓

---/FL240

143° 26NM

AGONY

---/FL240

<LEG DATA

LEG WIND>

1

1

MSG

DIR  
INTC

FPLN

DEP  
ARR

HOLD

↑

PREV  
PAGE

NEXT  
PAGE

INDEX

FIX

LEGS

SEC  
FPLN

VNAV

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MCDU  
MENU

EXEC

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TURN



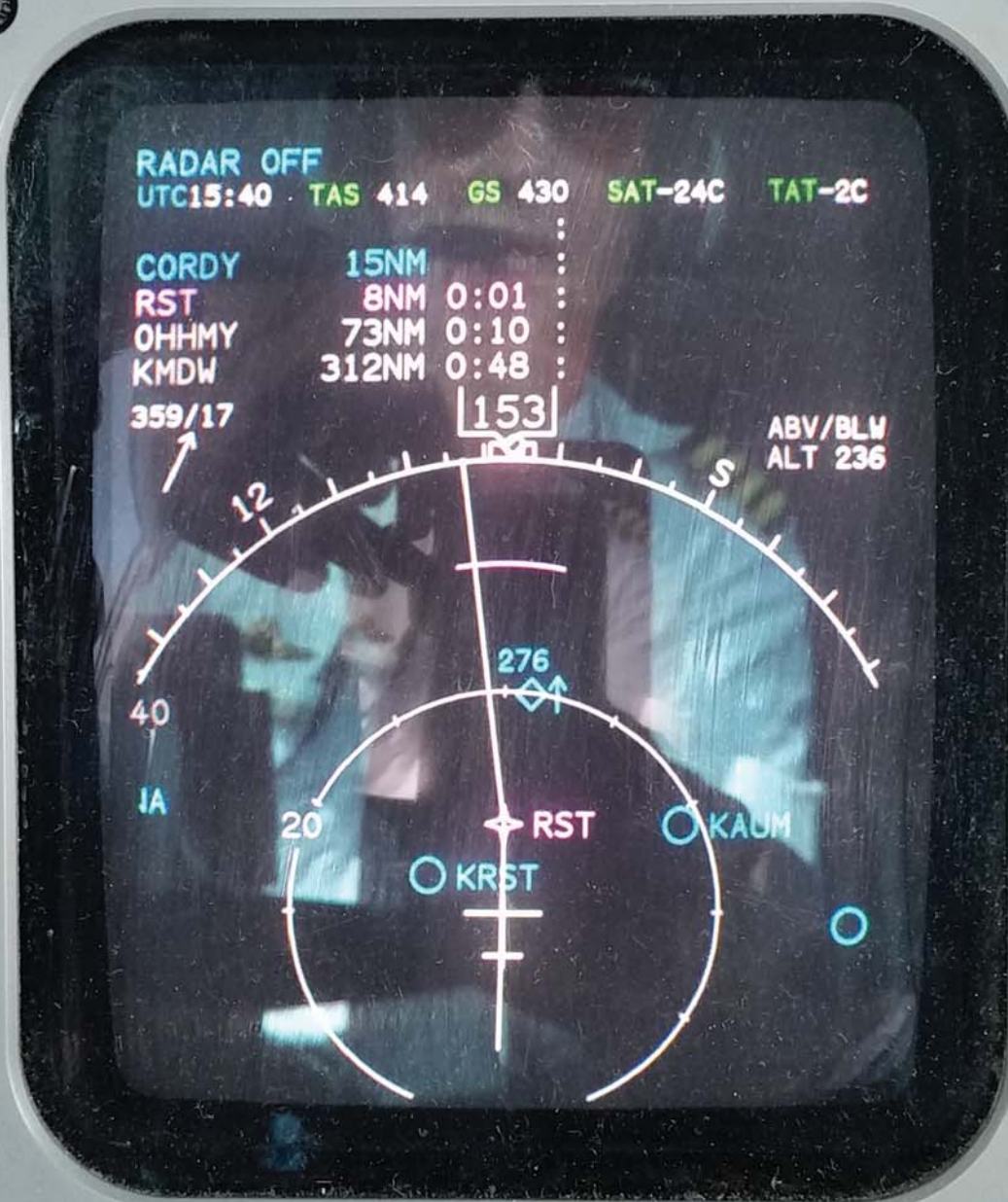




# AIRSPED LIMITS - ( INDICATED SPEEDS )

|                             |     |
|-----------------------------|-----|
| VFE ( 45° FLAPS )           | 170 |
| VFE ( 30° FLAPS )           | 185 |
| VFE ( 20° FLAPS )           | 230 |
| VFE ( 8° FLAPS & 1° FLAPS ) | 230 |
| VA (MANEUVERING)            |     |
| AT SEA LEVEL @ 70,000 LB)   | 240 |
| (31,750 KG)                 |     |
| AT SEA LEVEL @ 42,000 LB)   | 173 |
| (19,050 KG)                 |     |

|                                |      |
|--------------------------------|------|
| VMO ( BELOW 8,000 FT )         | 330  |
| VMO ( 8,000 TO 25,400 FT )     | 335  |
| MMO ( 25,400 FT TO 28,300 FT ) | 0.80 |
| VMO ( 28,300 FT TO 31,400 FT ) | 315  |
| MMO ( 31,400 FT TO 41,000 FT ) | 0.85 |
| VLO (EXT) (L/G EXTENSION)      | 220  |
| VLO (RET) (L/G RETRACTION)     | 200  |
| VLE (L/G EXTENDED)             | 220  |









VFE ( 45° FLAPS) ..... 170  
 VFE ( 30° FLAPS) ..... 185  
 VFE ( 20° FLAPS) ..... 230  
 VFE (8° FLAPS & 1° FLAPS)..... 230  
 VA (MANEUVERING)  
 (AT SEA LEVEL @ 70,000 LB)..... 240  
 (31,750 KG)  
 (AT SEA LEVEL @ 42,000 LB)..... 173  
 (19,050 KG)

VMO ( BELOW 8,000 FT) ..... 330  
 VMO ( 8,000 TO 25,400 FT) ..... 335  
 MMO ( 25,400 FT TO 28,300 FT)..... 0.80  
 VMO ( 28,300 FT TO 31,400 FT)..... 315  
 MMO ( 31,400 FT TO 41,000 FT)..... 0.85  
 VLO (EXT) (L/G EXTENSION)..... 220  
 VLO (RET) (L/G RETRACTION)..... 200  
 VLE (L/G EXTENDED)..... 220

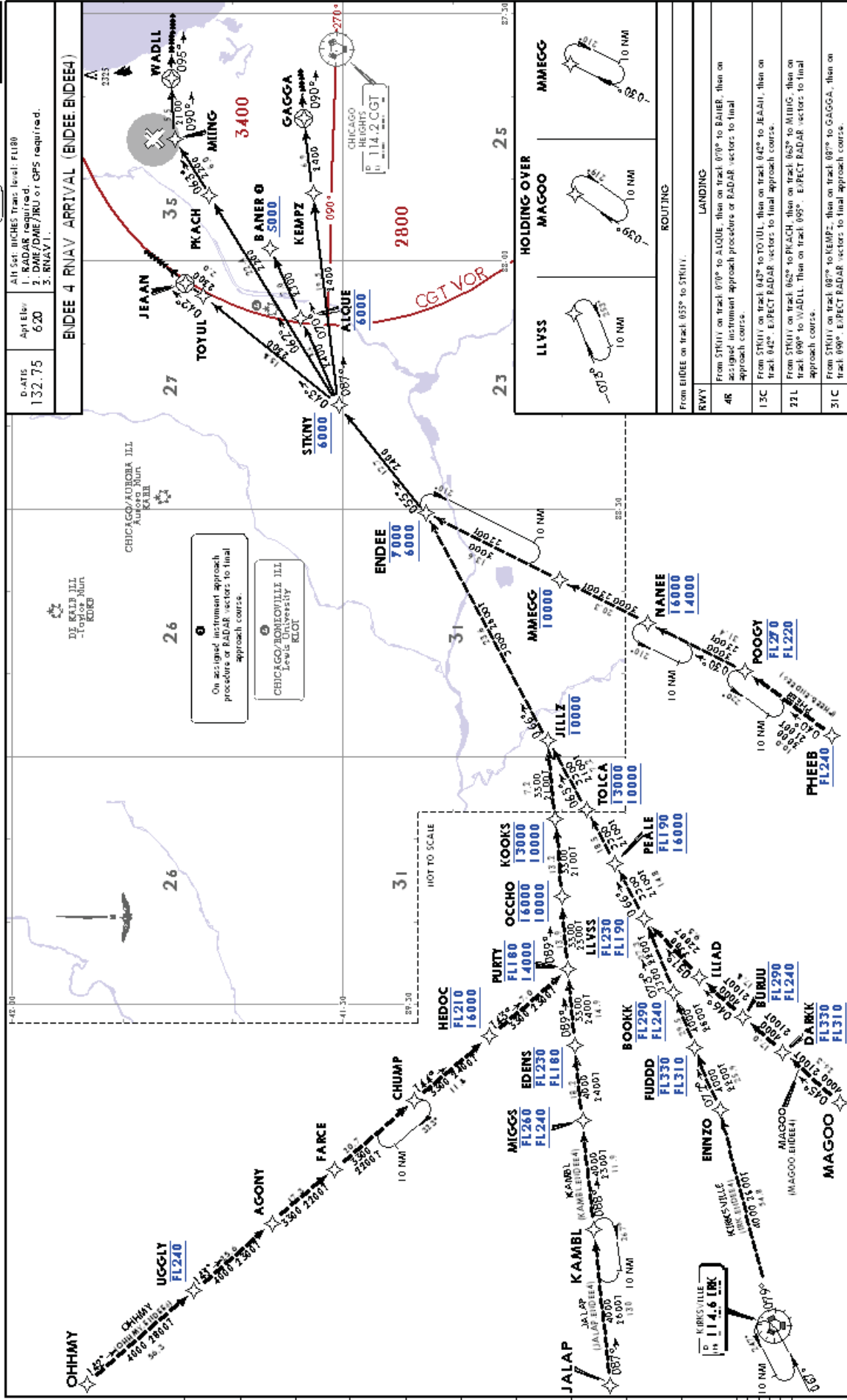




KMDW/MIDW  
-MIDWAY INTL  
10 FEB 17  
10-2  
CHICAGO, ILL  
RNAV STAR

AIH 541 BICHES Trac level: FL180  
1. RADAR required.  
2. DME/DME/IRU or GPS required.  
3. RNAV 1.

ENDEE 4 RNAV ARRIVAL (ENDEE ENDEE4)



CHANGES: 11-1-17

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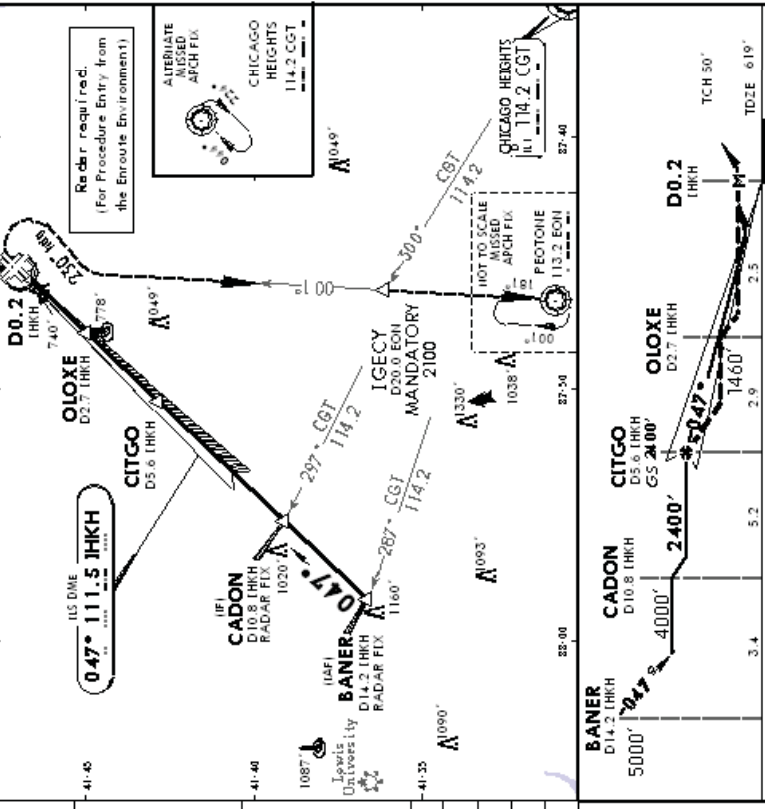
|         |                                     |
|---------|-------------------------------------|
| 10-2B   | GOSHEN 7 ARR                        |
| 10-2C   | MOTIF 5 ARR                         |
| 10-2D   | PANGG 3 RNAV ARR                    |
| 10-3    | CICERO 9 DEP                        |
| 10-3    | CICERO 8 DEP                        |
| 10-3A   | MIDWAY 2 DEP                        |
| 10-3A   | MIDWAY 3 DEP                        |
| 10-30B1 | TAKEOFF OBSTACLE NOTES              |
| 10-30B2 | TAKEOFF OBSTACLE NOTES (CONTD)      |
| 10-7    | AIRPORT INFO                        |
| 10-7A   | AIRPORT INFO (CONTD)                |
| 10-9    | AIRPORT, AIRPORT INFO               |
| 10-9A   | AIRPORT INFO (CONTD), TAKE-OFF MNMS |
| 10-9B   | RWY 31C HOLD PAD DETAIL             |
| 10-9C   | PARKING SPOTS                       |
| 10-9D   | PARKING SPOT COORDS                 |
| 11-1    | ILS OR LOC DME RWY 4R               |
| 11-2    | ILS OR LOC DME RWY 13C              |
| 11-3    | ILS OR LOC DME RWY 31C              |
| 12-1    | RNAV (GPS) RWY 4L                   |
| 12-2    | RNAV (GPS) Z RWY 4R                 |
| 12-20   | RNAV (RNP) Y RWY 4R                 |
| 12-21   | RNAV (RNP) Y RWY 13C                |
| 12-22   | RNAV (RNP) Y RWY 22L                |
| 12-23   | RNAV (RNP) X RWY 22L                |
| 12-24   | RNAV (RNP) Y RWY 31C                |
| 12-3    | RNAV (GPS) RWY 13L                  |
| 12-4    | RNAV (GPS) Z RWY 13C                |
| 12-5    | RNAV (GPS) Z RWY 22L                |
| 12-6    | RNAV (GPS) RWY 22R                  |
| 12-7    | RNAV (GPS) Z RWY 31C                |

# KMDW/MDW -MIDWAY INTL CHICAGO, ILL ILS or LOC DME Rwy 4R

|                       |                            |                     |                    |                             |           |                  |
|-----------------------|----------------------------|---------------------|--------------------|-----------------------------|-----------|------------------|
| LOC<br>111.5<br>111.5 | Final<br>Appch Crs<br>047° | GS<br>2400' (1781') | CITGO<br>D5.6 IHHK | ILS<br>DA(H)<br>869' (250') | TDZE 619' | Ground<br>121.65 |
|-----------------------|----------------------------|---------------------|--------------------|-----------------------------|-----------|------------------|

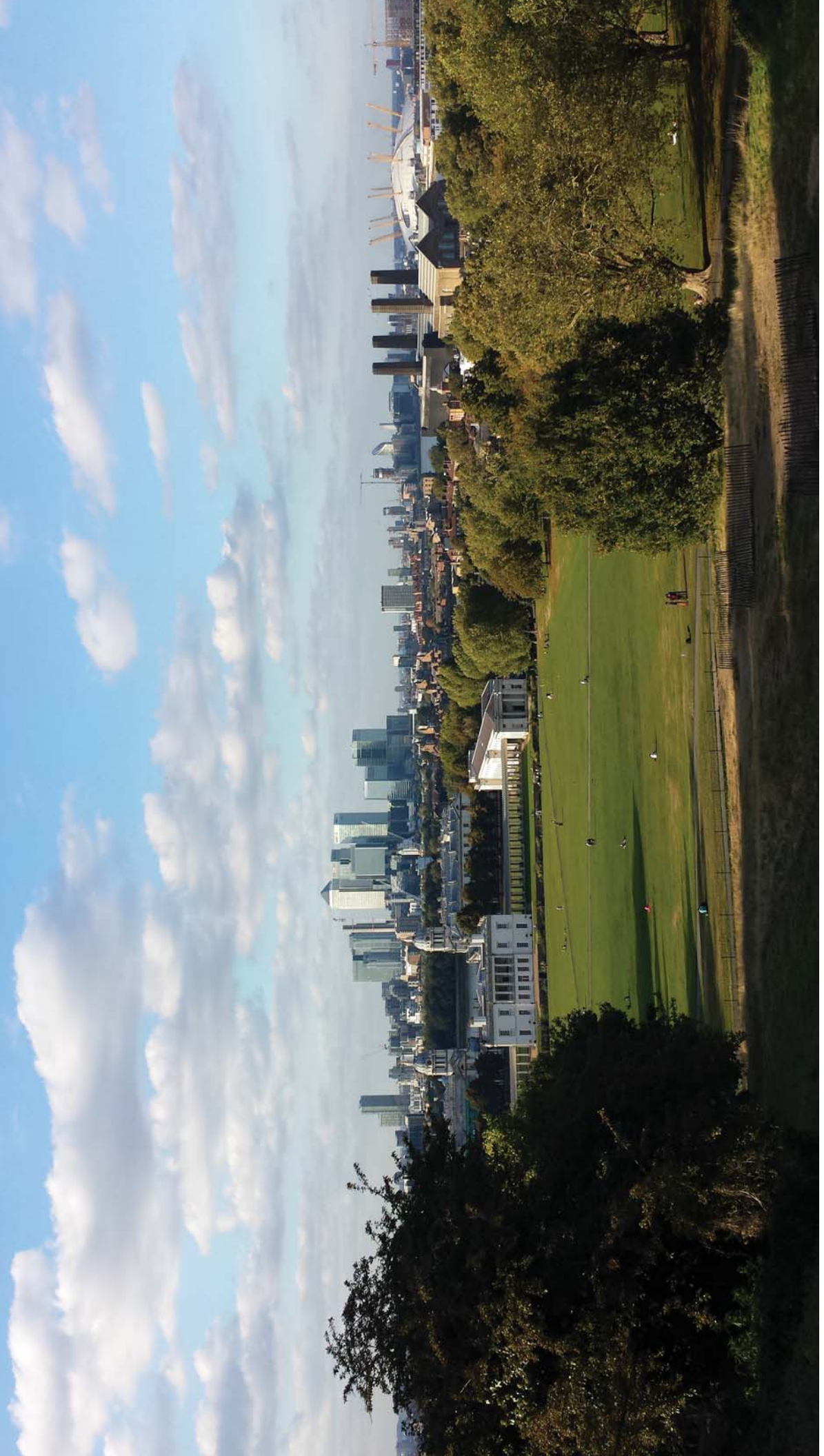
MISSED APCH: Climb to 1100', then climbing RIGHT turn to 2100' on heading 230° and inbound on EON VOR R-001 until crossing IGEY INT/D20.0 EON, then climb to 2600' to EON VOR and hold, or as directed by ATIS.

Alt Set: ICHES  
1. Height landing: Rwy 4R CAT C and D operational VGS1 required, remain on or above VGS1 glidepath until threshold. 2. VGS1 and ILS glidepath not coincident.  
3. Helicopter visibility reduction below RVR 40 or 3/4 SM not authorized.



|               |               |         |                    |     |                  |
|---------------|---------------|---------|--------------------|-----|------------------|
| LOC (GS out)  | 1100' 2100'   | EQN     | 230° and 113.2     | RT  | R-001            |
| DA(H)         | 869' (250')   | MDA(H)  | 1000' (381')       | Max | 90               |
| RVR 40 or 3/4 | RVR 55 or 1   | RVR 120 | 1120' (300') - 1   | 140 | 1340' (720') - 2 |
| RVR 50 or 1   | RVR 60 or 1/4 | RVR 165 | 1340' (720') - 2/4 |     |                  |











13

## The Greenwich Meridian Telescope

Behind the window is the telescope which defines the Greenwich Meridian, the transit circle of 1850 designed by 7th Astronomer Royal, George Airy. It was the centre-line of this instrument which was adopted by an international conference in Washington, USA, in 1884 as the prime meridian for the world, or Longitude 00° 00' 00". Both time and longitude are measured from this line.









Collins

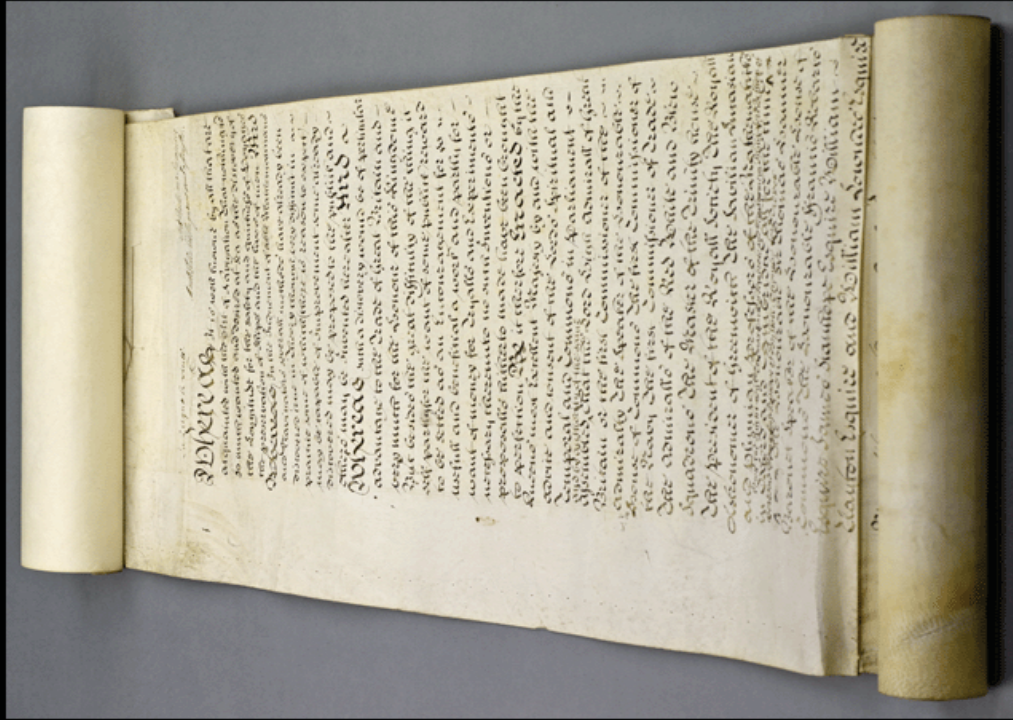
ROYAL  
MUSEUMS  
GREENWICH

# *Ships, Clocks & Stars*

THE QUEST *for* LONGITUDE



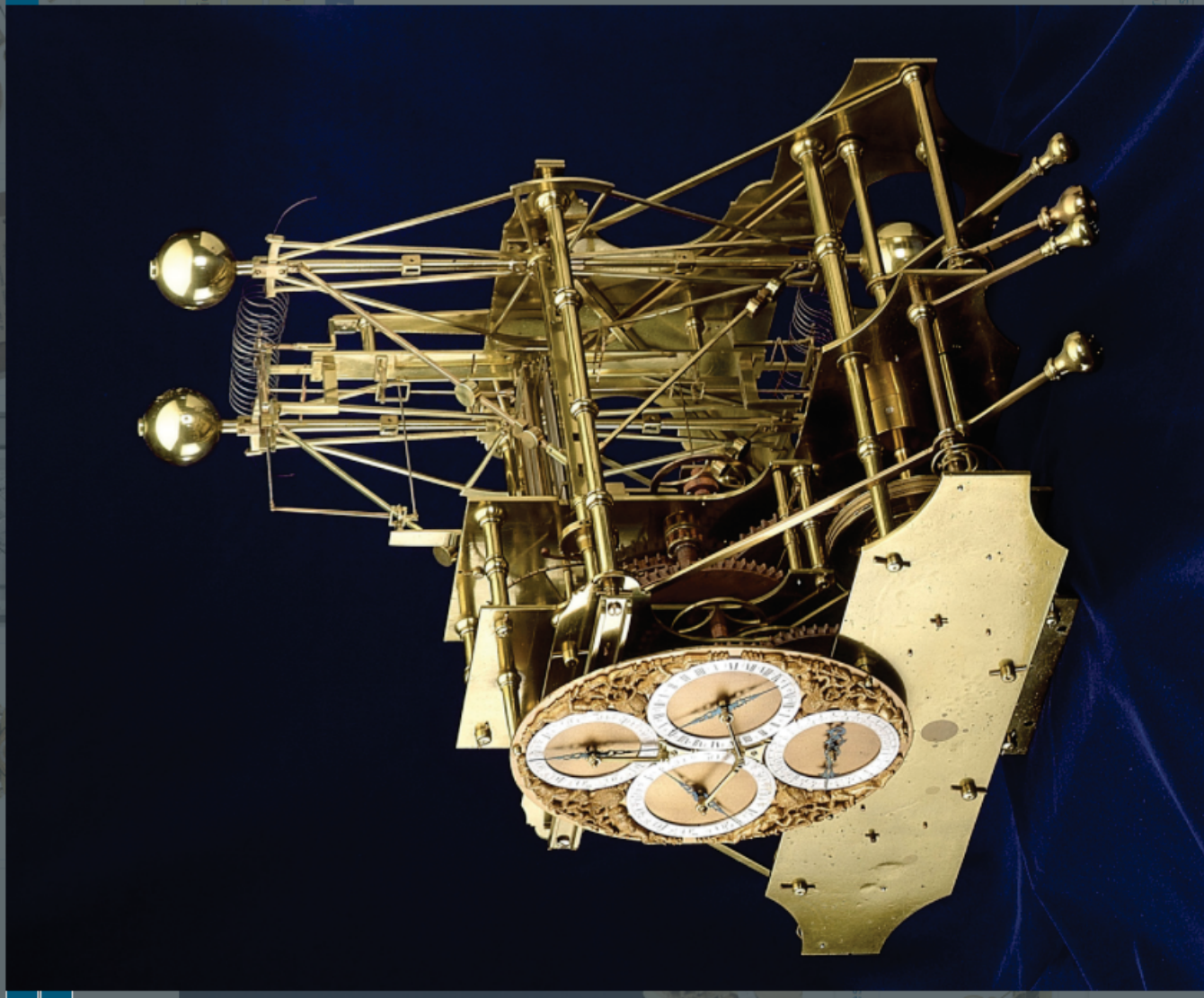












Title

H1

Timekeeping

Images

Object details:

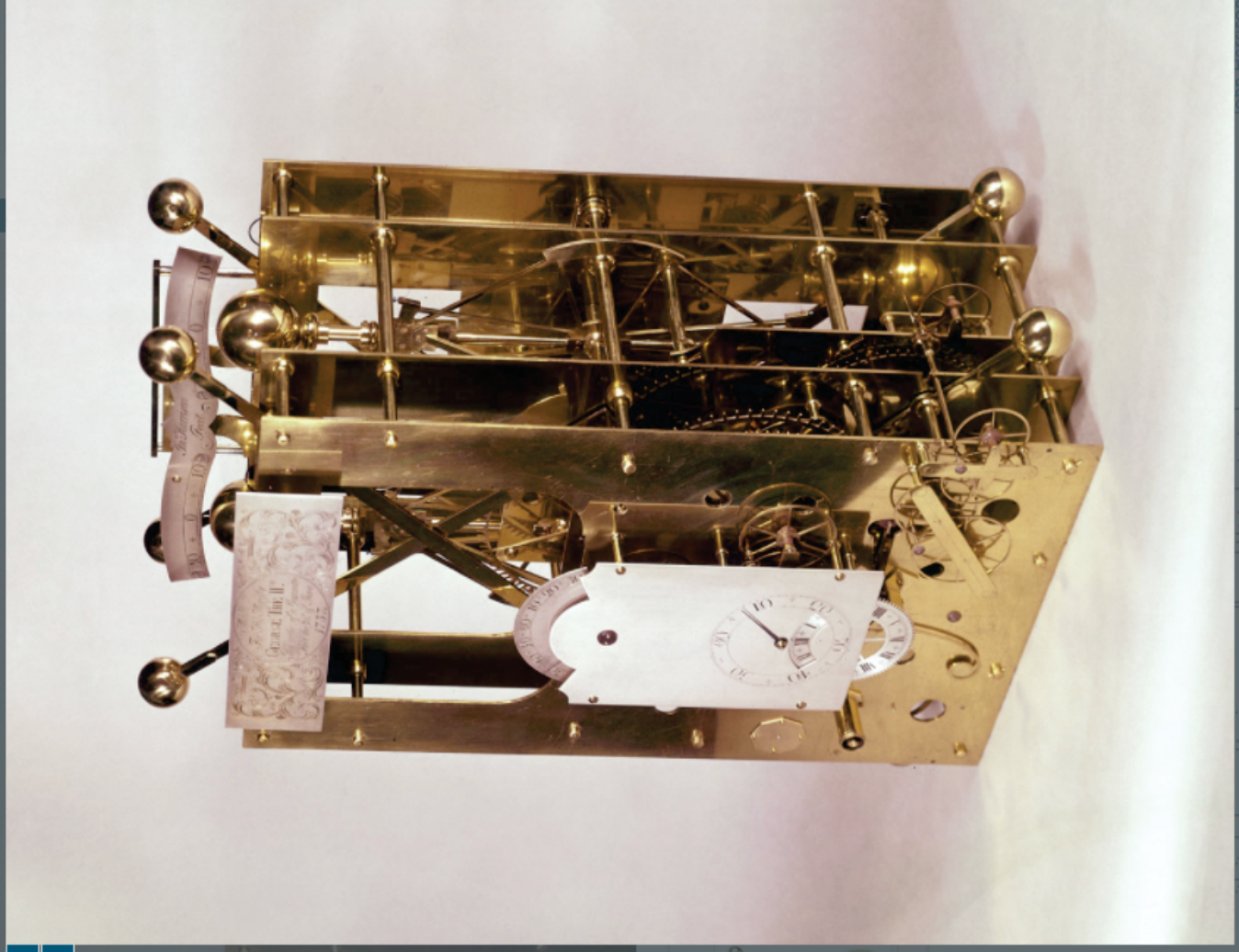
Object ID

Description



Repro ID: A2760

Buy this image



Images

Object details:

Object ID

Description

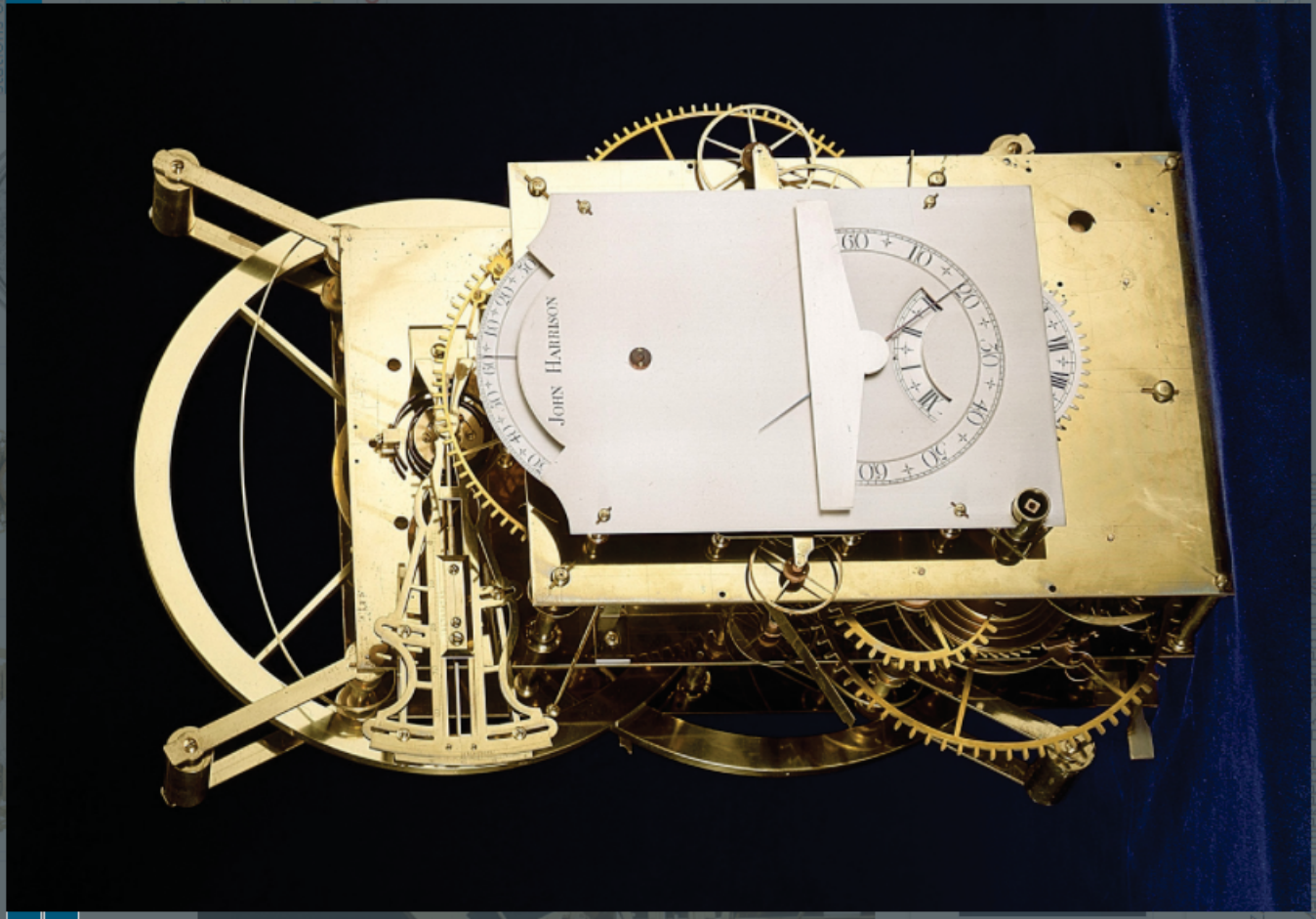
Chronometers,  
Ships and timekeepers  
Latitude, Ships, Clocks &  
East for Longitude  
Harrison  
Longitude by

John Harrison by NMMCollections

Gallery location

with its balances, Harrison never allowed H2 to be tested  
at sea. He kept it running at his house for many years





Title

H3

Timekeeping

Images

Object details:

Object ID

Description

Marine timekeeper, H3. Started in 1780, this timekeeper took Harrison nearly 19 years to build and adjust, although it was not to win the great

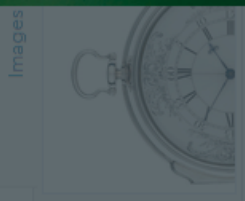
Exhibitions

Time and Longitude, Ships, Clocks & Watches and timekeepers

between 57½ and 60 the fitting out berth at stations on the port side Scott's Shipbuilding &



Title  
H4  
Timekeeping



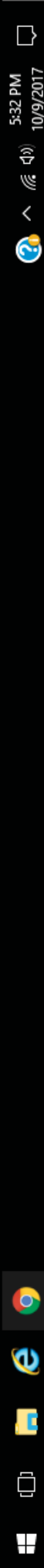
Object details:  
Object ID  
Description

various timekeeper, H4. This is Harrison's prize-winning longitude watch, completed in 1759. Harrison had been working on improving watches as a sideline to his

Exhibitions

Time and Longitude, Ships, Clocks & Astronomers, and timekeepers







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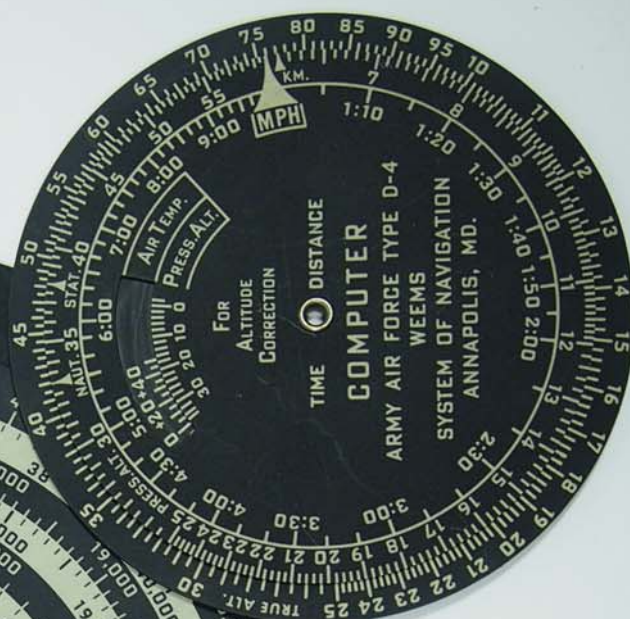


William E. Kazianka

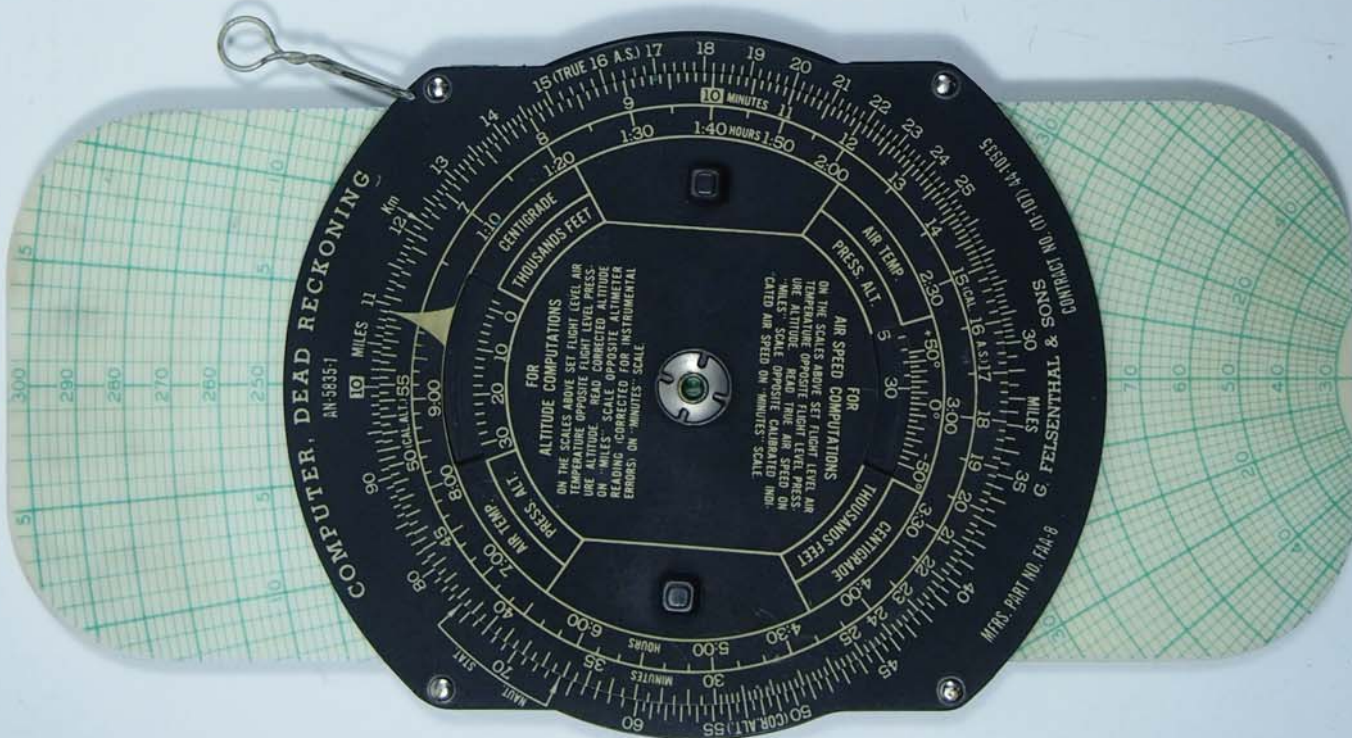


Donald R. Olander











# AIR NAVIGATION

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WEEMS







H. O. Pub. No. 216

---

# AIR NAVIGATION



U. S. NAVY HYDROGRAPHIC OFFICE



FIG. 198.—Celestial-navigation equipment.

## CHAPTER XII

## CELESTIAL NAVIGATION—EQUIPMENT

All the equipment discussed in Chap. VII for dead reckoning is required by the celestial navigator. In addition, four principal items that are applicable solely to celestial navigation are needed:

1. The sextant.
2. The accurate timepiece.
3. The Almanac.
4. Methods of converting observations into positions.

Figure 198 shows a sample celestial-navigation outfit.

## THE SEXTANT

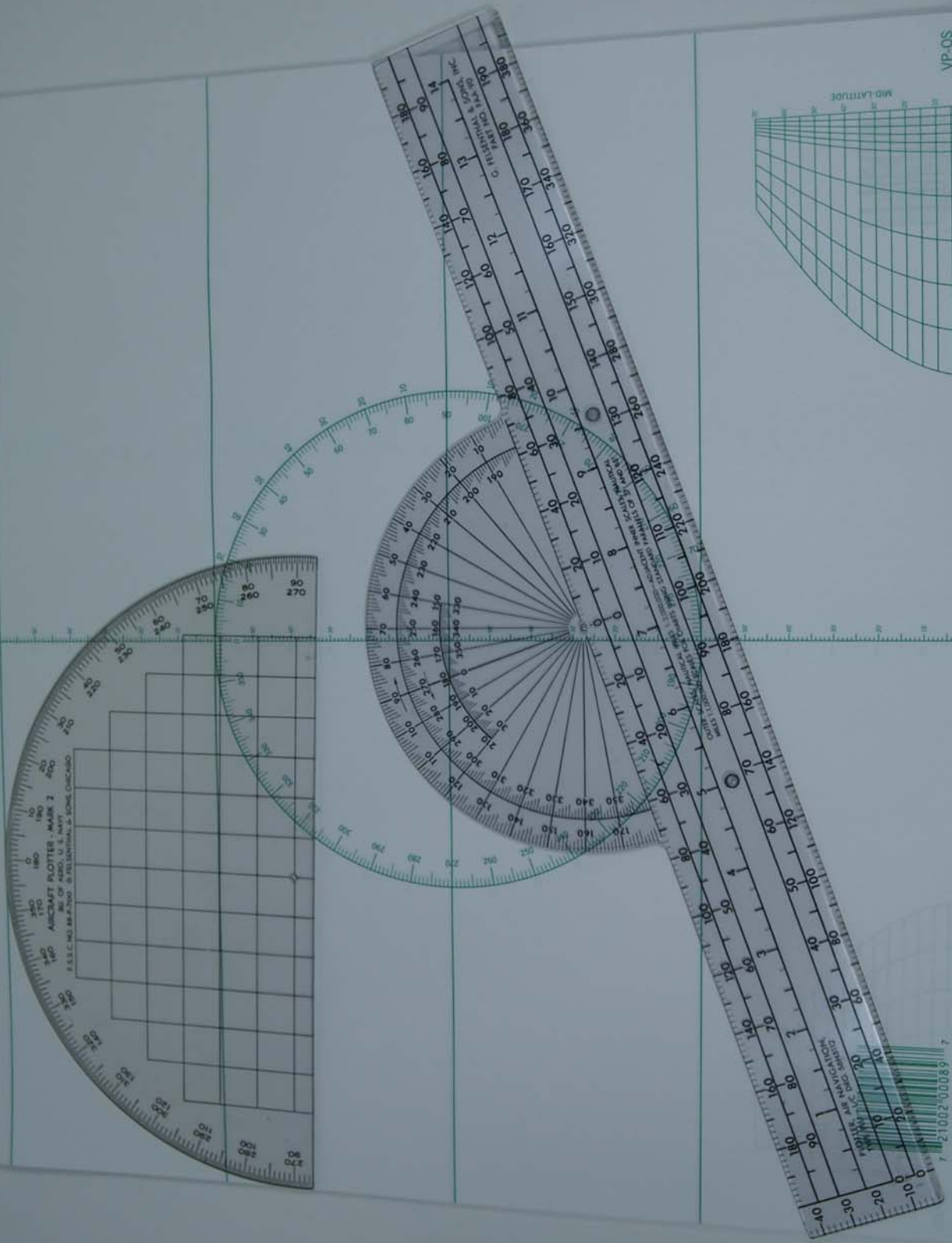
The sextant is an instrument for measuring the angle between two objects by bringing into coincidence at the eye of the observer rays of light received directly from the one object and by reflection from the other object, the measure being afforded by the inclination of the reflecting surfaces relative to each other.

**Optical Principle.**—One of the fundamental principles of optics is that "when a ray of light is reflected from a plane surface, the angle of incidence is equal to the angle of reflection." From this it may be proved that when a ray of light undergoes two reflections in the same plane the angle between its first and its last direction is equal to twice the inclination of the reflecting surfaces. Upon this fact the construction of the sextant is based.

Since, in direct observations, altitudes may vary from  $0^\circ$  to  $90^\circ$ , it follows from the above principle that an angle of  $45^\circ$  between the two reflecting surfaces would be sufficient to measure the altitude of any heavenly body. Since an arc of  $45^\circ$  is one-eighth of a circle, instruments of this general type, having a maximum angle of  $45^\circ$  between the two reflectors, are known as *octants*. Instruments having an arc or limb of  $60^\circ$ , or one-sixth of a circle, for measuring the angle between reflectors are called *sextants*, and those having arcs of  $90^\circ$ , or one-quarter of a circle are called *quadrants*. Either octants or sextants are suitable for aerial use, but the quadrant is too bulky. For a great many years practically all instruments used by marine navigators for measuring altitudes have been sextants, and the term sextant has become so gen-





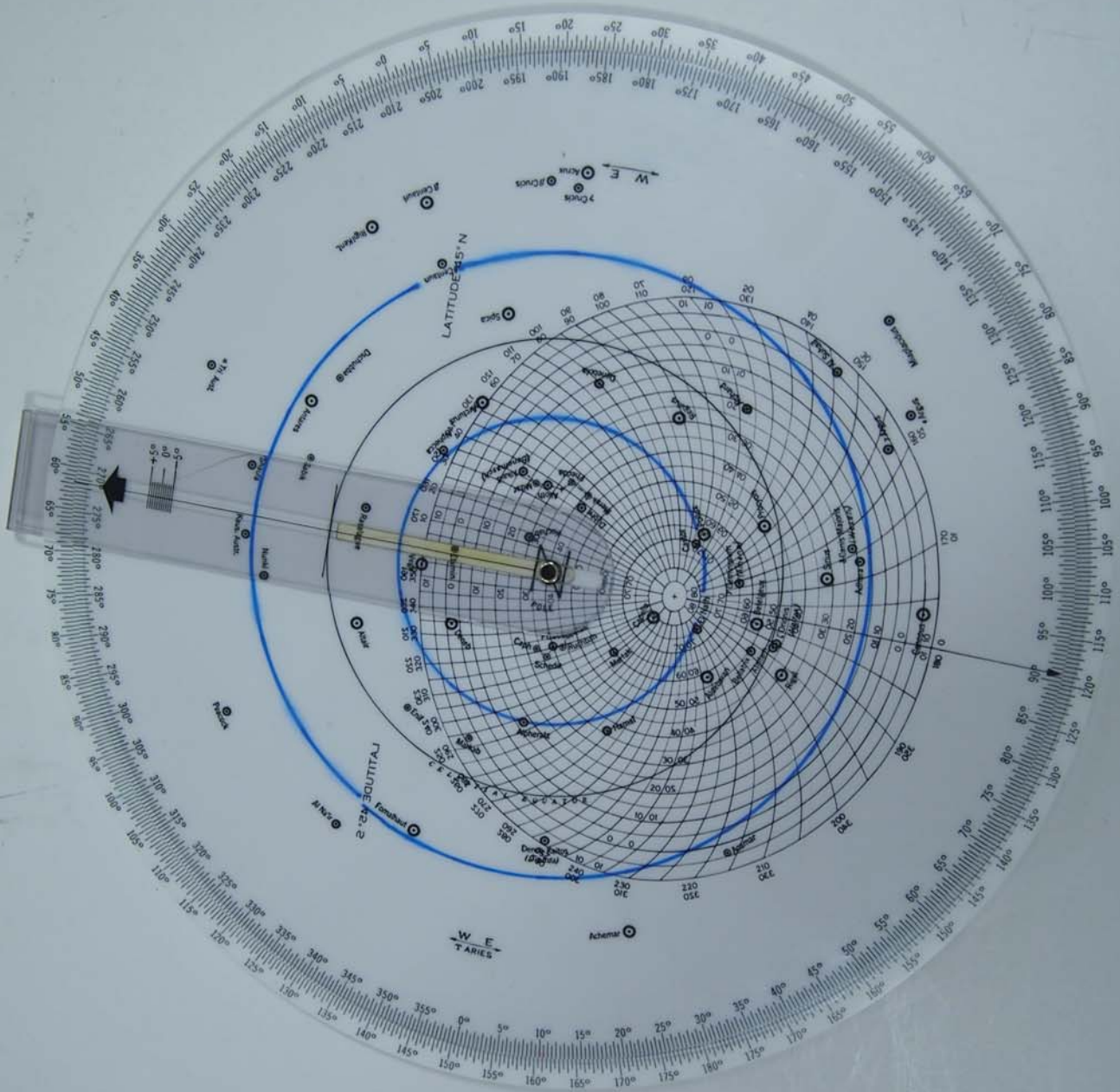


UNIVERSAL PLOTTING SHEET

Published by Celestaire, Inc., August 2014  
 416 S. Pershing, Wichita, Kansas 67218 Tel: 316-666-0755

VP-OS







ESEN

WATERMAN / WATERMAN

Model 20-1

Co.

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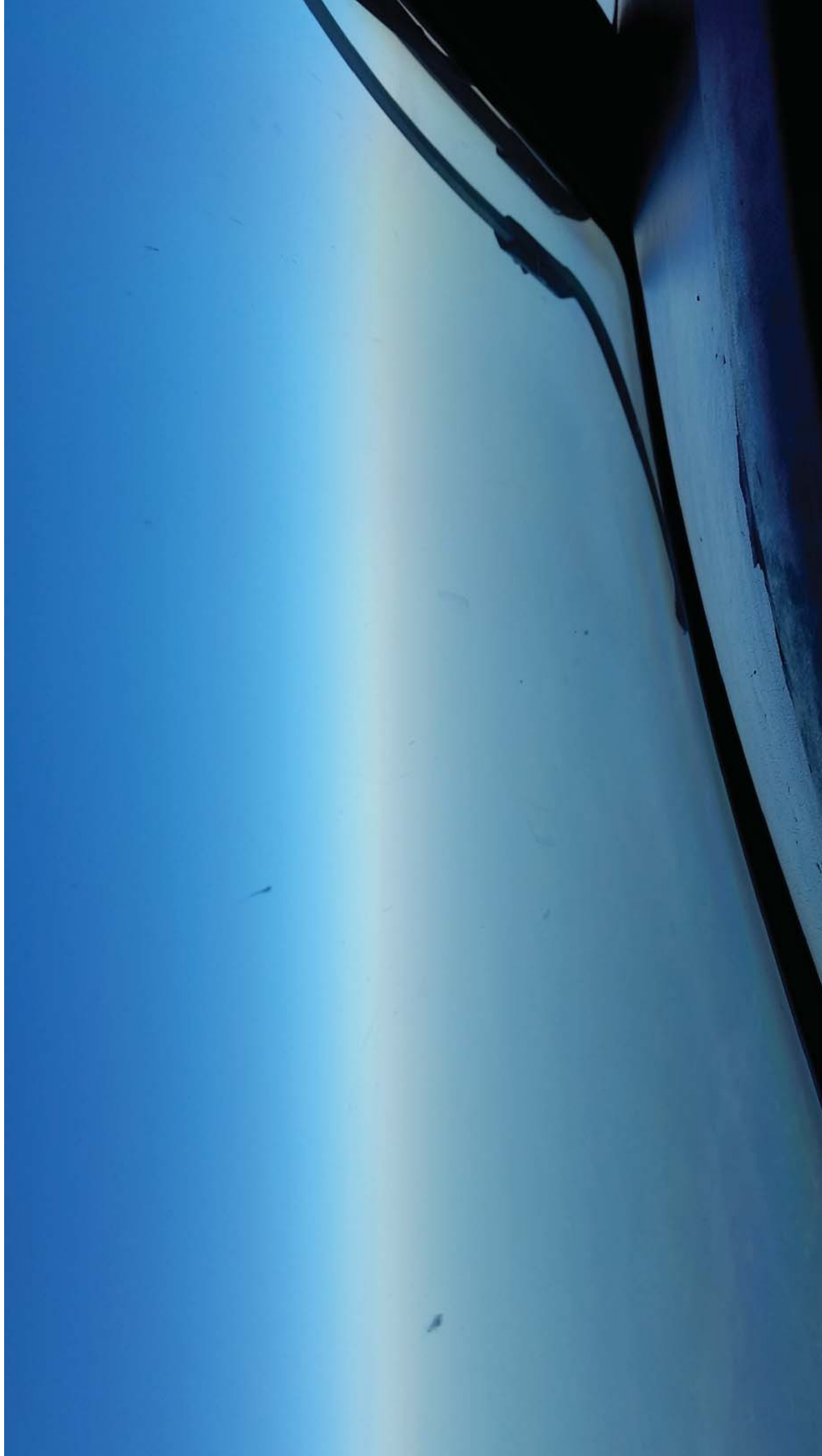
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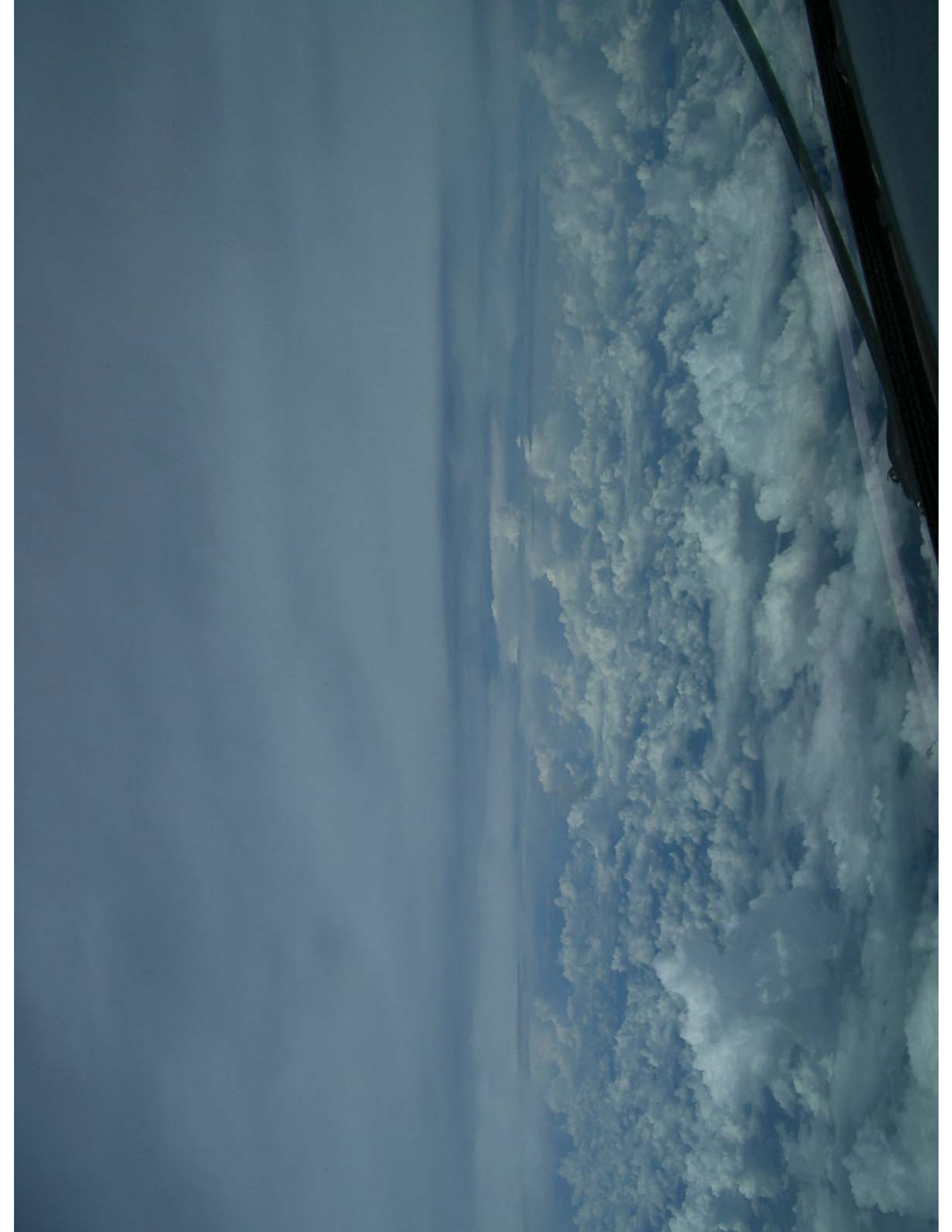
1000











U.S. NAVY

SEXTANT (BUBBLE)

TYPE A-12 SERIAL 2198-43

CONTRACT NO. NOA(s) 149

MFR'S. DRAWING NO. 11734

LINK AVIATION DEVICES INC.



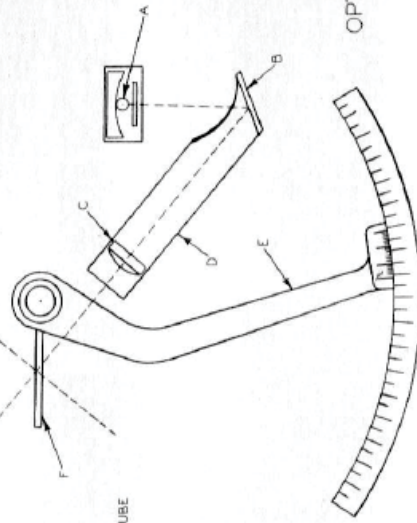








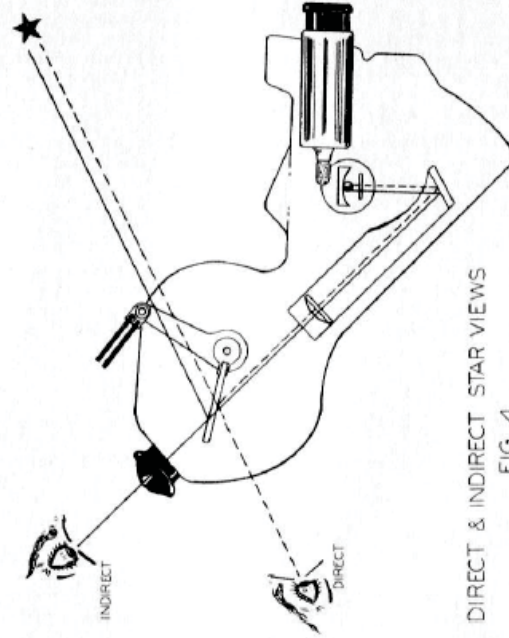
L-367



- A - BUBBLE
- B - MIRROR
- C - MIRROR
- D - MIRROR LENS TUBE
- E - ARM
- F - INDEX GLASS

OPTICAL SYSTEM  
FIG. 3

L-368



DIRECT & INDIRECT STAR VIEWS  
FIG. 4















June 21 2016

Polaris

A-12

DR L  $40^{\circ}46'36''$  N  
 $\lambda$   $111^{\circ}50.9'$  W

\* Polaris

hs  $40^{\circ}15'$  from tripod  
 T  $4:50$  Z

$\rightarrow$  GHA T =  $342^{\circ}79.2'$   
 $\lambda$  (-W)  $111^{\circ}50.9'$   
 LHA T  $230^{\circ}28.3'$

hs  $40^{\circ}15'$   
 + R  $1'$   
 Ho  $40^{\circ}16'$   
 Q  $+ 40'$   
 L  $40^{\circ}56'$  +  $10'$  fm  $\lambda$

hs is  $+10'$  IC =  $-10$

Jun 28 2016

hs  $40^{\circ}15'$  from tripod  
 T  $4:19:30$  Z

T 4:10  
 i 9:30  
 GHA T  
 $\lambda$  (-W)  
 LHA T

$339^{\circ}11.5'$   
 $2^{\circ}22.9'$   
 $340^{\circ}34.4'$   
 $111^{\circ}50.9'$   
 $229^{\circ}43.5'$

hs  $40^{\circ}15'$   
 R  $1'$   
 Ho  $40^{\circ}16'$   
 Q +  $40'$

L  $40^{\circ}56'$  +  $10'$  fm  $\lambda$  IC =  $-10$

22-141 50 SHEETS  
 22-142 100 SHEETS  
 22-144 200 SHEETS













| TIME SIGHT         | COSINE-HAVERSINE   | H. O. NO. 211 AGETON          | H. O. NO. 208             | LINE OF POSITION BOOK     | H. O. NO. 214   | STARALT. CURVES                 |
|--------------------|--------------------|-------------------------------|---------------------------|---------------------------|-----------------|---------------------------------|
| GCT                | GCT                | GCT                           | GCT                       | GCT                       | GCT             | H <sub>1</sub> ST <sub>0</sub>  |
| GHA                | GHA                | GHA                           | GHA                       | GHA                       | GHA             | H <sub>2</sub> 2ND <sub>0</sub> |
| CORR               | CORR               | CORR                          | CORR                      | CORR                      | CORR            | GST                             |
| GHA                | GHA                | GHA                           | GHA                       | GHA                       | GHA             | LST                             |
|                    | LONG               | LONG                          | LONG (A)                  | LONG (A)                  | LONG (A)        | LONG (T)                        |
| H                  | LHA                | LHA                           | LHA                       | LHA                       | LHA             | LONG                            |
| L                  |                    | DEC                           | LAT (A)                   | LAT (A)                   |                 | LAT                             |
| P                  | LAT                |                               |                           |                           | DEC             |                                 |
| 2)                 | DEC                | LHA A                         | DEC                       | DEC                       | LAT (A)         |                                 |
| S                  | L~DEC              | DEC <sup>+</sup> <sub>B</sub> | <i>b</i>                  | K                         |                 |                                 |
| S-H                |                    | R A                           | <i>b</i> ~DEC             | K~DEC                     | H               |                                 |
|                    | LAT COS            |                               |                           |                           | $\Delta d$ CORR |                                 |
| L SEC              | DEC COS            | DEC A                         | A                         | A                         | H <sub>c</sub>  |                                 |
| P CSC              | LHA HAV            | R B                           | <sup>+</sup> <sub>B</sub> | <sup>+</sup> <sub>B</sub> | H <sub>0</sub>  |                                 |
| S COS              | $\theta$ HAV       | K A                           | LOG H <sub>c</sub>        | LOG H <sub>c</sub>        | <i>a</i>        |                                 |
| S-H SIN            | $\theta$ N HAV     | K                             | H <sub>c</sub>            | H <sub>c</sub>            |                 |                                 |
| LHA HAV            | L~ <i>d</i> N HAV  | L                             | H <sub>0</sub>            | H <sub>0</sub>            | Z               |                                 |
| LHA                | ZD N HAV           | K~L                           | <i>a</i>                  | <i>a</i>                  | $\Delta d$ CORR |                                 |
| GHA                | ZD                 | K~L B                         |                           | Z                         | Z               |                                 |
| LONG               | H <sub>c</sub>     | R <sup>+</sup> <sub>B</sub>   | C                         |                           |                 |                                 |
|                    | H <sub>0</sub>     | H <sub>c</sub> A              | D                         |                           |                 |                                 |
| LHA SIN            | <i>a</i>           | H <sub>c</sub>                | C+D                       |                           |                 |                                 |
| DEC COS            |                    | H <sub>0</sub>                | Z'                        |                           |                 |                                 |
| H <sub>0</sub> SEC | LHA SIN            | <i>a</i>                      | Z''                       |                           |                 |                                 |
| Z SIN              | DEC COS            |                               | Z                         |                           |                 |                                 |
| Z                  | H <sub>c</sub> SEC | R A                           |                           |                           |                 |                                 |
|                    | Z SIN              | H <sub>c</sub> B              |                           |                           |                 |                                 |
|                    | Z                  | Z A                           |                           |                           |                 |                                 |
|                    |                    | Z                             |                           |                           |                 |                                 |

FIG. 175. Forms for reducing observations to positions.

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# THE AIR ALMANAC 2017

Issued by  
The Nautical Almanac Office  
United States Naval Observatory  
under the authority of the  
Secretary of the Navy



Washington: 2016



PUB. NO. 249

VOL. 2

# SIGHT REDUCTION TABLES

FOR

## AIR NAVIGATION

LATITUDES  $0^{\circ}$ – $40^{\circ}$

DECLINATIONS  $0^{\circ}$ – $29^{\circ}$



NATIONAL IMAGERY AND MAPPING AGENCY

FIX L  
λ  
+

FIX L  
λ  
+

FL  
MC  
MH  
TAS  
GS  
SAT  
W

Air  
ALm  
Pub  
249

Body: Sun

Formalhaut

Moon

DR L N37°37'  
λW113°15'

N44°59'  
W111°47'

N43°47'  
W112°07'

+ 19:01:50

01:45:00

01:44:30

A167 Tbl 6

hs 29°04'

11°55'

30°59'

R -1

-2

-1

IC -8

-2

-9

Bk. Cov. Tbl 7

Do -6

-8

-5

P

+51

Ho 28°49'

11°43'

31°35'

A167 Tbl 7 Z coniolis 7 R

8 R

7 R

Day Pg. H:M 104°39' (19:00)

121°58' (01:40)

47°43' (01:40)

F3 M:S 28 (01:50)

1°15' (05:00)

1°05' (04:30)

F3 SHA

15°22'

48°48'

GHA 105°07'

138°35'

112°48'

aλ w 113°07'

w 111°35'

-64°

LHA -8

27°

360

(360) 360

27°

296°

LHA 352°

aL N38°  
contrary

N45°  
contrary

N44°  
same

Day Pg. Dec 523°17'

F3 529°32'

N17°52'

L Pg. H 28°32'

12°01'

30°19'

Tbl 5 (d) (-59) -17'

(-57) -30

(39) 34

Hc 28°15'

11°31'

30°53'

Ho 28°49'

11°43'

31°35'

a -34

-12

-42

to

to

to

L Pg. (360) Z 172°

360

95

Zn 172°

-156

95°

204°



# CORRECTIONS TO BE APPLIED TO SEXTANT ALTITUDE A167

## REFRACTION

To be subtracted from sextant altitude (referred to as observed altitude in A.P. 3270)

| $R_0$ | Height above sea level in units of 1 000 ft. |    |    |    |    |    |    |    |    |    |    |    | $R = R_0 \times f$ |     |
|-------|----------------------------------------------|----|----|----|----|----|----|----|----|----|----|----|--------------------|-----|
|       | 0                                            | 5  | 10 | 15 | 20 | 25 | 30 | 35 | 40 | 45 | 50 | 55 | $R_0$              | $f$ |
|       | Sextant Altitude                             |    |    |    |    |    |    |    |    |    |    |    | $R$                |     |
| 0     | 90                                           | 90 | 90 | 90 | 90 | 90 | 90 | 90 | 90 | 90 | 90 | 90 | 0                  | 0   |
| 1     | 63                                           | 59 | 55 | 51 | 46 | 41 | 36 | 31 | 26 | 20 | 17 | 13 | 1                  | 1   |
| 2     | 33                                           | 29 | 26 | 22 | 19 | 16 | 14 | 11 | 9  | 7  | 6  | 4  | 2                  | 2   |
| 3     | 21                                           | 19 | 16 | 14 | 12 | 10 | 8  | 7  | 5  | 4  | 2  | 1  | 3                  | 3   |
| 4     | 12                                           | 11 | 9  | 8  | 7  | 5  | 4  | 3  | 2  | 1  | 0  | 0  | 4                  | 4   |
| 5     | 10                                           | 9  | 7  | 5  | 4  | 3  | 2  | 1  | 0  | 0  | 0  | 0  | 5                  | 5   |
| 6     | 8                                            | 6  | 5  | 4  | 3  | 2  | 1  | 0  | 0  | 0  | 0  | 0  | 6                  | 6   |
| 7     | 6                                            | 5  | 4  | 3  | 2  | 1  | 0  | 0  | 0  | 0  | 0  | 0  | 7                  | 7   |
| 8     | 5                                            | 4  | 3  | 2  | 1  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 8                  | 8   |
| 9     | 4                                            | 3  | 2  | 1  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 9                  | 9   |
| 10    | 3                                            | 2  | 1  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 10                 | 10  |
| 11    | 2                                            | 1  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 11                 | 11  |
| 12    | 1                                            | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 12                 | 12  |
| 13    | 0                                            | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 13                 | 13  |
| 14    | 0                                            | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 14                 | 14  |
| 15    | 0                                            | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 15                 | 15  |
| 16    | 0                                            | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 16                 | 16  |
| 17    | 0                                            | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 17                 | 17  |
| 18    | 0                                            | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 18                 | 18  |
| 19    | 0                                            | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 19                 | 19  |
| 20    | 0                                            | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 20                 | 20  |
| 21    | 0                                            | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 21                 | 21  |
| 22    | 0                                            | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 22                 | 22  |
| 23    | 0                                            | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 23                 | 23  |
| 24    | 0                                            | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 24                 | 24  |
| 25    | 0                                            | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 25                 | 25  |
| 26    | 0                                            | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 26                 | 26  |
| 27    | 0                                            | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 27                 | 27  |
| 28    | 0                                            | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 28                 | 28  |
| 29    | 0                                            | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 29                 | 29  |
| 30    | 0                                            | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 30                 | 30  |
| 31    | 0                                            | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 31                 | 31  |
| 32    | 0                                            | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 32                 | 32  |
| 33    | 0                                            | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 33                 | 33  |
| 34    | 0                                            | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 34                 | 34  |
| 35    | 0                                            | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 35                 | 35  |
| 36    | 0                                            | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 36                 | 36  |
| 37    | 0                                            | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 37                 | 37  |
| 38    | 0                                            | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 38                 | 38  |
| 39    | 0                                            | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 39                 | 39  |
| 40    | 0                                            | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 40                 | 40  |
| 41    | 0                                            | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 41                 | 41  |
| 42    | 0                                            | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 42                 | 42  |
| 43    | 0                                            | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 43                 | 43  |
| 44    | 0                                            | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 44                 | 44  |
| 45    | 0                                            | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 45                 | 45  |
| 46    | 0                                            | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 46                 | 46  |
| 47    | 0                                            | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 47                 | 47  |
| 48    | 0                                            | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 48                 | 48  |
| 49    | 0                                            | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 49                 | 49  |
| 50    | 0                                            | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 50                 | 50  |
| 51    | 0                                            | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 51                 | 51  |
| 52    | 0                                            | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 52                 | 52  |
| 53    | 0                                            | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 53                 | 53  |
| 54    | 0                                            | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 54                 | 54  |
| 55    | 0                                            | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 55                 | 55  |
| 56    | 0                                            | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 56                 | 56  |
| 57    | 0                                            | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 57                 | 57  |
| 58    | 0                                            | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 58                 | 58  |
| 59    | 0                                            | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 59                 | 59  |
| 60    | 0                                            | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 60                 | 60  |

Choose the column appropriate to height, in units of 1 000 ft., and find the range of altitude in which the sextant altitude lies; the corresponding value of  $R_0$  is the refraction, to be subtracted from sextant altitude, unless conditions are extreme. In that case find  $f$  from the lower table, with critical argument temperature. Use the table on the right to form the refraction,  $R = R_0 \times f$ .

## COROLIS (Z) CORRECTION

To be applied by moving the position line a distance  $Z$  to starboard (right) of the track in northern latitudes and to port (left) in southern latitudes.

| G/S<br>KNOTS | Latitude |         |         |         |         |    | G/S<br>KNOTS | Latitude |         |         |         |         |    |
|--------------|----------|---------|---------|---------|---------|----|--------------|----------|---------|---------|---------|---------|----|
|              | 0° 10'   | 20° 30' | 40° 50' | 60° 70' | 80° 90° |    |              | 0° 10'   | 20° 30' | 40° 50' | 60° 70' | 80° 90° |    |
| 150          | 0        | 1       | 2       | 3       | 4       | 4  | 550          | 0        | 3       | 5       | 7       | 9       | 11 |
| 200          | 0        | 1       | 2       | 3       | 4       | 5  | 600          | 0        | 3       | 5       | 8       | 10      | 12 |
| 250          | 0        | 1       | 2       | 3       | 4       | 5  | 650          | 0        | 3       | 6       | 9       | 11      | 13 |
| 300          | 0        | 1       | 3       | 4       | 5       | 6  | 700          | 0        | 3       | 6       | 9       | 12      | 14 |
| 350          | 0        | 2       | 3       | 5       | 6       | 7  | 750          | 0        | 3       | 7       | 10      | 13      | 15 |
| 400          | 0        | 2       | 4       | 5       | 7       | 8  | 800          | 0        | 4       | 7       | 10      | 13      | 16 |
| 450          | 0        | 2       | 4       | 6       | 8       | 9  | 850          | 0        | 4       | 8       | 11      | 14      | 17 |
| 500          | 0        | 2       | 4       | 7       | 8       | 10 | 900          | 0        | 4       | 8       | 12      | 15      | 18 |

Where  $R_0$  is less than 10' or the height greater than 35 000 ft. use  $R = R_0$ .

STANDARD DOME  
REFRACTION

To be subtracted from sextant altitude when using sextant suspension in a perspex dome.

| Alt.<br>° | Refn.<br>' | Alt.<br>° | Refn.<br>' |
|-----------|------------|-----------|------------|
| 10        | 8          | 50        | 4          |
| 20        | 7          | 60        | 4          |
| 30        | 6          | 70        | 3          |
| 40        | 5          | 80        | 3          |

This table must not be used if a calibration table is fitted to the dome, or if a flat glass plate is provided, or for non-standard domes.

## BUBBLE SEXTANT ERROR

| Sextant Number | Alt.<br>° | Corr.<br>' |
|----------------|-----------|------------|
|----------------|-----------|------------|

CORRECTIONS TO BE APPLIED  
TO MARINE SEXTANT ALTITUDES

CORRECTION FOR DIP OF THE HORIZON  
To be subtracted from sextant altitude.

| Ht.<br>Ft. | Dip<br>' | Ht.<br>Ft. | Dip<br>' | Ht.<br>Ft. | Dip<br>' | Ht.<br>Ft. | Dip<br>' |
|------------|----------|------------|----------|------------|----------|------------|----------|
| 0          | 1        | 114        | 11       | 437        | 21       | 968        | 31       |
| 2          | 2        | 137        | 12       | 481        | 22       | 1033       | 32       |
| 6          | 3        | 162        | 13       | 527        | 23       | 1099       | 33       |
| 12         | 4        | 189        | 14       | 575        | 24       | 1168       | 34       |
| 21         | 5        | 218        | 15       | 625        | 25       | 1239       | 35       |
| 31         | 6        | 250        | 16       | 677        | 26       | 1311       | 36       |
| 43         | 7        | 283        | 17       | 731        | 27       | 1386       | 37       |
| 58         | 8        | 318        | 18       | 787        | 28       | 1463       | 38       |
| 75         | 9        | 356        | 19       | 845        | 29       | 1543       | 39       |
| 93         | 10       | 395        | 20       | 906        | 30       | 1624       | 40       |
| 114        |          | 437        |          | 968        |          | 1707       |          |

## CORRECTIONS

In addition to sextant error and dip, corrections are to be applied for:

Refraction  
Semi-diameter (for the Sun and Moon)  
Parallax (for the Moon)  
Dome refraction (if applicable)

## MARINE SEXTANT ERROR

Sextant Number

Index Error

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TABLE 6. — Refraction

To be subtracted from sextant altitude

| Height above sea level in thousands of feet |   |   |    |    |    |    |    |    |    |    |    |    | R = R <sub>0</sub> × f |     |
|---------------------------------------------|---|---|----|----|----|----|----|----|----|----|----|----|------------------------|-----|
| Sextant Altitude                            |   |   |    |    |    |    |    |    |    |    |    |    | f                      |     |
| R <sub>0</sub>                              | 0 | 5 | 10 | 15 | 20 | 25 | 30 | 35 | 40 | 45 | 50 | 55 | R <sub>0</sub>         |     |
| 0                                           | 0 | 0 | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0.9                    | 1.0 |
| 1                                           | 0 | 0 | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1.1                    | 1.2 |
| 2                                           | 0 | 0 | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | R                      |     |
| 3                                           | 0 | 0 | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | f                      |     |
| 4                                           | 0 | 0 | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0.9                    | 1.0 |
| 5                                           | 0 | 0 | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1.1                    | 1.2 |
| 6                                           | 0 | 0 | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | R                      |     |
| 7                                           | 0 | 0 | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | f                      |     |
| 8                                           | 0 | 0 | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0.9                    | 1.0 |
| 9                                           | 0 | 0 | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1.1                    | 1.2 |
| 10                                          | 0 | 0 | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | R                      |     |
| 11                                          | 0 | 0 | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | f                      |     |
| 12                                          | 0 | 0 | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0.9                    | 1.0 |
| 13                                          | 0 | 0 | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1.1                    | 1.2 |
| 14                                          | 0 | 0 | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | R                      |     |
| 15                                          | 0 | 0 | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | f                      |     |
| 16                                          | 0 | 0 | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0.9                    | 1.0 |
| 17                                          | 0 | 0 | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1.1                    | 1.2 |
| 18                                          | 0 | 0 | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | R                      |     |
| 19                                          | 0 | 0 | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | f                      |     |
| 20                                          | 0 | 0 | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0.9                    | 1.0 |
| 21                                          | 0 | 0 | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1.1                    | 1.2 |
| 22                                          | 0 | 0 | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | R                      |     |
| 23                                          | 0 | 0 | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | f                      |     |
| 24                                          | 0 | 0 | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0.9                    | 1.0 |
| 25                                          | 0 | 0 | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1.1                    | 1.2 |
| 26                                          | 0 | 0 | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | R                      |     |
| 27                                          | 0 | 0 | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | f                      |     |
| 28                                          | 0 | 0 | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0.9                    | 1.0 |
| 29                                          | 0 | 0 | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1.1                    | 1.2 |
| 30                                          | 0 | 0 | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | R                      |     |
| 31                                          | 0 | 0 | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | f                      |     |
| 32                                          | 0 | 0 | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0.9                    | 1.0 |
| 33                                          | 0 | 0 | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1.1                    | 1.2 |
| 34                                          | 0 | 0 | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | R                      |     |
| 35                                          | 0 | 0 | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | f                      |     |
| 36                                          | 0 | 0 | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0.9                    | 1.0 |
| 37                                          | 0 | 0 | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1.1                    | 1.2 |
| 38                                          | 0 | 0 | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | R                      |     |
| 39                                          | 0 | 0 | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | f                      |     |
| 40                                          | 0 | 0 | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0.9                    | 1.0 |
| 41                                          | 0 | 0 | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1.1                    | 1.2 |
| 42                                          | 0 | 0 | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | R                      |     |
| 43                                          | 0 | 0 | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | f                      |     |
| 44                                          | 0 | 0 | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0.9                    | 1.0 |
| 45                                          | 0 | 0 | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1.1                    | 1.2 |
| 46                                          | 0 | 0 | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | R                      |     |
| 47                                          | 0 | 0 | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | f                      |     |
| 48                                          | 0 | 0 | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0.9                    | 1.0 |
| 49                                          | 0 | 0 | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1.1                    | 1.2 |
| 50                                          | 0 | 0 | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | R                      |     |
| 51                                          | 0 | 0 | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | f                      |     |
| 52                                          | 0 | 0 | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0.9                    | 1.0 |
| 53                                          | 0 | 0 | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1.1                    | 1.2 |
| 54                                          | 0 | 0 | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | R                      |     |
| 55                                          | 0 | 0 | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | f                      |     |
| 56                                          | 0 | 0 | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0.9                    | 1.0 |
| 57                                          | 0 | 0 | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1.1                    | 1.2 |
| 58                                          | 0 | 0 | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | R                      |     |
| 59                                          | 0 | 0 | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | f                      |     |
| 60                                          | 0 | 0 | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0.9                    | 1.0 |

Choose the column appropriate to height, in units of 1,000 feet, and find the range of altitude in which the sextant altitude lies; thus find R<sub>0</sub>. This is the refraction corresponding to the sextant altitude unless conditions are extreme. In that case find f from the lower table corresponding to the range of temperature for the appropriate height, and use the table on the right to find R. Example: at a height of 30,000 feet and temperature (-) 60° C, a celestial body is observed at altitude (-) 2° 36'. R<sub>0</sub> is 50', f is 1.1 and R is 55'. Subtracting this from the sextant altitude gives (-) 3° 31'.

TABLE 7. — Coriolis (Z) Correction

| Ground speed knots | Latitude |     |     |     |     | Ground speed knots |
|--------------------|----------|-----|-----|-----|-----|--------------------|
|                    | 0°       | 10° | 20° | 30° | 40° |                    |
| 50                 | 0        | 0   | 0   | 0   | 0   | 50                 |
| 100                | 0        | 0   | 0   | 0   | 0   | 100                |
| 150                | 0        | 0   | 0   | 0   | 0   | 150                |
| 200                | 0        | 0   | 0   | 0   | 0   | 200                |
| 250                | 0        | 0   | 0   | 0   | 0   | 250                |
| 300                | 0        | 0   | 0   | 0   | 0   | 300                |
| 350                | 0        | 0   | 0   | 0   | 0   | 350                |
| 400                | 0        | 0   | 0   | 0   | 0   | 400                |
| 450                | 0        | 0   | 0   | 0   | 0   | 450                |
| 500                | 0        | 0   | 0   | 0   | 0   | 500                |
| 550                | 0        | 0   | 0   | 0   | 0   | 550                |
| 600                | 0        | 0   | 0   | 0   | 0   | 600                |
| 650                | 0        | 0   | 0   | 0   | 0   | 650                |
| 700                | 0        | 0   | 0   | 0   | 0   | 700                |
| 750                | 0        | 0   | 0   | 0   | 0   | 750                |
| 800                | 0        | 0   | 0   | 0   | 0   | 800                |
| 850                | 0        | 0   | 0   | 0   | 0   | 850                |
| 900                | 0        | 0   | 0   | 0   | 0   | 900                |

To be applied by moving the position line a distance Z to starboard (right) of the track in northern latitudes and to port (left) in southern latitudes.

| STANDARD DOME REFRACTION                                                                                                                   |              | BUBBLE SEXTANT ERROR |              |
|--------------------------------------------------------------------------------------------------------------------------------------------|--------------|----------------------|--------------|
| To be subtracted from observed altitude when using sextant suspension in a perspex dome.                                                   | Alt. Refn. ° | Sextant No. 2198-43  | Alt. Corr. ° |
|                                                                                                                                            | Alt. Refn. ° |                      |              |
|                                                                                                                                            | 10 8         |                      |              |
|                                                                                                                                            | 20 7         |                      |              |
|                                                                                                                                            | 30 6         |                      |              |
|                                                                                                                                            | 40 5         |                      |              |
| This table must not be used if a calibration table is fitted to the dome, or if a flat glass plate is provided, or for non-standard domes. |              |                      |              |

| STANDARD DOME REFRACTION                                                                                                                   |              | BUBBLE SEXTANT ERROR |              |
|--------------------------------------------------------------------------------------------------------------------------------------------|--------------|----------------------|--------------|
| To be subtracted from observed altitude when using sextant suspension in a perspex dome.                                                   | Alt. Refn. ° | Sextant No. 2198-43  | Alt. Corr. ° |
|                                                                                                                                            | Alt. Refn. ° |                      |              |
|                                                                                                                                            | 10 8         |                      |              |
|                                                                                                                                            | 20 7         |                      |              |
|                                                                                                                                            | 30 6         |                      |              |
|                                                                                                                                            | 40 5         |                      |              |
| This table must not be used if a calibration table is fitted to the dome, or if a flat glass plate is provided, or for non-standard domes. |              |                      |              |



FIX L  
λ  
+

FIX L  
λ  
+

FL  
MC  
MH  
TAS  
GS  
SAT  
W

Air  
ALm  
Pub  
249

Body: Sun

Formalhaut

Moon

DR L N37°37'  
λW113°15'

N44°59'  
W111°47'

N43°47'  
W112°07'

+ 19:01:50

01:45:00

01:44:30

hs 29°04'

11°55'

30°59'

R -1

-2

-1

IC -8

-2

-9

Do -6

-8

-5

P

+51

Ho 28°49'

11°43'

31°35'

A167 Tb17 Z coniolis 7R

8R

7R

Day Pg. H:M 104°39' (19:00)  
F3 M:S 28 (01:50)

Y 121°58' (01:40)  
1°15' (05:00)

C 47°43' (01:40)  
1°05' (04:30)

F3 SHA

15°22'

GHA 105°07'

138°35'

48°48'

aλ w 113°07'

w 111°35'

w 112°48'

LHA -8

27°

-64°

(360) 360

360

LHA 352°

27°

296°

aL N38°  
contrary

N45°  
contrary

N44°  
same

Day Pg. Dec 523°17'

F3 529°32'

N17°52'

L Pg. H 28°32'

12°01'

30°19'

Tb15 (d) (-59) -17'

(-57) -30

(39) 34

Hc 28°15'

11°31'

30°53'

Ho 28°49'

11°43'

31°35'

a -34

-12

-42

to

to

to

L Pg. (360)

360

95

Z 172°

-156

95°

Zn 172°

204°



(DAY 001) GREENWICH A. M. 2017 JANUARY 1 (SUNDAY)

1

| UT    | SUN      | ARIES    | VENUS-43        | JUPITER-1.9 | SATURN0.5 | MOON    | Lat.    | Diff.         |               |         |          |         |         |
|-------|----------|----------|-----------------|-------------|-----------|---------|---------|---------------|---------------|---------|----------|---------|---------|
| h m   | GHA      | Dec.     | GHA             | Dec.        | GHA       | Dec.    | GHA     | Dec.          |               |         |          |         |         |
| 00 00 | 179 08.4 | S22 59.9 | 100 50.2        | 130 39      | S13 41    | 260 49  | S 7 04  | 200 08 S21 52 | 147 06 S15 20 | N       | h m      | m       |         |
| 10 10 | 181 38.3 | 59.9 103 | 206.6 133 09    | 263 19      | 202 39    | 149 31  | 19      | 205 09        | 151 56        | 18      | 72 11 58 | -06     |         |
| 20 20 | 184 08.3 | 59.9 105 | 210.0 135 39    | 265 50      | 205 09    | 151 56  | 18      | 207 59        | 154 21        | 17      | 70 11 30 | +01     |         |
| 30 30 | 186 38.2 | 59.8 108 | 214.4 138 09    | 268 20      | 210 10    | 156 46  | 16      | 212 40        | 159 11        | 14      | 68 11 09 | +05     |         |
| 40 40 | 189 08.2 | 59.8 110 | 218.8 140 38    | 270 50      | 215 10    | 161 36  | 15      | 217 41        | 164 01        | 12      | 64 10 52 | +08     |         |
| 50 50 | 191 38.1 | 59.8 113 | 222.2 143 08    | 273 21      | 217 41    | 164 01  | 12      | 222 42        | 168 26        | 11      | 60 10 27 | +11     |         |
| 01 00 | 194 08.1 | S22 59.7 | 115 52.6 145 38 | S13 40      | 275 51    | 217 41  | 12      | 227 42        | 173 41        | 08      | 54 09 54 | +15     |         |
| 10 10 | 196 38.0 | 59.7 118 | 231.4 148 08    | 278 21      | 220 11    | 168 26  | 11      | 232 43        | 178 31        | 06      | 50 09 42 | +17     |         |
| 20 20 | 199 08.0 | 59.7 120 | 235.5 150 38    | 280 52      | 222 42    | 168 26  | 11      | 237 44        | 183 21        | 04      | 45 09 30 | +18     |         |
| 30 30 | 201 37.9 | 59.6 123 | 239.5 153 08    | 283 22      | 225 12    | 171 16  | 09      | 242 44        | 188 11        | 02      | 40 09 20 | +19     |         |
| 40 40 | 204 07.8 | 59.6 125 | 243.5 155 38    | 285 53      | 227 42    | 173 41  | 08      | 247 45        | 193 01        | 00      | 35 09 12 | +20     |         |
| 50 50 | 206 37.8 | 59.6 128 | 247.5 158 08    | 288 23      | 230 13    | 176 06  | 15      | 252 46        | 197 51        | 00      | 30 09 04 | +21     |         |
| 02 00 | 209 07.8 | S22 59.5 | 130 53.1 160 38 | S13 39      | 290 53    | 230 13  | 06      | 257 47        | 202 41        | 55      | 25 07 54 | +28     |         |
| 10 10 | 211 37.7 | 59.5 133 | 255.1 163 08    | 293 24      | 232 43    | 178 31  | 06      | 262 48        | 207 32        | 53      | 20 07 46 | +29     |         |
| 20 20 | 214 07.7 | 59.5 135 | 259.5 165 38    | 295 54      | 235 13    | 180 56  | 05      | 267 49        | 212 22        | 51      | 15 07 37 | +30     |         |
| 30 30 | 216 37.6 | 59.4 138 | 263.5 168 08    | 298 24      | 237 44    | 183 21  | 04      | 272 50        | 217 12        | 49      | 10 07 27 | +31     |         |
| 40 40 | 219 07.6 | 59.4 140 | 267.5 170 38    | 300 55      | 240 14    | 186 01  | 03      | 277 51        | 222 02        | 46      | 05 07 15 | +32     |         |
| 50 50 | 221 37.5 | 59.4 143 | 272.2 173 08    | 303 25      | 242 44    | 188 11  | 02      | 282 52        | 226 52        | 44      | 00 06 38 | +37     |         |
| 03 00 | 224 07.5 | S22 59.3 | 145 57.6 175 38 | S13 38      | 305 55    | 245 15  | 01      | 287 53        | 231 42        | 42      | 55 07 09 | +33     |         |
| 10 10 | 226 37.4 | 59.3 148 | 280.0 178 08    | 308 26      | 247 45    | 190 36  | 15      | 292 54        | 236 32        | 40      | 50 06 26 | +35     |         |
| 20 20 | 229 07.4 | 59.3 150 | 284.0 180 38    | 310 57      | 250 16    | 193 01  | 13      | 297 55        | 241 22        | 38      | 45 05 14 | +36     |         |
| 30 30 | 231 37.3 | 59.2 152 | 288.0 183 08    | 313 27      | 252 46    | 195 26  | 12      | 302 56        | 246 12        | 35      | 40 04 02 | +37     |         |
| 40 40 | 234 07.3 | 59.2 155 | 292.0 185 38    | 315 57      | 255 17    | 197 51  | 11      | 307 57        | 251 02        | 33      | 35 02 50 | +38     |         |
| 50 50 | 236 37.2 | 59.1 158 | 296.0 188 08    | 318 27      | 257 47    | 200 13  | 10      | 312 58        | 255 52        | 31      | 30 01 38 | +39     |         |
| 04 00 | 239 07.2 | S22 59.1 | 161 00.0 190 38 | S13 37      | 320 58    | 260 17  | 09      | 317 59        | 260 42        | 28      | 25 00 26 | +40     |         |
| 10 10 | 241 37.2 | 59.1 163 | 300.0 193 08    | 323 28      | 262 48    | 263 07  | 08      | 322 59        | 265 32        | 26      | 20 00 14 | +41     |         |
| 20 20 | 244 07.1 | 59.0 166 | 304.0 195 38    | 325 58      | 265 18    | 265 32  | 25      | 327 60        | 270 22        | 24      | 15 00 00 | +42     |         |
| 30 30 | 246 37.1 | 59.0 168 | 313.5 198 08    | 328 28      | 267 48    | 268 02  | 19      | 332 61        | 275 12        | 22      | 10 00 00 | +43     |         |
| 40 40 | 249 07.0 | 59.0 171 | 317.5 200 38    | 330 59      | 270 18    | 270 18  | 18      | 337 62        | 280 02        | 19      | 05 00 00 | +44     |         |
| 50 50 | 251 37.0 | 58.9 173 | 321.5 203 08    | 333 30      | 272 49    | 272 49  | 17      | 342 63        | 284 92        | 17      | 00 00 00 | +45     |         |
| 05 00 | 254 06.9 | S22 58.9 | 176 02.5 205 38 | S13 36      | 336 00    | 275 19  | 16      | 347 64        | 289 82        | 15      | 55 07 09 | +46     |         |
| 10 10 | 256 36.8 | 58.9 178 | 329.0 208 08    | 338 30      | 277 49    | 277 49  | 15      | 352 65        | 294 72        | 13      | 50 06 38 | +36     |         |
| 20 20 | 259 06.8 | 58.8 181 | 333.0 210 38    | 341 01      | 280 20    | 280 20  | 14      | 357 66        | 299 62        | 11      | 45 07 37 | +30     |         |
| 30 30 | 261 36.8 | 58.8 183 | 337.0 213 08    | 343 31      | 282 50    | 282 50  | 13      | 362 67        | 304 52        | 09      | 40 07 15 | +31     |         |
| 40 40 | 264 06.7 | 58.8 186 | 341.0 215 38    | 346 01      | 285 21    | 285 21  | 12      | 367 68        | 309 42        | 07      | 35 07 09 | +33     |         |
| 50 50 | 266 36.7 | 58.7 188 | 345.0 218 08    | 348 32      | 287 51    | 287 51  | 11      | 372 69        | 314 32        | 05      | 30 07 30 | +34     |         |
| 06 00 | 269 06.6 | S22 58.7 | 191 05.0 220 38 | S13 35      | 351 02    | 290 21  | 10      | 377 70        | 319 22        | 03      | 25 07 30 | +35     |         |
| 10 10 | 271 36.5 | 58.7 193 | 354.0 223 08    | 353 32      | 292 52    | 292 52  | 09      | 382 71        | 324 12        | 01      | 20 07 30 | +36     |         |
| 20 20 | 274 06.5 | 58.6 196 | 358.0 225 38    | 356 03      | 295 22    | 295 22  | 08      | 387 72        | 329 02        | 58      | 15 07 30 | +37     |         |
| 30 30 | 276 36.5 | 58.6 198 | 362.0 228 08    | 358 33      | 297 52    | 297 52  | 07      | 392 73        | 333 92        | 56      | 10 07 30 | +38     |         |
| 40 40 | 279 06.4 | 58.6 201 | 366.0 230 38    | 361 04      | 300 23    | 300 23  | 06      | 397 74        | 338 82        | 54      | 05 07 30 | +39     |         |
| 50 50 | 281 36.4 | 58.5 203 | 370.0 233 08    | 363 34      | 302 53    | 302 53  | 05      | 402 75        | 343 72        | 52      | 00 07 30 | +40     |         |
| 07 00 | 284 06.3 | S22 58.5 | 206 07.4 235 38 | S13 34      | 366 04    | 305 23  | 04      | 407 76        | 348 62        | 50      | 55 07 30 | +41     |         |
| 10 10 | 286 36.3 | 58.4 208 | 378.0 238 08    | 368 35      | 307 54    | 307 54  | 03      | 412 77        | 353 52        | 48      | 50 07 30 | +42     |         |
| 20 20 | 289 06.2 | 58.4 211 | 382.0 240 38    | 371 05      | 310 24    | 310 24  | 02      | 417 78        | 358 42        | 46      | 45 07 30 | +43     |         |
| 30 30 | 291 36.2 | 58.4 213 | 386.0 243 08    | 373 35      | 312 55    | 312 55  | 01      | 422 79        | 363 32        | 44      | 40 07 30 | +44     |         |
| 40 40 | 294 06.1 | 58.3 216 | 390.0 245 38    | 376 06      | 315 25    | 315 25  | 00      | 427 80        | 368 22        | 42      | 35 07 30 | +45     |         |
| 50 50 | 296 36.1 | 58.3 218 | 395.0 248 08    | 378 36      | 317 55    | 317 55  | 59      | 432 81        | 373 12        | 40      | 30 07 30 | +46     |         |
| 08 00 | 299 06.0 | S22 58.3 | 221 09.9 250 38 | S13 33      | 381 07    | 320 26  | 00      | 437 82        | 378 02        | 38      | 25 07 30 | +47     |         |
| 10 10 | 301 36.0 | 58.2 223 | 403.0 253 08    | 383 37      | 322 56    | 322 56  | 59      | 442 83        | 382 92        | 36      | 20 07 30 | +48     |         |
| 20 20 | 304 05.9 | 58.2 226 | 407.0 255 38    | 386 07      | 325 26    | 325 26  | 58      | 447 84        | 387 82        | 34      | 15 07 30 | +49     |         |
| 30 30 | 306 35.9 | 58.2 228 | 411.0 258 08    | 388 38      | 327 57    | 327 57  | 57      | 452 85        | 392 72        | 32      | 10 07 30 | +50     |         |
| 40 40 | 309 05.8 | 58.1 231 | 415.0 260 38    | 391 08      | 330 27    | 330 27  | 56      | 457 86        | 397 62        | 30      | 05 07 30 | +51     |         |
| 50 50 | 311 35.8 | 58.1 233 | 419.0 263 08    | 393 38      | 332 57    | 332 57  | 55      | 462 87        | 402 52        | 28      | 00 07 30 | +52     |         |
| 09 00 | 314 05.7 | S22 58.1 | 226 12.4 265 38 | S13 31      | 396 09    | 335 28  | 00      | 467 88        | 407 42        | 26      | 55 07 30 | +53     |         |
| 10 10 | 316 35.7 | 58.0 228 | 428.0 268 08    | 398 39      | 337 58    | 337 58  | 59      | 472 89        | 412 32        | 24      | 50 07 30 | +54     |         |
| 20 20 | 319 05.6 | 58.0 241 | 432.0 270 38    | 401 09      | 340 28    | 340 28  | 58      | 477 90        | 417 22        | 22      | 45 07 30 | +55     |         |
| 30 30 | 321 35.6 | 58.0 243 | 436.0 273 08    | 403 39      | 342 59    | 342 59  | 57      | 482 91        | 422 12        | 20      | 40 07 30 | +56     |         |
| 40 40 | 324 05.5 | 57.9 246 | 440.0 275 38    | 406 10      | 345 29    | 345 29  | 56      | 487 92        | 427 02        | 18      | 35 07 30 | +57     |         |
| 50 50 | 326 35.5 | 57.9 248 | 444.0 278 08    | 408 41      | 348 00    | 348 00  | 55      | 492 93        | 431 92        | 16      | 30 07 30 | +58     |         |
| 10 10 | 329 05.4 | S22 57.8 | 251 14.8 280 38 | S13 30      | 411 11    | 350 30  | 00      | 497 94        | 436 82        | 14      | 25 07 30 | +59     |         |
| 20 20 | 331 35.4 | 57.8 253 | 452.0 283 08    | 413 41      | 353 00    | 353 00  | 59      | 502 95        | 441 72        | 12      | 20 07 30 | +60     |         |
| 30 30 | 334 05.3 | 57.8 256 | 456.0 285 38    | 416 12      | 355 31    | 355 31  | 58      | 507 96        | 446 62        | 10      | 15 07 30 | +61     |         |
| 40 40 | 336 35.3 | 57.7 258 | 460.0 288 08    | 418 42      | 358 01    | 358 01  | 57      | 512 97        | 451 52        | 08      | 10 07 30 | +62     |         |
| 50 50 | 339 05.2 | 57.7 261 | 465.0 290 38    | 421 13      | 360 32    | 360 32  | 56      | 517 98        | 456 42        | 06      | 05 07 30 | +63     |         |
| 11 00 | 341 35.2 | 57.7 263 | 469.0 293 08    | 423 43      | 363 03    | 363 03  | 55      | 522 99        | 461 32        | 04      | 00 07 30 | +64     |         |
| 10 10 | 344 05.1 | S22 57.6 | 266 17.3 295 38 | S13 29      | 426 54    | 366 31  | 00      | 527 00        | 466 22        | 02      | 55 07 30 | +65     |         |
| 20 20 | 346 35.1 | 57.6 268 | 477.0 298 08    | 426 13      | 369 03    | 369 03  | 59      | 532 01        | 471 12        | 00      | 50 07 30 | +66     |         |
| 30 30 | 349 05.0 | 57.6 271 | 481.0 300 38    | 428 44      | 371 34    | 371 34  | 58      | 537 02        | 476 02        | 56      | 45 07 30 | +67     |         |
| 40 40 | 351 35.0 | 57.5 273 | 485.0 303 08    | 431 14      | 374 05    | 374 05  | 57      | 542 03        | 480 92        | 54      | 40 07 30 | +68     |         |
| 50 50 | 354 04.9 | 57.5 276 | 489.0 305 37    | 433 45      | 376 35    | 376 35  | 56      | 547 04        | 485 82        | 52      | 35 07 30 | +69     |         |
| Rate  | 356 34.9 | 14 59.7  | NO 00.2         | 14 59.9     | NO 01.1   | 15 00.2 | 15 00.2 | 15 00.2       | 15 00.2       | 15 00.2 | 15 00.2  | 15 00.2 | 15 00.2 |

# STARS, 2017

| No. | Name        | Mag  | SHA        | Dec     |
|-----|-------------|------|------------|---------|
| 7*  | Acamar      | 3.2  | 315 16     | S 40 14 |
| 5*  | Achernar    | 0.5  | 335 25     | S 57 09 |
| 30* | Acrux       | 1.3  | 173 06     | S 63 12 |
| 19  | Adhara      | 1.5  | 255 10     | S 29 00 |
| 10* | Aldebaran   | 0.9  | 290 46     | N 16 32 |
| 32* | Alioth      | 1.8  | 166 18     | N 55 52 |
| 34* | Alnilad     | 1.9  | 152 57     | N 49 14 |
| 55  | Al No'ir    | 1.7  | 27 40      | S 46 53 |
| 15  | Alnilam     | 1.7  | 275 44     | S 1 12  |
| 25* | Alphard     | 2.0  | 217 53     | S 8 44  |
| 41* | Alphecca    | 2.2  | 126 09     | N 26 40 |
| 1*  | Alpheratz   | 2.1  | 357 41     | N 29 11 |
| 51* | Altair      | 0.8  | 62 06      | N 8 55  |
| 2   | Antares     | 2.4  | 353 13     | S 43 13 |
| 42* | Antares     | 1.0  | 112 23     | S 26 28 |
| 37* | Arcturus    | 0.0  | 145 53     | N 19 06 |
| 43  | Atria       | 1.9  | 107 22     | S 69 03 |
| 22  | Avior       | 1.9  | 234 17     | S 59 34 |
| 13  | Bellatrix   | 1.6  | 278 29     | N 6 22  |
| 16* | Berelgeuse  | 0.1  | 113 270 58 | N 7 24  |
| 17* | Canopus     | -0.7 | 263 55     | S 52 42 |
| 12* | Capella     | 0.1  | 280 30     | N 46 01 |
| 53* | Deneb       | 1.3  | 49 30      | N 45 21 |
| 28* | Denebola    | 2.1  | 182 31     | N 14 29 |
| 4*  | Diphda      | 2.0  | 348 53     | S 17 54 |
| 27* | Dubhe       | 1.8  | 193 49     | N 61 39 |
| 14  | Elnath      | 1.7  | 278 09     | N 28 37 |
| 47  | Eltanin     | 2.2  | 90 45      | N 51 29 |
| 54* | Enif        | 2.4  | 33 44      | N 9 57  |
| 56* | Fomalhaut   | 1.2  | 15 21      | S 29 32 |
| 31  | Gacrax      | 1.6  | 171 58     | S 57 13 |
| 29* | Gienah      | 2.6  | 175 49     | S 17 38 |
| 35  | Hadar       | 0.6  | 148 44     | S 60 27 |
| 6*  | Hamal       | 2.0  | 327 58     | N 23 33 |
| 48  | Kaus Aust.  | 1.9  | 83 40      | S 34 22 |
| 40* | Kochab      | 2.1  | 137 20     | N 74 05 |
| 57  | Markab      | 2.5  | 13 36      | N 15 18 |
| 8*  | Mekkar      | 2.5  | 314 12     | N 4 09  |
| 36  | Meknt       | 2.1  | 148 04     | S 36 27 |
| 24* | Muplaciadus | 1.7  | 221 39     | S 69 47 |
| 9*  | Mirfak      | 1.8  | 308 36     | N 49 55 |
| 50* | Nunki       | 2.0  | 75 55      | S 26 16 |
| 52* | Praecox     | 1.9  | 53 15      | S 56 41 |
| 21* | Pollux      | 1.1  | 243 24     | N 27 59 |
| 20* | Procyon     | 0.4  | 244 57     | N 5 11  |
| 46* | Rasalhague  | 2.1  | 96 04      | N 12 33 |
| 26* | Regulus     | 1.4  | 207 41     | N 11 53 |
| 11* | Rigel       | 0.1  | 281 09     | S 8 11  |
| 38* | Rigel Kent. | -0.3 | 139 48     | S 60 54 |
| 44  | Sorik       | 2.4  | 102 09     | S 15 45 |
| 3*  | Schedar     | 2.2  | 349 37     | N 56 38 |
| 45* | Shaula      | 1.6  | 96 18      | S 37 07 |
| 18* | Sirius      | -1.5 | 258 31     | S 16 45 |
| 33* | Spica       | 1.0  | 158 28     | S 11 15 |
| 23* | Sobell      | 2.2  | 222 50     | S 43 30 |
| 49* | Vega        | 0.0  | 80 37      | N 38 48 |
| 39  | Zubens'abi  | 2.8  | 137 02     | S 16 07 |

# INTERPOLATION OF GHA

Increment to be added for intervals of UT to GHA of Sun, Arctes and planets; Moon.

| SUN, etc. | MOON  | SUN, etc. | MOON     | SUN, etc. | MOON     |
|-----------|-------|-----------|----------|-----------|----------|
| m         | s     | m         | s        | m         | s        |
| 00 00     | 00 00 | 03 17     | 03 25    | 06 37     | 06 52    |
| 01        | 00 01 | 21        | 05 03 29 | 41        | 14 06 56 |
| 05        | 00 02 | 25        | 05 03 33 | 45        | 14 07 00 |
| 09        | 00 03 | 29        | 05 03 37 | 49        | 14 07 04 |
| 13        | 00 04 | 33        | 05 03 41 | 53        | 14 07 08 |
| 17        | 00 05 | 37        | 05 03 45 | 57        | 14 07 13 |
| 21        | 00 06 | 41        | 05 03 49 | 01        | 14 07 17 |
| 25        | 00 07 | 45        | 05 03 54 | 05        | 14 07 21 |
| 29        | 00 08 | 49        | 05 03 58 | 09        | 14 07 25 |
| 33        | 00 09 | 53        | 05 04 02 | 13        | 14 07 29 |
| 37        | 00 10 | 57        | 05 04 06 | 17        | 14 07 33 |
| 41        | 00 11 | 01        | 05 04 10 | 21        | 14 07 37 |
| 45        | 00 12 | 05        | 05 04 14 | 25        | 14 07 42 |
| 49        | 00 13 | 09        | 05 04 18 | 29        | 14 07 46 |
| 53        | 00 14 | 13        | 05 04 23 | 33        | 14 07 50 |
| 57        | 00 15 | 17        | 05 04 27 | 37        | 14 07 54 |
| 01        | 00 16 | 21        | 05 04 31 | 41        | 14 07 58 |
| 05        | 00 17 | 25        | 05 04 35 | 45        | 14 08 02 |
| 09        | 00 18 | 29        | 05 04 39 | 49        | 14 08 06 |
| 13        | 00 19 | 33        | 05 04 43 | 53        | 14 08 11 |
| 17        | 00 20 | 37        | 05 04 48 | 57        | 14 08 15 |
| 21        | 00 21 | 41        | 05 04 52 | 01        | 14 08 19 |
| 25        | 00 22 | 45        | 05 04 56 | 05        | 14 08 23 |
| 29        | 00 23 | 49        | 05 05 00 | 09        | 14 08 27 |
| 33        | 00 24 | 53        | 05 05 04 | 13        | 08 31    |
| 37        | 00 25 | 57        | 05 05 08 | 17        | 08 35    |
| 41        | 00 26 | 01        | 05 05 12 | 21        | 08 39    |
| 45        | 00 27 | 05        | 05 05 16 | 25        | 08 44    |
| 49        | 00 28 | 09        | 05 05 21 | 29        | 08 48    |
| 53        | 00 29 | 13        | 05 05 25 | 33        | 08 52    |
| 57        | 00 30 | 17        | 05 05 29 | 37        | 08 56    |
| 01        | 00 31 | 21        | 05 05 33 | 41        | 09 00    |
| 05        | 00 32 | 25        | 05 05 37 | 45        | 09 04    |
| 09        | 00 33 | 29        | 05 05 41 | 49        | 09 08    |
| 13        | 00 34 | 33        | 05 05 45 | 53        | 09 13    |
| 17        | 00 35 | 37        | 05 05 49 | 57        | 09 17    |
| 21        | 00 36 | 41        | 05 05 53 | 01        | 09 21    |
| 25        | 00 37 | 45        | 05 05 58 | 05        | 09 25    |
| 29        | 00 38 | 49        | 05 06 02 | 09        | 09 29    |
| 33        | 00 39 | 53        | 05 06 06 | 13        | 09 33    |
| 37        | 00 40 | 57        | 05 06 10 | 17        | 09 38    |
| 41        | 00 41 | 01        | 05 06 14 | 21        | 09 42    |
| 45        | 00 42 | 05        | 05 06 19 | 25        | 09 46    |
| 49        | 00 43 | 09        | 05 06 23 | 29        | 09 50    |
| 53        | 00 44 | 13        | 05 06 27 | 33        | 09 54    |
| 57        | 00 45 | 17        | 05 06 31 | 37        | 09 58    |
| 01        | 00 46 | 21        | 05 06 35 | 41        | 10 00    |
| 05        | 00 47 | 25        | 05 06 39 | 45        | 10 04    |
| 09        | 00 48 | 29        | 05 06 43 | 49        | 10 08    |
| 13        | 00 49 | 33        | 05 06 48 | 53        | 10 12    |
| 17        | 00 50 | 37        | 05 06 52 | 57        | 10 16    |
| 21        | 00 51 | 41        | 05 06 56 | 01        | 10 20    |
| 25        | 00 52 | 45        | 05 06 59 | 05        | 10 24    |
| 29        | 00 53 | 49        | 05 07 03 | 09        | 10 28    |
| 33        | 00 54 | 53        | 05 07 07 | 13        | 10 32    |
| 37        | 00 55 | 57        | 05 07 11 | 17        | 10 36    |
| 41        | 00 56 | 01        | 05 07 15 | 21        | 10 40    |
| 45        | 00 57 | 05        | 05 07 19 | 25        | 10 44    |
| 49        | 00 58 | 09        | 05 07 23 | 29        | 10 48    |
| 53        | 00 59 | 13        | 05 07 27 | 33        | 10 52    |
| 57        | 00 60 | 17        | 05 07 31 | 37        | 10 56    |
| 01        | 00 61 | 21        | 05 07 35 | 41        | 11 00    |
| 05        | 00 62 | 25        | 05 07 39 | 45        | 11 04    |
| 09        | 00 63 | 29        | 05 07 43 | 49        | 11 08    |
| 13        | 00 64 | 33        | 05 07 47 | 53        | 11 12    |
| 17        | 00 65 | 37        | 05 07 51 | 57        | 11 16    |
| 21        | 00 66 | 41        | 05 07 55 | 01        | 11 20    |
| 25        | 00 67 | 45        | 05 07 59 | 05        | 11 24    |
| 29        | 00 68 | 49        | 05 08 03 | 09        | 11 28    |
| 33        | 00 69 | 53        | 05 08 07 | 13        | 11 32    |
| 37        | 00 70 | 57        | 05 08 11 | 17        | 11 36    |
| 41        | 00 71 | 01        | 05 08 15 | 21        | 11 40    |
| 45        | 00 72 | 05        | 05 08 19 | 25        | 11 44    |
| 49        | 00 73 | 09        | 05 08 23 | 29        | 11 48    |
| 53        | 00 74 | 13        | 05 08 27 | 33        | 11 52    |
| 57        | 00 75 | 17        | 05 08 31 | 37        | 11 56    |
| 01        | 00 76 | 21        | 05 08 35 | 41        | 12 00    |
| 05        | 00 77 | 25        | 05 08 39 | 45        | 12 04    |
| 09        | 00 78 | 29        | 05 08 43 | 49        | 12 08    |
| 13        | 00 79 | 33        | 05 08 47 | 53        | 12 12    |
| 17        | 00 80 | 37        | 05 08 51 | 57        | 12 16    |
| 21        | 00 81 | 41        | 05 08 55 | 01        | 12 20    |
| 25        | 00 82 | 45        | 05 08 59 | 05        | 12 24    |
| 29        | 00 83 | 49        | 05 09 03 | 09        | 12 28    |
| 33        | 00 84 | 53        | 05 09 07 | 13        | 12 32    |
| 37        | 00 85 | 57        | 05 09 11 | 17        | 12 36    |
| 41        | 00 86 | 01        | 05 09 15 | 21        | 12 40    |
| 45        | 00 87 | 05        | 05 09 19 | 25        | 12 44    |
| 49        | 00 88 | 09        | 05 09 23 | 29        | 12 48    |
| 53        | 00 89 | 13        | 05 09 27 | 33        | 12 52    |
| 57        | 00 90 | 17        | 05 09 31 | 37        | 12 56    |
| 01        | 00 91 | 21        | 05 09 35 | 41        | 13 00    |
| 05        | 00 92 | 25        | 05 09 39 | 45        | 13 04    |
| 09        | 00 93 | 29        | 05 09 43 | 49        | 13 08    |
| 13        | 00 94 | 33        | 05 09 47 | 53        | 13 12    |
| 17        | 00 95 | 37        | 05 09 51 | 57        | 13 16    |
| 21        | 00 96 | 41        | 05 09 55 | 01        | 13 20    |
| 25        | 00 97 | 45        | 05 09 59 | 05        | 13 24    |
| 29        | 00 98 | 49        | 05 10 03 | 09        | 13 28    |
| 33        | 00 99 | 53        | 05 10 07 | 13        | 13 32    |
| 37        | 01 00 | 57        | 05 10 11 | 17        | 13 36    |
| 41        | 01 01 | 01        | 05 10 15 | 21        | 13 40    |
| 45        | 01 02 | 05        | 05 10 19 | 25        | 13 44    |
| 49        | 01 03 | 09        | 05 10 23 | 29        | 13 48    |
| 53        | 01 04 | 13        | 05 10 27 | 33        | 13 52    |
| 57        | 01 05 | 17        | 05 10 31 | 37        | 13 56    |
| 01        | 01 06 | 21        | 05 10 35 | 41        | 14 00    |
| 05        | 01 07 | 25        | 05 10 39 | 45        | 14 04    |
| 09        | 01 08 | 29        | 05 10 43 | 49        | 14 08    |
| 13        | 01 09 | 33        | 05 10 47 | 53        | 14 12    |
| 17        | 01 10 | 37        | 05 10 51 | 57        | 14 16    |
| 21        | 01 11 | 41        | 05 10 55 | 01        | 14 20    |
| 25        | 01 12 | 45        | 05 10 59 | 05        | 14 24    |
| 29        | 01 13 | 49        | 05 11 03 | 09        | 14 28    |
| 33        | 01 14 | 53        | 05 11 07 | 13        | 14 32    |
| 37        | 01 15 | 57        | 05 11 11 | 17        | 14 36    |
| 41        | 01 16 | 01        | 05 11 15 | 21        | 14 40    |
| 45        | 01 17 | 05        | 05 11 19 | 25        | 14 44    |
| 49        | 01 18 | 09        | 05 11 23 | 29        | 14 48    |
| 53        | 01 19 | 13        | 05 11 27 | 33        | 14 52    |
| 57        | 01 20 | 17        | 05 11 31 | 37        | 14 56    |
| 01        | 01 21 | 21        | 05 11 35 | 41        | 15 00    |
| 05        | 01 22 | 25        | 05 11 39 | 45        | 15 04    |
| 09        | 01 23 | 29        | 05 11 43 | 49        | 15 08    |
| 13        | 01 24 | 33        | 05 11 47 | 53        | 15 12    |
| 17        | 01 25 | 37        | 05 11 51 | 57        | 15 16    |
| 21        | 01 26 | 41        | 05 11 55 | 01        | 15 20    |
| 25        | 01 27 | 45        | 05 11 59 | 05        | 15 24    |
| 29        | 01 28 | 49        | 05 12 03 | 09        | 15 28    |
| 33        | 01 29 | 53        | 05 12 07 | 13        | 15 32    |
| 37        | 01 30 | 57        | 05 12 11 | 17        | 15 36    |
| 41        | 01 31 | 01        | 05 12 15 | 21        | 15 40    |
| 45        | 01 32 | 05        | 05 12 19 | 25        | 15 44    |
| 49        | 01 33 | 09        | 05 12 23 | 29        | 15 48    |
| 53        | 01 34 | 13        | 05 12 27 | 33        | 15 52    |
| 57        | 01 35 | 17        | 05 12 31 | 37        | 15 56    |
| 01        | 01 36 | 21        | 05 12 35 | 41        | 16 00    |
| 05        | 01 37 | 25        | 05 12 39 | 45        | 16 04    |
| 09        | 01 38 | 29        | 05 12 43 | 49        | 16 08    |
| 13        | 01 39 | 33        | 05 12 47 | 53        | 16 12    |
| 17        | 01 40 | 37        | 05 12 51 | 57        | 16 16    |
| 21        | 01 41 | 41        | 05 12 55 | 01        | 16 20    |
| 25        | 01 42 | 45        | 05 12 59 | 05        | 16 24    |
| 29        | 01 43 | 49        | 05 13 03 | 09        | 16 28    |
| 33        | 01 44 | 53        | 05 13 07 | 13        | 16 32    |
| 37        | 01 45 | 57        | 05 13 11 | 17        | 16 36    |
| 41        | 01 46 | 01        | 05 13 15 | 21        | 16 40    |
| 45        | 01 47 | 05        | 05 13 19 | 25        | 16 44    |
| 49        | 01 48 | 09        | 05 13 23 | 29        | 16 48    |
| 53        | 01 49 | 13        | 05 13 27 | 33        | 16 52    |
| 57        | 01 50 | 17        | 05 13 31 | 37        | 16 56    |
| 01        | 01 51 | 21        | 05 13 35 | 41        | 17 00    |
| 05        | 01 52 | 25        | 05 13 39 | 45        | 17 04    |
| 09        | 01 53 | 29        | 05 13 43 | 49        | 17 08    |
| 13        | 01 54 | 33        | 05 13 47 | 53        | 17 12    |
| 17        | 01 55 | 37        | 05 13 51 | 57        | 17 16    |
| 21        | 01 56 | 41        | 05 13 55 | 01        | 17 20    |
| 25        | 01 57 | 45        | 05 13 59 | 05        | 17 24    |
| 29        | 01 58 | 49        | 05 14 03 | 09        | 17 28    |
| 33        | 01 59 | 53        | 05 14 07 | 13        | 17 32    |
| 37        | 02 00 | 57        | 05 14 11 | 17        | 17 36    |
| 41        | 02 01 | 01        | 05 14 15 | 21        | 17 40    |
| 45        | 02 02 | 05        | 05 14 19 | 25        | 17 44    |
| 49        | 02 03 | 09        | 05 14 23 | 29        | 17 48    |
| 53        | 02 04 | 13        | 05 14 27 | 33        | 17 52    |
| 57        | 02 05 | 17        | 05 14 31 | 37        | 17 56    |
| 01        | 02 06 | 21        | 05 14 35 | 41        | 18 00    |
| 05        | 02 07 | 25        | 05 14 39 | 45        | 18 04    |
| 09        | 02 08 | 29        | 05 14 43 | 49        | 18 08    |
| 13        | 02 09 | 33        | 05 14 47 | 53        | 18 12    |
| 17        | 02 10 | 37        | 05 14 51 | 57        | 18 16    |
| 21        | 02 11 | 41        | 05 14 55 | 01        | 18 20    |
| 25        | 02 12 | 45        | 05 14 59 | 05        | 18 24    |
| 29        | 02 13 | 49        | 05 15 03 | 09        | 18 28    |
| 33        | 02 14 | 53        | 05 15 07 | 13        | 18 32    |
| 37        | 02 15 | 57        | 05 15 11 | 17        | 18 36    |
| 41        | 02 16 | 01        | 05 15 15 | 21        | 18 40    |
| 45        | 02 17 | 05        | 05 15 19 | 25        | 18 44    |
| 49        | 02 18 | 09        | 05 15 23 | 29        | 18 48    |
| 53        | 02 19 | 13        | 05 15 27 | 33        | 18 52    |
| 57        | 02 20 | 17        | 05 15 31 | 37        | 18 56    |
| 01        | 02 21 | 21        | 05 15 35 | 41        | 19 00    |
| 05        | 02 22 | 25        | 05 15 39 | 45        | 19 04    |
| 09        | 02 23 | 29        | 05 15 43 | 49        | 19 08    |
| 13        | 02 24 | 33        | 05 15 47 | 53        | 19 12    |
| 17        | 02 25 | 37        | 05 15 51 | 57        | 19 16    |
| 21        | 02 26 | 41        | 05 15 55 | 01        | 19 20    |
| 25        | 02 27 | 45        | 05 15 59 | 05        | 19 24    |
| 29        | 02 28 | 49        | 05 16 03 | 09        | 19 28    |
| 33        | 02 29 | 53        | 05 16 07 | 13        | 19 32    |
| 37        | 02 30 | 57        | 05 16 11 | 17        | 19 36    |
| 41        | 02 31 | 01        | 05 16 15 | 21        | 19 40    |
| 45        | 02 32 | 05        | 05 16 19 | 25        | 19 44    |
| 49        | 02 33 | 09        | 05 16 23 | 29        | 19 48    |
| 53        | 02 34 | 13        | 05 16 27 | 33        | 19 52    |
| 57        | 02 35 | 17        | 05 16 31 | 37        | 19 56    |
| 01        | 02 36 | 21        | 05 16 35 | 41        | 20 00    |
| 05        | 02 37 | 25        | 05 16 39 | 45        | 20 04    |
| 09        | 02 38 | 29        | 05 16 43 | 49        | 20 08    |
| 13        | 02 39 | 33        | 05 16 47 | 53        | 20 12    |
| 17        | 02 40 | 37        | 05 16 51 | 57        | 20 16    |
| 21        | 02 41 | 41        | 05 16 55 | 01        | 20 20    |
| 25        | 02 42 | 45        | 05 16 59 | 05        | 20 24    |
| 29        | 02 43 | 49        | 05 17 03 | 09        | 20 28    |
| 33        | 02 44 | 53        | 05 17 07 | 13        | 20 32    |
| 37        | 02 45 | 57        | 05 17 11 | 17        | 20 36    |
| 41        | 02 46 | 01        | 05 17 15 | 21        | 20 40    |
| 45        | 02 47 | 05        | 05 17 19 | 25        | 20 44    |
| 49        | 02 48 | 09        | 05 17 23 | 29        | 20 48    |
| 53        | 02 49 | 13        | 05 17 27 | 33        | 20 52    |
| 57        | 02 50 | 17        | 05 17 31 | 37</      |          |



FIX L  
λ  
+

FIX L  
λ  
+

FL  
MC  
MH  
TAS  
GS  
SAT  
W

Air  
ALm  
Pub  
249

Body: Sun

Formalhaut

Moon

DR L N37°37'  
λW113°15'

N44°59'  
W111°47'

N43°47'  
W112°07'

+ 19:01:50

01:45:00

01:44:30

hs 29°04'

11°55'

30°59'

R -1

-2

-1

IC -8

-2

-9

Do -6

-8

-5

P

+51

Ho 28°49'

11°43'

31°35'

A167 Tb17 Z coniolis 7R

8R

7R

Day Pg. H:M 104°39' (19:00)  
F3 M:S 28 (01:50)

Y 121°58' (01:40)  
1°15' (05:00)

C 47°43' (01:40)  
1°05' (04:30)

F3 SHA

15°22'

GHA 105°07'

138°35'

48°48'

aλ w 113°07'

w 111°35'

w 112°48'

LHA -8

27°

-64°

(360) 360

360

LHA 352°

27°

296°

aL N38°  
contrary

N45°  
contrary

N44°  
same

Day Pg. Dec 523°17'

F3 529°32'

N17°52'

L Pg. H 28°32'

12°01'

30°19'

Tb15 (d) (-59) -17'

(-57) -30

(39) 34

Hc 28°15'

11°31'

30°53'

Ho 28°49'

11°43'

31°35'

a -34

-12

-42

to

to

to

L Pg. (360)

360

95

Z 172°

-156

95°

Zn 172°

204°











N. Lat. { L.H.A. greater than 180° .....Zn=Z  
L.H.A. less than 180° .....Zn=360°-Z

# DECLINATION (0° - 14°) CONT.

| LHA | 0°    |     |     | 1°    |     |     | 2°    |     |     | 3°    |     |     | 4°    |     |     | 5°    |     |     | 6°    |     |     | 7     |
|-----|-------|-----|-----|-------|-----|-----|-------|-----|-----|-------|-----|-----|-------|-----|-----|-------|-----|-----|-------|-----|-----|-------|
|     | Hc    | d   | Z   | Hc    | d   | Z   | Hc    | d   | Z   | Hc    | d   | Z   | Hc    | d   | Z   | Hc    | d   | Z   | Hc    | d   | Z   | Hc    |
| 69  | 15 42 | -41 | 104 | 15 01 | -42 | 105 | 14 19 | -41 | 106 | 13 38 | -41 | 106 | 12 57 | -42 | 107 | 12 15 | -41 | 108 | 11 34 | -42 | 109 | 10 52 |
| 68  | 16 25 | -41 | 105 | 15 44 | -41 | 106 | 15 03 | -41 | 106 | 14 22 | -42 | 107 | 13 40 | -42 | 108 | 12 58 | -42 | 109 | 12 16 | -41 | 109 | 11 35 |
| 67  | 17 09 | -41 | 106 | 16 28 | -42 | 106 | 15 46 | -41 | 107 | 15 05 | -42 | 108 | 14 23 | -42 | 109 | 13 41 | -42 | 109 | 12 59 | -42 | 110 | 12 17 |
| 66  | 17 53 | -42 | 106 | 17 11 | -41 | 107 | 16 30 | -42 | 108 | 15 48 | -42 | 109 | 15 06 | -42 | 109 | 14 24 | -42 | 110 | 13 42 | -43 | 111 | 12 59 |
| 65  | 18 36 | -42 | 107 | 17 54 | -41 | 108 | 17 13 | -42 | 109 | 16 31 | -43 | 109 | 15 48 | -42 | 110 | 15 06 | -42 | 111 | 14 24 | -43 | 111 | 13 41 |
| 64  | 19 19 | -42 | 108 | 18 37 | -42 | 109 | 17 55 | -42 | 109 | 17 13 | -42 | 110 | 16 31 | -43 | 111 | 15 48 | -42 | 111 | 15 06 | -43 | 112 | 14 23 |
| 63  | 20 02 | -42 | 108 | 19 20 | -42 | 109 | 18 38 | -42 | 110 | 17 56 | -43 | 111 | 17 13 | -43 | 111 | 16 30 | -42 | 112 | 15 48 | -43 | 113 | 15 05 |
| 62  | 20 45 | -42 | 109 | 20 03 | -42 | 110 | 19 21 | -43 | 111 | 18 38 | -43 | 111 | 17 55 | -43 | 112 | 17 12 | -43 | 113 | 16 29 | -43 | 114 | 15 46 |
| 61  | 21 28 | -43 | 110 | 20 45 | -42 | 111 | 20 03 | -43 | 111 | 19 20 | -43 | 112 | 18 37 | -43 | 113 | 17 54 | -43 | 114 | 17 11 | -44 | 114 | 16 27 |
| 60  | 22 10 | -42 | 111 | 21 28 | -43 | 112 | 20 45 | -43 | 112 | 20 02 | -43 | 113 | 19 19 | -44 | 114 | 18 35 | -43 | 114 | 17 52 | -44 | 115 | 17 08 |
| 59  | 22 52 | -42 | 112 | 22 10 | -43 | 112 | 21 27 | -44 | 113 | 20 43 | -43 | 114 | 20 00 | -44 | 115 | 19 16 | -43 | 115 | 18 33 | -44 | 116 | 17 49 |
| 58  | 23 34 | -43 | 112 | 22 51 | -43 | 113 | 22 08 | -43 | 114 | 21 25 | -44 | 115 | 20 41 | -44 | 115 | 19 57 | -44 | 116 | 19 13 | -44 | 117 | 18 29 |
| 57  | 24 16 | -43 | 113 | 23 33 | -44 | 114 | 22 49 | -43 | 115 | 22 06 | -44 | 115 | 21 22 | -44 | 116 | 20 38 | -45 | 117 | 19 53 | -44 | 118 | 19 09 |
| 56  | 24 58 | -44 | 114 | 24 14 | -44 | 115 | 23 30 | -43 | 115 | 22 47 | -45 | 116 | 22 02 | -44 | 117 | 21 18 | -45 | 118 | 20 33 | -44 | 118 | 19 49 |
| 55  | 25 39 | -44 | 115 | 24 55 | -44 | 115 | 24 11 | -44 | 116 | 23 27 | -44 | 117 | 22 43 | -45 | 118 | 21 58 | -45 | 118 | 21 13 | -45 | 119 | 20 28 |
| 54  | 26 20 | -44 | 115 | 25 36 | -44 | 116 | 24 52 | -45 | 117 | 24 07 | -44 | 118 | 23 23 | -45 | 118 | 22 38 | -45 | 119 | 21 53 | -46 | 120 | 21 07 |
| 53  | 27 01 | -45 | 116 | 26 16 | -44 | 117 | 25 32 | -45 | 118 | 24 47 | -45 | 119 | 24 02 | -45 | 119 | 23 17 | -45 | 120 | 22 32 | -46 | 121 | 21 46 |
| 52  | 27 41 | -44 | 117 | 26 57 | -45 | 118 | 26 12 | -45 | 119 | 25 27 | -45 | 119 | 24 42 | -46 | 120 | 23 56 | -46 | 121 | 23 10 | -45 | 122 | 22 25 |
| 51  | 28 21 | -44 | 118 | 27 37 | -46 | 119 | 26 51 | -45 | 119 | 26 06 | -45 | 120 | 25 21 | -46 | 121 | 24 35 | -46 | 122 | 23 49 | -46 | 122 | 23 03 |
| 50  | 29 01 | -45 | 119 | 28 16 | -45 | 120 | 27 31 | -46 | 120 | 26 45 | -46 | 121 | 25 59 | -46 | 122 | 25 13 | -46 | 122 | 24 27 | -46 | 123 | 23 41 |
| 49  | 29 41 | -46 | 120 | 28 55 | -45 | 120 | 28 10 | -46 | 121 | 27 24 | -46 | 122 | 26 38 | -47 | 123 | 25 51 | -46 | 123 | 25 05 | -47 | 124 | 24 18 |
| 48  | 30 20 | -46 | 121 | 29 34 | -46 | 121 | 28 48 | -46 | 122 | 28 02 | -46 | 123 | 27 16 | -47 | 123 | 26 29 | -47 | 124 | 25 42 | -47 | 125 | 24 55 |
| 47  | 30 59 | -46 | 121 | 30 13 | -47 | 122 | 29 26 | -46 | 123 | 28 40 | -47 | 124 | 27 53 | -47 | 124 | 27 06 | -47 | 125 | 26 19 | -47 | 126 | 25 32 |
| 46  | 31 37 | -46 | 122 | 30 51 | -47 | 123 | 30 04 | -47 | 124 | 29 17 | -47 | 125 | 28 30 | -47 | 125 | 27 43 | -48 | 126 | 26 55 | -47 | 127 | 26 08 |
| 45  | 32 15 | -46 | 123 | 31 29 | -47 | 124 | 30 42 | -48 | 125 | 29 54 | -47 | 125 | 29 07 | -48 | 126 | 28 19 | -47 | 127 | 27 32 | -48 | 128 | 26 44 |
| 44  | 32 53 | -47 | 124 | 32 06 | -47 | 125 | 31 19 | -48 | 126 | 30 31 | -48 | 126 | 29 43 | -48 | 127 | 28 55 | -48 | 128 | 28 07 | -48 | 128 | 27 19 |
| 43  | 33 30 | -47 | 125 | 32 43 | -48 | 126 | 31 55 | -48 | 127 | 31 07 | -48 | 127 | 30 19 | -48 | 128 | 29 31 | -48 | 129 | 28 43 | -49 | 129 | 27 54 |
| 42  | 34 07 | -48 | 126 | 33 19 | -48 | 127 | 32 31 | -48 | 128 | 31 43 | -48 | 128 | 30 55 | -49 | 129 | 30 06 | -49 | 130 | 29 17 | -49 | 130 | 28 28 |
| 41  | 34 43 | -48 | 127 | 33 55 | -48 | 128 | 33 07 | -49 | 128 | 32 18 | -48 | 129 | 31 30 | -49 | 130 | 30 41 | -49 | 131 | 29 52 | -50 | 131 | 29 02 |







FIX L  
λ  
+

FIX L  
λ  
+

FL  
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SAT  
W

Air  
ALm  
Pub  
249

Body: Sun

Formalhaut

Moon

DR L N37°37'  
λW113°15'

N44°59'  
W111°47'

N43°47'  
W112°07'

+ 19:01:50

01:45:00

01:44:30

hs 29°04'

11°55'

30°59'

R -1

-2

-1

IC -8

-2

-9

Do -6

-8

-5

P

+51

Ho 28°49'

11°43'

31°35'

A167 Tb17 Z coniolis 7R

8R

7R

Day Pg. H:M 104°39' (19:00)  
F3 M:S 28 (01:50)

Y 121°58' (01:40)  
1°15' (05:00)

C 47°43' (01:40)  
1°05' (04:30)

F3 SHA

15°22'

GHA 105°07'

138°35'

48°48'

aλ w 113°07'

w 111°35'

w 112°48'

LHA -8

27°

-64°

(360) 360

360

LHA 352°

27°

296°

aL N38°  
contrary

N45°  
contrary

N44°  
same

Day Pg. Dec 523°17'

F3 529°32'

N17°52'

L Pg. H 28°32'

12°01'

30°19'

Tb15 (d) (-59) -17'

(-57) -30

(39) 34

Hc 28°15'

11°31'

30°53'

Ho 28°49'

11°43'

31°35'

a -34

-12

-42

to

to

to

L Pg. (360)

360

95

Z 172°

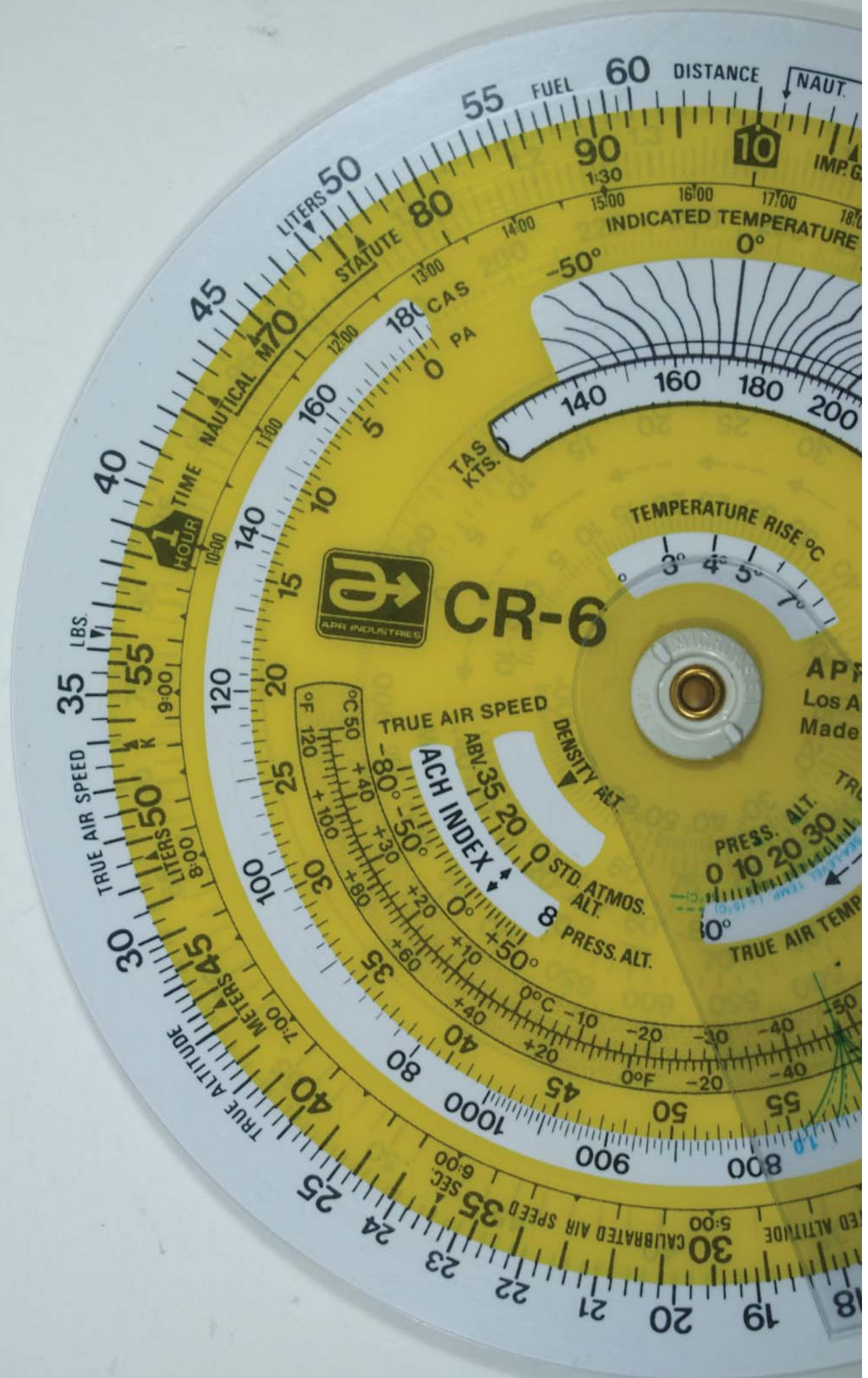
-156

95°

Zn 172°

204°







# LINE OF POSITION BOOK

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WEEMS

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FOURTH EDITION

WEEMS SYSTEM OF NAVIGATION  
ANNAPOLIS, MARYLAND  
1943



# LINE OF POSITION BOOK

FOURTH EDITION

BY

LIEUTENANT COMMANDER P. V. H. WEEMS, U. S. NAVY

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[illegible]



TABLE A

| H.A.<br>Lat. | 16° (1h 4m) |    |      | 17° (1h 8m) |    |      | 18° (1h 12m) |    |       | 19° (1h 16m) |    |       | 20° (1h 20m) |    |       |
|--------------|-------------|----|------|-------------|----|------|--------------|----|-------|--------------|----|-------|--------------|----|-------|
|              | A           | K  | '    | A           | K  | '    | A            | K  | '     | A            | K  | '     | A            | K  | '     |
| 0            | 1715.8      | 0  | 0.0  | 1940.4      | 0  | 0.0  | 2179.4       | 0  | 0.0   | 2433.0       | 0  | 0.0   | 2701.4       | 0  | 0.0   |
| 1            | 1715.3      | 1  | 2.4  | 1939.7      | 1  | 2.7  | 2178.6       | 1  | 3.1   | 2432.2       | 1  | 3.5   | 2700.6       | 1  | 3.8   |
| 2            | 1713.7      | 2  | 4.8  | 1937.9      | 2  | 5.5  | 2176.6       | 2  | 6.2   | 2429.8       | 2  | 6.9   | 2697.9       | 2  | 7.7   |
| 3            | 1711.0      | 3  | 7.2  | 1934.8      | 3  | 8.2  | 2173.1       | 3  | 9.2   | 2426.0       | 3  | 10.4  | 2693.5       | 3  | 11.5  |
| 4            | 1707.2      | 4  | 9.6  | 1930.5      | 4  | 10.9 | 2168.2       | 4  | 12.3  | 2420.5       | 4  | 13.8  | 2687.4       | 4  | 15.3  |
| 5            | 1702.3      | 5  | 12.0 | 1925.0      | 5  | 13.6 | 2162.0       | 5  | 15.4  | 2413.4       | 5  | 17.2  | 2679.6       | 5  | 19.1  |
| 6            | 1696.4      | 6  | 14.4 | 1918.2      | 6  | 16.3 | 2154.3       | 6  | 18.4  | 2404.9       | 6  | 20.6  | 2670.0       | 6  | 22.9  |
| 7            | 1689.4      | 7  | 16.7 | 1910.3      | 7  | 19.0 | 2145.4       | 7  | 21.4  | 2394.8       | 7  | 23.9  | 2658.7       | 7  | 26.7  |
| 8            | 1681.3      | 8  | 19.1 | 1901.1      | 8  | 21.6 | 2135.0       | 8  | 24.4  | 2383.2       | 8  | 27.3  | 2645.8       | 8  | 30.4  |
| 9            | 1672.2      | 9  | 21.4 | 1890.8      | 9  | 24.2 | 2123.3       | 9  | 27.3  | 2370.1       | 9  | 30.6  | 2631.1       | 9  | 34.0  |
| 10           | 1662.1      | 10 | 23.7 | 1879.3      | 10 | 26.8 | 2110.4       | 10 | 30.2  | 2355.5       | 10 | 33.8  | 2614.8       | 10 | 37.7  |
| 11           | 1650.9      | 11 | 25.9 | 1866.6      | 11 | 29.4 | 2096.1       | 11 | 33.1  | 2339.5       | 11 | 37.0  | 2596.9       | 11 | 41.2  |
| 12           | 1638.8      | 12 | 28.1 | 1852.8      | 12 | 31.9 | 2080.5       | 12 | 35.9  | 2322.0       | 12 | 40.2  | 2577.4       | 12 | 44.7  |
| 13           | 1625.7      | 13 | 30.3 | 1837.9      | 13 | 34.3 | 2063.7       | 13 | 38.7  | 2303.1       | 13 | 43.3  | 2556.3       | 13 | 48.2  |
| 14           | 1611.6      | 14 | 32.4 | 1821.9      | 14 | 36.8 | 2045.6       | 14 | 41.4  | 2282.8       | 14 | 46.3  | 2533.7       | 14 | 51.6  |
| 15           | 1596.6      | 15 | 34.5 | 1804.8      | 15 | 39.1 | 2026.4       | 15 | 44.1  | 2261.2       | 15 | 49.3  | 2509.6       | 15 | 54.9  |
| 16           | 1580.6      | 16 | 36.6 | 1786.7      | 16 | 41.5 | 2005.9       | 16 | 46.7  | 2238.3       | 16 | 52.3  | 2484.0       | 16 | 58.2  |
| 17           | 1563.8      | 17 | 38.6 | 1767.6      | 17 | 43.7 | 1984.3       | 17 | 49.2  | 2214.0       | 17 | 55.1  | 2456.9       | 17 | 63.5  |
| 18           | 1546.0      | 18 | 40.6 | 1747.4      | 18 | 46.0 | 1961.5       | 18 | 51.7  | 2188.5       | 18 | 57.9  | 2428.4       | 18 | 69.8  |
| 19           | 1527.4      | 19 | 42.5 | 1726.3      | 19 | 48.1 | 1937.7       | 19 | 54.2  | 2161.8       | 19 | 63.5  | 2398.6       | 19 | 76.1  |
| 20           | 1508.0      | 20 | 44.3 | 1704.2      | 20 | 50.2 | 1912.8       | 20 | 56.5  | 2133.9       | 20 | 69.8  | 2367.5       | 20 | 84.4  |
| 21           | 1487.7      | 21 | 46.1 | 1681.3      | 21 | 52.2 | 1886.9       | 21 | 58.8  | 2104.8       | 21 | 77.1  | 2335.1       | 21 | 93.7  |
| 22           | 1466.7      | 22 | 47.8 | 1657.4      | 22 | 54.2 | 1860.0       | 22 | 65.9  | 2074.7       | 22 | 86.2  | 2301.5       | 22 | 104.0 |
| 23           | 1445.0      | 23 | 49.5 | 1632.7      | 23 | 56.1 | 1832.2       | 23 | 73.6  | 2043.5       | 23 | 98.1  | 2266.6       | 23 | 115.3 |
| 24           | 1422.5      | 24 | 51.1 | 1607.2      | 24 | 57.9 | 1803.4       | 24 | 82.4  | 2011.2       | 24 | 109.6 | 2230.7       | 24 | 127.6 |
| 25           | 1399.3      | 25 | 52.7 | 1580.8      | 25 | 59.7 | 1773.7       | 25 | 91.1  | 1978.0       | 25 | 122.9 | 2193.6       | 25 | 142.1 |
| 26           | 1375.4      | 26 | 54.2 | 1553.8      | 26 | 61.3 | 1743.2       | 26 | 100.0 | 1943.8       | 26 | 132.9 | 2155.5       | 26 | 153.6 |
| 27           | 1350.9      | 27 | 55.6 | 1526.0      | 27 | 62.9 | 1711.9       | 27 | 108.8 | 1908.7       | 27 | 144.0 | 2116.5       | 27 | 166.1 |
| 28           | 1325.8      | 28 | 56.9 | 1497.6      | 28 | 64.5 | 1679.9       | 28 | 118.5 | 1872.8       | 28 | 156.1 | 2076.5       | 28 | 179.6 |
| 29           | 1300.2      | 29 | 58.2 | 1468.5      | 29 | 66.1 | 1647.1       | 29 | 128.1 | 1836.2       | 29 | 168.6 | 2035.6       | 29 | 194.1 |
| 30           | 1274.0      | 30 | 59.4 | 1438.8      | 30 | 67.7 | 1613.7       | 30 | 138.6 | 1798.7       | 30 | 181.6 | 1993.9       | 30 | 209.6 |
| 31           | 1247.3      | 31 | 60.5 | 1408.5      | 31 | 69.1 | 1579.6       | 31 | 149.1 | 1760.6       | 31 | 195.1 | 1951.5       | 31 | 221.1 |
| 32           | 1220.2      | 32 | 61.6 | 1377.8      | 32 | 70.6 | 1545.0       | 32 | 158.6 | 1721.8       | 32 | 206.1 | 1908.3       | 32 | 232.6 |
| 33           | 1192.6      | 33 | 62.5 | 1346.5      | 33 | 72.1 | 1509.8       | 33 | 168.1 | 1682.4       | 33 | 216.6 | 1864.5       | 33 | 244.1 |

| H.A.<br>Lat. | 15° (1h 0m) |    |      | 16° (1h 4m) |    |      | 17° (1h 8m) |    |      | 18° (1h 12m) |    |       | 19° (1h 16m) |    |       | 20° (1h 20m) |    |       |
|--------------|-------------|----|------|-------------|----|------|-------------|----|------|--------------|----|-------|--------------|----|-------|--------------|----|-------|
|              | A           | K  | '    | A           | K  | '    | A           | K  | '    | A            | K  | '     | A            | K  | '     | A            | K  | '     |
| 0            | 1505.6      | 0  | 0.0  | 1715.8      | 0  | 0.0  | 1940.4      | 0  | 0.0  | 2179.4       | 0  | 0.0   | 2433.0       | 0  | 0.0   | 2701.4       | 0  | 0.0   |
| 1            | 1505.2      | 1  | 2.1  | 1715.3      | 1  | 2.4  | 1939.7      | 1  | 2.7  | 2178.6       | 1  | 3.1   | 2432.2       | 1  | 3.5   | 2700.6       | 1  | 3.8   |
| 2            | 1503.7      | 2  | 4.2  | 1713.7      | 2  | 4.8  | 1937.9      | 2  | 5.5  | 2176.6       | 2  | 6.2   | 2429.8       | 2  | 6.9   | 2697.9       | 2  | 7.7   |
| 3            | 1501.4      | 3  | 6.3  | 1711.0      | 3  | 7.2  | 1934.8      | 3  | 8.2  | 2173.1       | 3  | 9.2   | 2426.0       | 3  | 10.4  | 2693.5       | 3  | 11.5  |
| 4            | 1498.0      | 4  | 8.4  | 1707.2      | 4  | 9.6  | 1930.5      | 4  | 10.9 | 2168.2       | 4  | 12.3  | 2420.5       | 4  | 13.8  | 2687.4       | 4  | 15.3  |
| 5            | 1493.8      | 5  | 10.5 | 1702.3      | 5  | 12.0 | 1925.0      | 5  | 13.6 | 2162.0       | 5  | 15.4  | 2413.4       | 5  | 17.2  | 2679.6       | 5  | 19.1  |
| 6            | 1488.6      | 6  | 12.6 | 1696.4      | 6  | 14.4 | 1918.2      | 6  | 16.3 | 2154.3       | 6  | 18.4  | 2404.9       | 6  | 20.6  | 2670.0       | 6  | 22.9  |
| 7            | 1482.5      | 7  | 14.7 | 1689.4      | 7  | 16.7 | 1910.3      | 7  | 19.0 | 2145.4       | 7  | 21.4  | 2394.8       | 7  | 23.9  | 2658.7       | 7  | 26.7  |
| 8            | 1475.4      | 8  | 16.7 | 1681.3      | 8  | 19.1 | 1901.1      | 8  | 21.6 | 2135.0       | 8  | 24.4  | 2383.2       | 8  | 27.3  | 2645.8       | 8  | 30.4  |
| 9            | 1467.5      | 9  | 18.7 | 1672.2      | 9  | 21.4 | 1890.8      | 9  | 24.2 | 2123.3       | 9  | 27.3  | 2370.1       | 9  | 30.6  | 2631.1       | 9  | 34.0  |
| 10           | 1458.7      | 10 | 20.7 | 1662.1      | 10 | 23.7 | 1879.3      | 10 | 26.8 | 2110.4       | 10 | 30.2  | 2355.5       | 10 | 33.8  | 2614.8       | 10 | 37.7  |
| 11           | 1448.9      | 11 | 22.7 | 1650.9      | 11 | 25.9 | 1866.6      | 11 | 29.4 | 2096.1       | 11 | 33.1  | 2339.5       | 11 | 37.0  | 2596.9       | 11 | 41.2  |
| 12           | 1438.3      | 12 | 24.6 | 1638.8      | 12 | 28.1 | 1852.8      | 12 | 31.9 | 2080.5       | 12 | 35.9  | 2322.0       | 12 | 40.2  | 2577.4       | 12 | 44.7  |
| 13           | 1426.9      | 13 | 26.5 | 1625.7      | 13 | 30.3 | 1837.9      | 13 | 34.3 | 2063.7       | 13 | 38.7  | 2303.1       | 13 | 43.3  | 2556.3       | 13 | 48.2  |
| 14           | 1414.6      | 14 | 28.4 | 1611.6      | 14 | 32.4 | 1821.9      | 14 | 36.8 | 2045.6       | 14 | 41.4  | 2282.8       | 14 | 46.3  | 2533.7       | 14 | 51.6  |
| 15           | 1401.4      | 15 | 30.2 | 1596.6      | 15 | 34.5 | 1804.8      | 15 | 39.1 | 2026.4       | 15 | 44.1  | 2261.2       | 15 | 49.3  | 2509.6       | 15 | 54.9  |
| 16           | 1387.5      | 16 | 32.0 | 1580.6      | 16 | 36.6 | 1786.7      | 16 | 41.5 | 2005.9       | 16 | 46.7  | 2238.3       | 16 | 52.3  | 2484.0       | 16 | 58.2  |
| 17           | 1372.8      | 17 | 33.8 | 1563.8      | 17 | 38.6 | 1767.6      | 17 | 43.7 | 1984.3       | 17 | 49.2  | 2214.0       | 17 | 55.1  | 2456.9       | 17 | 63.5  |
| 18           | 1357.2      | 18 | 35.5 | 1546.0      | 18 | 40.6 | 1747.4      | 18 | 46.0 | 1961.5       | 18 | 51.7  | 2188.5       | 18 | 57.9  | 2428.4       | 18 | 69.8  |
| 19           | 1341.0      | 19 | 37.2 | 1527.4      | 19 | 42.5 | 1726.3      | 19 | 48.1 | 1937.7       | 19 | 54.2  | 2161.8       | 19 | 63.5  | 2398.6       | 19 | 76.1  |
| 20           | 1324.0      | 20 | 38.8 | 1508.0      | 20 | 44.3 | 1704.2      | 20 | 50.2 | 1912.8       | 20 | 56.5  | 2133.9       | 20 | 69.8  | 2367.5       | 20 | 84.4  |
| 21           | 1306.3      | 21 | 40.4 | 1487.7      | 21 | 46.1 | 1681.3      | 21 | 52.2 | 1886.9       | 21 | 58.8  | 2104.8       | 21 | 77.1  | 2335.1       | 21 | 93.7  |
| 22           | 1287.9      | 22 | 41.9 | 1466.7      | 22 | 47.8 | 1657.4      | 22 | 54.2 | 1860.0       | 22 | 65.9  | 2074.7       | 22 | 86.2  | 2301.5       | 22 | 104.0 |
| 23           | 1268.9      | 23 | 43.4 | 1445.0      | 23 | 49.5 | 1632.7      | 23 | 56.1 | 1832.2       | 23 | 73.6  | 2043.5       | 23 | 98.1  | 2266.6       | 23 | 115.3 |
| 24           | 1249.2      | 24 | 44.8 | 1422.5      | 24 | 51.1 | 1607.2      | 24 | 57.9 | 1803.4       | 24 | 82.4  | 2011.2       | 24 | 109.6 | 2230.7       | 24 | 127.6 |
| 25           | 1228.9      | 25 | 46.2 | 1399.3      | 25 | 52.7 | 1580.8      | 25 | 59.7 | 1773.7       | 25 | 91.1  | 1978.0       | 25 | 122.9 | 2193.6       | 25 | 142.1 |
| 26           | 1208.1      | 26 | 47.5 | 1375.4      | 26 | 54.2 | 1553.8      | 26 | 61.3 | 1743.2       | 26 | 100.0 | 1943.8       | 26 | 132.9 | 2155.5       | 26 | 153.6 |
| 27           | 1186.6      | 27 | 48.7 | 1350.9      | 27 | 55.6 | 1526.0      | 27 | 62.9 | 1711.9       | 27 | 108.8 | 1908.7       | 27 | 144.0 | 2116.5       | 27 | 166.1 |
| 28           | 1164.7      | 28 | 49.9 | 1325.8      | 28 | 56.9 | 1497.6      | 28 | 64.5 | 1679.9       | 28 | 118.5 | 1872.8       | 28 | 156.1 | 2076.5       | 28 | 179.6 |
| 29           | 1142.2      | 29 | 51.0 | 1300.2      | 29 | 58.2 | 1468.5      | 29 | 66.1 | 1647.1       | 29 | 128.1 | 1836.2       | 29 | 168.6 | 2035.6       | 29 | 194.1 |
| 30           | 1119.3      | 30 | 52.0 | 1274.0      | 30 | 59.4 | 1438.8      | 30 | 67.7 | 1613.7       | 30 | 138.6 | 1798.7       | 30 | 181.6 | 1993.9       | 30 | 209.6 |
| 31           | 1096.0      | 31 | 53.0 | 1247.3      | 31 | 60.5 | 1408.5      | 31 | 69.1 | 1579.6       | 31 | 149.1 | 1760.6       | 31 | 195.1 | 1951.5       | 31 | 221.1 |
| 32           | 1072.2      | 32 | 54.0 | 1220.2      | 32 | 61.6 | 1377.8      | 32 | 70.6 | 1545.0       | 32 | 158.6 | 1721.8       | 32 | 206.1 | 1908.3       | 32 | 232.6 |
| 33           | 1048.4      | 33 | 54.9 | 1192.6      | 33 | 62.5 | 1346.5      | 33 | 72.1 | 1509.8       | 33 | 168.1 | 1682.4       | 33 | 216.6 | 1864.5       | 33 | 244.1 |



TABLE B

| K <sub>d</sub> | 0°  | 1°   | 2°   | 3°   | 4°    | 5°    | 6°    | 7°    | 8°    | 9°    | MIN.<br>ALT. |
|----------------|-----|------|------|------|-------|-------|-------|-------|-------|-------|--------------|
| 0              | 0.0 | 6.6  | 26.5 | 59.6 | 105.9 | 165.6 | 238.6 | 324.9 | 424.7 | 538.0 | 60           |
| 1              | 0.0 | 6.8  | 26.9 | 60.2 | 106.8 | 166.7 | 239.9 | 326.5 | 426.5 | 540.0 | 59           |
| 2              | 0.0 | 7.1  | 27.4 | 60.9 | 107.7 | 167.8 | 241.2 | 328.0 | 428.3 | 542.0 | 58           |
| 3              | 0.0 | 7.3  | 27.8 | 61.6 | 108.6 | 168.9 | 242.6 | 329.6 | 430.1 | 544.0 | 57           |
| 4              | 0.0 | 7.5  | 28.3 | 62.2 | 109.5 | 170.0 | 243.9 | 331.2 | 431.9 | 546.0 | 56           |
| 5              | 0.0 | 7.8  | 28.7 | 62.9 | 110.4 | 171.1 | 245.3 | 332.7 | 433.6 | 548.1 | 55           |
| 6              | 0.1 | 8.0  | 29.2 | 63.6 | 111.3 | 172.3 | 246.6 | 334.3 | 435.4 | 550.1 | 54           |
| 7              | 0.1 | 8.2  | 29.6 | 64.3 | 112.2 | 173.4 | 248.0 | 335.9 | 437.2 | 552.1 | 53           |
| 8              | 0.1 | 8.5  | 30.1 | 65.0 | 113.1 | 174.5 | 249.3 | 337.5 | 439.0 | 554.1 | 52           |
| 9              | 0.1 | 8.7  | 30.6 | 65.7 | 114.0 | 175.7 | 250.7 | 339.0 | 440.9 | 556.2 | 51           |
| 10             | 0.2 | 9.0  | 31.1 | 66.4 | 114.9 | 176.8 | 252.0 | 340.6 | 442.7 | 558.2 | 50           |
| 11             | 0.2 | 9.3  | 31.5 | 67.1 | 115.9 | 178.0 | 253.4 | 342.2 | 444.5 | 560.2 | 49           |
| 12             | 0.3 | 9.5  | 32.0 | 67.8 | 116.8 | 179.1 | 254.8 | 343.8 | 446.3 | 562.3 | 48           |
| 13             | 0.3 | 9.8  | 32.5 | 68.5 | 117.7 | 180.3 | 256.1 | 345.4 | 448.1 | 564.3 | 47           |
| 14             | 0.4 | 10.1 | 33.0 | 69.2 | 118.7 | 181.4 | 257.5 | 347.0 | 449.9 | 566.4 | 46           |
| 15             | 0.4 | 10.3 | 33.5 | 69.9 | 119.6 | 182.6 | 258.9 | 348.6 | 451.8 | 568.4 | 45           |
| 16             | 0.5 | 10.6 | 34.0 | 70.6 | 120.5 | 183.7 | 260.3 | 350.2 | 453.6 | 570.5 | 44           |
| 17             | 0.5 | 10.9 | 34.5 | 71.3 | 121.5 | 184.9 | 261.7 | 351.8 | 455.4 | 572.6 | 43           |
| 18             | 0.6 | 11.2 | 35.0 | 72.1 | 122.4 | 186.1 | 263.1 | 353.5 | 457.3 | 574.6 | 42           |
| 19             | 0.7 | 11.5 | 35.5 | 72.8 | 123.4 | 187.2 | 264.5 | 355.1 | 459.1 | 576.7 | 41           |
| 20             | 0.7 | 11.8 | 36.0 | 73.5 | 124.3 | 188.4 | 265.9 | 356.7 | 461.0 | 578.8 | 40           |
| 21             | 0.8 | 12.1 | 36.5 | 74.3 | 125.3 | 189.6 | 267.3 | 358.3 | 462.8 | 580.9 | 39           |
| 22             | 0.9 | 12.4 | 37.1 | 75.0 | 126.2 | 190.8 | 268.7 | 360.0 | 464.7 | 582.9 | 38           |
| 23             | 1.0 | 12.7 | 37.6 | 75.8 | 127.2 | 192.0 | 270.1 | 361.6 | 466.6 | 585.0 | 37           |
| 24             | 1.1 | 13.0 | 38.1 | 76.5 | 128.2 | 193.2 | 271.5 | 363.2 | 468.4 | 587.1 | 36           |
| 25             | 1.1 | 13.3 | 38.6 | 77.3 | 129.2 | 194.4 | 272.9 | 364.9 | 470.3 | 589.2 | 35           |
| 26             | 1.2 | 13.6 | 39.2 | 78.0 | 130.1 | 195.6 | 274.3 | 366.5 | 472.2 | 591.3 | 34           |
| 27             | 1.3 | 13.9 | 39.7 | 78.8 | 131.1 | 196.8 | 275.8 | 368.2 | 474.0 | 593.4 | 33           |
| 28             | 1.4 | 14.2 | 40.3 | 79.5 | 132.1 | 198.0 | 277.2 | 369.8 | 475.9 | 595.5 | 32           |
| 29             | 1.5 | 14.6 | 40.8 | 80.3 | 133.1 | 199.2 | 278.6 | 371.5 | 477.8 | 597.6 | 31           |
| 30             | 1.7 | 14.9 | 41.4 | 81.1 | 134.1 | 200.4 | 280.1 | 373.1 | 479.7 | 599.7 | 30           |
| 31             | 1.8 | 15.2 | 41.9 | 81.9 | 135.1 | 201.6 | 281.5 | 374.8 | 481.6 | 601.8 | 29           |
| 32             | 1.9 | 15.6 | 42.5 | 82.6 | 136.1 | 202.8 | 283.0 | 376.5 | 483.5 | 604.0 | 28           |
| 33             | 2.0 | 15.9 | 43.0 | 83.4 | 137.1 | 204.1 | 284.4 | 378.1 | 485.4 | 606.1 | 27           |

K<sub>d</sub>

10°

11°

K<sub>d</sub>

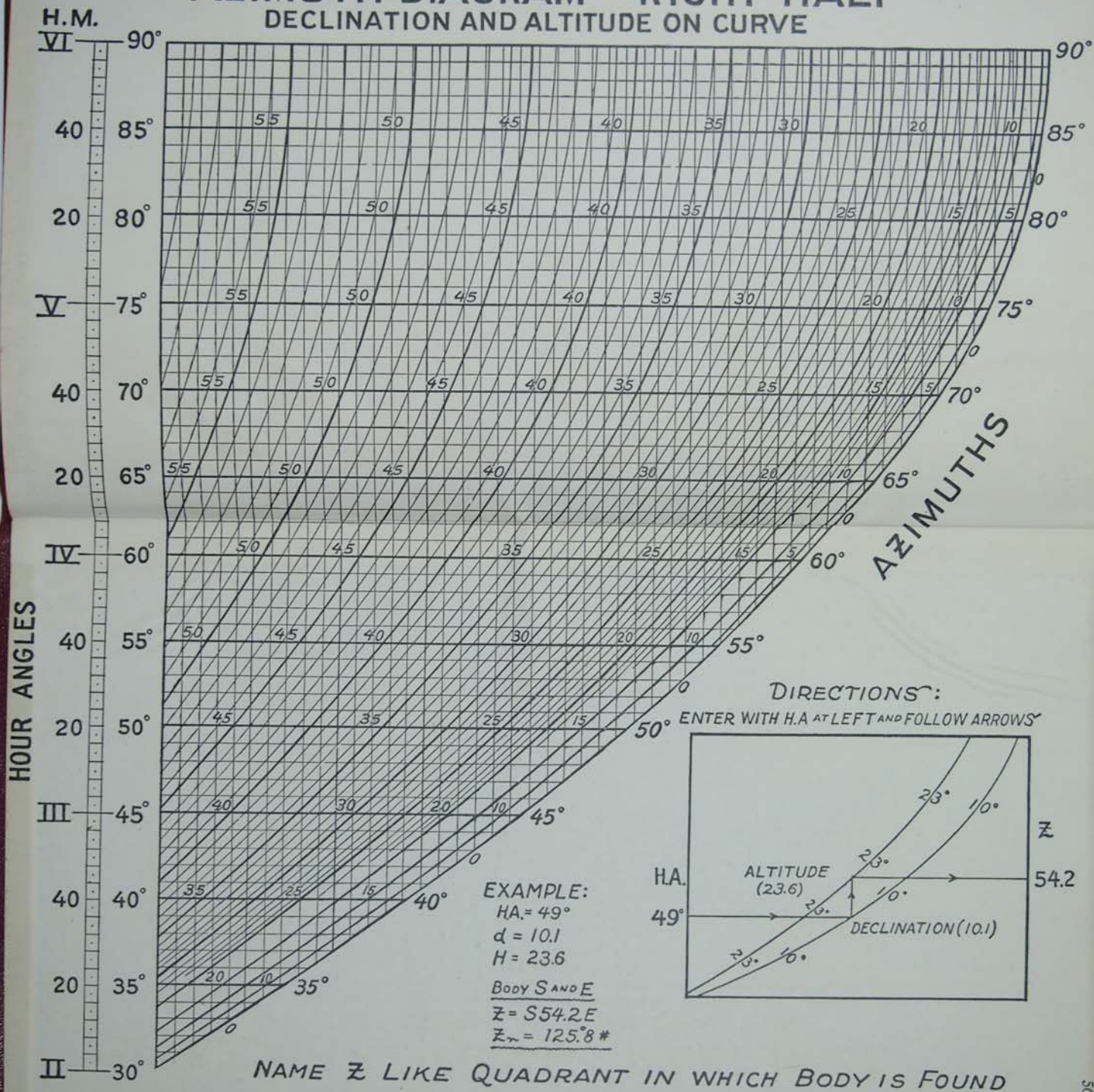
10°

11°



# AZIMUTH DIAGRAM - RIGHT HALF

## DECLINATION AND ALTITUDE ON CURVE





# LOP Book Cakes

| Date     | 12/19/2016 | 12/27/16  | 12/28/16    | 12/28/16 |
|----------|------------|-----------|-------------|----------|
| Body     | Sun        | Sun       | Formal hunt | Rigel    |
| GCT      | 21:44:00   | 19:01:50  | 01:45:00    | 01:50:00 |
| GHA      | 145°37.6'  | 104°38.9' | 121°58'     |          |
| CORR     | 1°00'      | 28'       | -1°15'      |          |
| GHA      | 146°37.6'  | 105°07'   | 138°35'     | 405°38'  |
| Long (A) | -111°37.6' | -113°07'  | -111°35'    | -111°38' |
| LHA (t)  | 35°W       | 8°E       | W27°        | 294°(6E) |
| Lat (A)  | N41°       | N38°      | N45°        | N44°     |
| Dec      | S23°25.5'  | S23°16.6' | S29°32'     | S08°11'  |
| K        | N46°42.0'  | N38°16.3' | N48°47.9'   | N67°9.6' |
| K~DEC    | 70°07.5'   | 61°32.9'  | 77°50'      | 75°20'   |

|        |        |        |        |        |
|--------|--------|--------|--------|--------|
| A      | 4507   | 262.7  | 2362   | 12277  |
| +B     | 46851  | 32202  | 67622  | 59733  |
| Log Hc | 51358  | 32465  | 69984  | 72010  |
| Hc     | 17°51' | 28°16' | 11°31' | 10°59' |
| Hu     | 18°23' | 29°03' | 11°43' | 10°38' |
| a      | -32'   | -47'   | -12'   | +21'   |
| Z      | S34W   | S8E    | S24W   | S66E   |
| Zn     | 214°   | 172°   | 204°   | 114°   |

|       |      |      |      |      |
|-------|------|------|------|------|
| H0249 |      |      |      |      |
| a     | -32  | -48  | -12  | +22  |
| Zn    | 214° | 172° | 204° | 113° |

22-141 50 SHEETS  
22-142 100 SHEETS  
22-144 200 SHEETS





PUB. NO. 249

VOL. 1

# SIGHT REDUCTION TABLES

FOR

## AIR NAVIGATION

(SELECTED STARS)

EPOCH 2015.0

COMMERCIAL EDITION  
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LAT 41°N

LAT 41°N

| LHA<br>° | Hc         | Zn         | Hc         | Zn         | FOMALHAUT  | ALTAIR     | Hc         | Zn         | ★VEGA      | Kochab     | LHA<br>°   | Hc         | Zn         | ★Dubhe     | REGULUS    | PROCYON    | ★SIRIUS    | Hc         | Zn    | RIGEL | ALDEBARAN | ★MIRFAK |       |     |       |     |
|----------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|-------|-------|-----------|---------|-------|-----|-------|-----|
|          |            |            |            |            |            |            |            |            |            |            |            |            |            |            |            |            |            |            |       |       |           |         |       |     |       |     |
| 0        | 34°36' 056 | 26°20' 091 | 30°12' 168 | 18°02' 194 | 30°50' 173 | 30°50' 173 | 16°59' 198 | 23°03' 262 | 27°07' 299 | 27°51' 349 | 90         | 41°33' 038 | 28°35' 099 | 47°46' 141 | 31°17' 167 | 39°45' 194 | 59°40' 222 | 61°49' 302 |       |       |           |         |       |     |       |     |
| 1        | 35 14      | 056        | 27°06' 091 | 30 21      | 169        | 26 01      | 259        | 26 01      | 259        | 28 27      | 348        | 91         | 42 00      | 038        | 29 20      | 100        | 48 14      | 143        | 31 27 | 168   | 39 33     | 196     | 59 09 | 224 | 61 11 | 302 |
| 2        | 35 52      | 057        | 27°51' 092 | 30 30      | 170        | 17 39      | 196        | 17 39      | 196        | 29 07      | 298        | 92         | 42 28      | 038        | 30 05      | 101        | 48 41      | 144        | 31 36 | 169   | 39 20     | 197     | 58 37 | 226 | 60 32 | 301 |
| 3        | 36 30      | 057        | 28°36' 093 | 30 37      | 171        | 17 26      | 197        | 24 32      | 260        | 28 27      | 298        | 93         | 42 56      | 038        | 30 49      | 102        | 48 41      | 145        | 31 44 | 170   | 39 07     | 198     | 58 04 | 227 | 59 54 | 301 |
| 4        | 37°08' 057 | 29°21' 093 | 30°44' 172 | 17°13' 198 | 23°48' 261 | 27°47' 299 | 28°00' 349 | 31°33' 102 | 49°32' 147 | 31°51' 172 | 38°52' 199 | 57°31' 228 | 59°15' 301 |            |            |            |            |            |       |       |           |         |       |     |       |     |
| 5        | 37°46' 058 | 30°07' 094 | 30°50' 173 | 16°59' 198 | 23°03' 262 | 27°07' 299 | 27°51' 349 | 32°15' 178 | 49°57' 148 | 31°57' 173 | 38°36' 201 | 56°56' 230 | 58°36' 301 |            |            |            |            |            |       |       |           |         |       |     |       |     |
| 6        | 38°25' 058 | 30°52' 095 | 30°54' 174 | 16°44' 199 | 22°18' 262 | 26°28' 300 | 27°43' 349 | 33°02' 104 | 50°20' 149 | 32°02' 174 | 38°20' 202 | 56°21' 231 | 57°58' 301 |            |            |            |            |            |       |       |           |         |       |     |       |     |
| 7        | 39°03' 058 | 31°37' 095 | 30°58' 175 | 16°29' 200 | 21°33' 263 | 25°48' 300 | 27°35' 350 | 33°45' 105 | 50°43' 151 | 32°07' 175 | 38°03' 203 | 55°46' 233 | 57°19' 301 |            |            |            |            |            |       |       |           |         |       |     |       |     |
| 8        | 39°42' 059 | 32°22' 096 | 31°02' 177 | 16°13' 201 | 20°48' 264 | 25°09' 301 | 27°26' 350 | 34°29' 105 | 51°04' 152 | 32°10' 176 | 37°44' 204 | 55°09' 234 | 56°40' 302 |            |            |            |            |            |       |       |           |         |       |     |       |     |
| 9        | 40°21' 059 | 33°07' 097 | 31°04' 178 | 15°56' 202 | 20°03' 264 | 24°30' 301 | 27°19' 350 | 35°13' 106 | 51°25' 154 | 32°13' 177 | 37°25' 205 | 54°32' 235 | 56°02' 302 |            |            |            |            |            |       |       |           |         |       |     |       |     |
| 10       | 41°00' 060 | 33°52' 097 | 31°05' 179 | 15°39' 203 | 19°18' 265 | 23°52' 302 | 27°11' 350 | 35°56' 107 | 51°44' 155 | 32°15' 178 | 37°06' 207 | 53°55' 236 | 55°23' 302 |            |            |            |            |            |       |       |           |         |       |     |       |     |
| 11       | 41°39' 060 | 34°37' 098 | 31°06' 180 | 15°21' 204 | 18°33' 266 | 23°13' 302 | 27°04' 351 | 36°39' 108 | 52°03' 157 | 32°15' 179 | 36°45' 208 | 53°17' 238 | 54°45' 302 |            |            |            |            |            |       |       |           |         |       |     |       |     |
| 12       | 42°18' 060 | 35°21' 099 | 31°05' 181 | 15°03' 204 | 17°48' 266 | 22°35' 303 | 26°56' 351 | 37°22' 109 | 52°20' 158 | 32°15' 181 | 36°23' 209 | 52°38' 239 | 54°06' 302 |            |            |            |            |            |       |       |           |         |       |     |       |     |
| 13       | 42°57' 060 | 36°06' 100 | 31°04' 182 | 14°44' 205 | 17°03' 267 | 21°57' 303 | 26°49' 351 | 38°05' 110 | 52°36' 160 | 32°15' 182 | 36°01' 210 | 52°00' 240 | 53°28' 302 |            |            |            |            |            |       |       |           |         |       |     |       |     |
| 14       | 43°37' 061 | 36°51' 100 | 31°02' 183 | 14°24' 206 | 16°17' 268 | 21°17' 304 | 26°43' 352 | 38°48' 110 | 52°51' 162 | 32°13' 183 | 35°38' 211 | 51°20' 241 | 52°50' 302 |            |            |            |            |            |       |       |           |         |       |     |       |     |
| 15       | 44°16' 061 | 37°36' 101 | 31°01' 184 | 13°40' 114 | 15°18' 269 | 20°43' 300 | 26°12' 353 | 39°30' 111 | 53°03' 111 | 32°10' 184 | 35°14' 212 | 50°40' 242 | 52°11' 302 |            |            |            |            |            |       |       |           |         |       |     |       |     |
| 16       | 44°56' 061 | 38°21' 102 | 31°00' 185 | 13°15' 115 | 14°24' 206 | 21°17' 304 | 26°43' 352 | 40°00' 112 | 53°12' 112 | 32°06' 185 | 34°49' 213 | 50°00' 243 | 51°33' 302 |            |            |            |            |            |       |       |           |         |       |     |       |     |
| 17       | 45°36' 062 | 39°06' 103 | 31°00' 186 | 12°50' 116 | 13°40' 114 | 20°43' 300 | 26°12' 353 | 40°54' 113 | 53°19' 113 | 32°02' 186 | 34°24' 215 | 48°19' 244 | 50°55' 303 |            |            |            |            |            |       |       |           |         |       |     |       |     |
| 18       | 46°16' 062 | 39°51' 104 | 31°00' 187 | 12°25' 117 | 12°50' 116 | 20°43' 300 | 26°12' 353 | 41°04' 114 | 53°28' 114 | 31°56' 187 | 33°58' 216 | 48°38' 245 | 50°17' 303 |            |            |            |            |            |       |       |           |         |       |     |       |     |
| 19       | 46°56' 062 | 40°36' 105 | 31°00' 188 | 12°00' 118 | 11°58' 260 | 20°43' 300 | 26°12' 353 | 41°19' 115 | 53°37' 115 | 31°50' 188 | 33°31' 217 | 47°57' 246 | 49°38' 303 |            |            |            |            |            |       |       |           |         |       |     |       |     |
| 20       | 47°36' 062 | 41°21' 106 | 31°00' 189 | 11°40' 119 | 11°40' 119 | 20°43' 300 | 26°12' 353 | 41°34' 116 | 53°46' 116 | 31°43' 190 | 33°04' 218 | 47°15' 247 | 49°00' 303 |            |            |            |            |            |       |       |           |         |       |     |       |     |
| 21       | 48°16' 063 | 42°06' 107 | 31°00' 190 | 11°20' 120 | 11°20' 120 | 20°43' 300 | 26°12' 353 | 41°59' 117 | 53°55' 117 | 31°33' 191 | 32°36' 219 | 46°33' 248 | 48°23' 303 |            |            |            |            |            |       |       |           |         |       |     |       |     |
| 22       | 48°56' 063 | 42°46' 108 | 31°00' 191 | 11°00' 121 | 11°00' 121 | 20°43' 300 | 26°12' 353 | 42°14' 118 | 54°06' 118 | 31°26' 192 | 32°07' 220 | 45°51' 249 | 47°45' 303 |            |            |            |            |            |       |       |           |         |       |     |       |     |
| 23       | 49°37' 063 | 43°27' 109 | 31°00' 192 | 10°40' 122 | 10°40' 122 | 20°43' 300 | 26°12' 353 | 42°32' 119 | 54°17' 119 | 31°16' 193 | 31°38' 221 | 45°29' 250 | 47°07' 304 |            |            |            |            |            |       |       |           |         |       |     |       |     |
| 24       | 50°17' 064 | 44°08' 110 | 31°00' 193 | 10°20' 123 | 10°20' 123 | 20°43' 300 | 26°12' 353 | 42°50' 120 | 54°28' 120 | 31°06' 194 | 31°08' 222 | 44°26' 251 | 46°29' 304 |            |            |            |            |            |       |       |           |         |       |     |       |     |
| 25       | 50°58' 064 | 44°49' 111 | 31°00' 194 | 10°00' 124 | 10°00' 124 | 20°43' 300 | 26°12' 353 | 43°08' 121 | 54°39' 121 | 30°54' 195 | 30°38' 223 | 43°43' 252 | 45°52' 304 |            |            |            |            |            |       |       |           |         |       |     |       |     |
| 26       | 51°39' 064 | 45°30' 112 | 31°00' 195 | 9°40' 125  | 9°40' 125  | 20°43' 300 | 26°12' 353 | 43°18' 122 | 54°50' 122 | 30°42' 196 | 30°27' 224 | 43°00' 253 | 45°14' 304 |            |            |            |            |            |       |       |           |         |       |     |       |     |
| 27       | 52°19' 064 | 46°11' 113 | 31°00' 196 | 9°20' 126  | 9°20' 126  | 20°43' 300 | 26°12' 353 | 43°28' 123 | 55°01' 123 | 30°30' 197 | 29°35' 225 | 42°16' 254 | 44°30' 304 |            |            |            |            |            |       |       |           |         |       |     |       |     |
| 28       | 53°00' 065 | 46°52' 114 | 31°00' 197 | 9°00' 127  | 9°00' 127  | 20°43' 300 | 26°12' 353 | 43°38' 124 | 55°12' 124 | 30°19' 198 | 29°03' 226 | 41°33' 255 | 44°00' 305 |            |            |            |            |            |       |       |           |         |       |     |       |     |
| 29       | 53°41' 065 | 47°33' 115 | 31°00' 198 | 8°40' 128  | 8°40' 128  | 20°43' 300 | 26°12' 353 | 43°48' 125 | 55°23' 125 | 30°01' 199 | 28°30' 227 | 40°49' 255 | 43°22' 305 |            |            |            |            |            |       |       |           |         |       |     |       |     |
| 30       | 54°22' 065 | 48°14' 116 | 31°00' 199 | 8°20' 129  | 8°20' 129  | 20°43' 300 | 26°12' 353 | 43°58' 126 | 55°34' 126 | 29°45' 201 | 27°57' 228 | 40°30' 294 |            |            |            |            |            |            |       |       |           |         |       |     |       |     |
| 31       | 55°03' 065 | 48°55' 117 | 31°00' 200 | 8°00' 130  | 8°00' 130  | 20°43' 300 | 26°12' 353 | 44°08' 127 | 55°45' 127 | 29°29' 202 | 27°24' 228 | 39°21' 257 | 59°08' 294 |            |            |            |            |            |       |       |           |         |       |     |       |     |
| 32       | 55°44' 065 | 49°36' 118 | 31°00' 201 | 7°40' 131  | 7°40' 131  | 20°43' 300 | 26°12' 353 | 44°18' 128 | 55°56' 128 | 29°12' 203 | 26°49' 229 | 38°37' 258 | 59°07' 294 |            |            |            |            |            |       |       |           |         |       |     |       |     |
| 33       | 56°25' 066 | 50°17' 119 | 31°00' 202 | 7°20' 132  | 7°20' 132  | 20°43' 300 | 26°12' 353 | 44°28' 129 | 56°07' 129 | 28°54' 204 | 26°15' 230 | 37°53' 259 | 58°25' 294 |            |            |            |            |            |       |       |           |         |       |     |       |     |
| 34       | 57°07' 066 | 50°58' 120 | 31°00' 203 | 7°00' 133  | 7°00' 133  | 20°43' 300 | 26°12' 353 | 44°38' 130 | 56°18' 130 | 28°35' 205 | 25°40' 231 | 37°08' 259 | 57°44' 294 |            |            |            |            |            |       |       |           |         |       |     |       |     |
| 35       | 57°48' 066 | 51°39' 121 | 31°00' 204 | 6°40' 134  | 6°40' 134  | 20°43' 300 | 26°12' 353 | 44°48' 131 | 56°29' 131 | 28°16' 206 | 25°04' 232 | 36°24' 260 | 57°03' 294 |            |            |            |            |            |       |       |           |         |       |     |       |     |
| 36       | 58°29' 066 | 52°20' 122 | 31°00' 205 | 6°20' 135  | 6°20' 135  | 20°43' 300 | 26°12' 353 | 44°58' 132 | 56°40' 132 | 27°56' 207 | 24°28' 233 | 35°39' 261 | 56°21' 294 |            |            |            |            |            |       |       |           |         |       |     |       |     |
| 37       | 59°11' 066 | 53°01' 123 | 31°00' 206 | 6°00' 136  | 6°00' 136  | 20°43' 300 | 26°12' 353 | 45°08' 133 | 56°51' 133 | 27°35' 208 | 23°52' 234 | 34°54' 262 | 55°40' 295 |            |            |            |            |            |       |       |           |         |       |     |       |     |
| 38       | 59°52' 066 | 53°42' 124 | 31°00' 207 | 5°40' 137  | 5°40' 137  | 20°43' 300 | 26°12' 353 | 45°18' 134 | 57°02' 134 | 27°15' 209 | 23°32' 235 | 34°29' 263 | 54°18' 295 |            |            |            |            |            |       |       |           |         |       |     |       |     |
| 39       | 60°34' 066 | 54°23' 125 | 31°00' 208 | 5°20' 138  | 5°20' 138  | 20°43' 300 | 26°12' 353 | 45°28' 135 | 57°13' 135 | 26°52' 210 | 22°38' 235 | 33°25' 263 | 54°18' 295 |            |            |            |            |            |       |       |           |         |       |     |       |     |
| 40       | 61°15' 067 | 55°04' 126 | 31°00' 209 | 5°00' 139  | 5°00' 139  | 20°43' 300 | 26°12' 353 | 45°38' 136 | 57°24' 136 | 26°29' 211 | 22°01' 236 | 32°40' 264 | 53°37' 295 |            |            |            |            |            |       |       |           |         |       |     |       |     |
| 41       | 61°57' 067 | 55°45' 127 | 31°00' 210 | 4°40' 140  | 4°40' 140  | 20°43' 300 | 26°12' 353 | 45°48' 137 | 57°35' 137 | 26°05' 212 | 21°23' 237 | 31°55' 264 | 52°56' 296 |            |            |            |            |            |       |       |           |         |       |     |       |     |
| 42       | 62°38' 067 | 56°26' 128 | 31°00' 211 | 4°20' 141  | 4°20' 141  | 20°43' 300 | 26°12' 353 | 45°58' 138 | 57°46' 138 | 25°41' 213 | 20°45' 238 | 31°25' 264 | 52°15' 296 |            |            |            |            |            |       |       |           |         |       |     |       |     |
| 43       | 63°20' 067 | 57°07' 129 | 31°00' 212 | 4°00' 142  | 4°00' 142  | 20°43' 300 | 26°12' 353 | 46°08' 139 | 57°57' 139 | 25°16' 214 | 20°06' 239 | 30°24' 266 | 51°35' 296 |            |            |            |            |            |       |       |           |         |       |     |       |     |
| 44       | 64°02' 067 | 57°48' 130 | 31°00' 213 | 3°40' 143  | 3°40' 143  | 20°43' 300 | 26°12' 353 | 46°18' 140 | 58°08' 140 | 24°51' 215 | 19°27' 240 | 29°39' 267 | 50°54' 296 |            |            |            |            |            |       |       |           |         |       |     |       |     |
| 45       | 64°43' 067 | 58°29' 131 | 31°00' 214 | 3°20' 144  | 3°20' 144  | 20°43' 300 | 26°12' 353 | 46°28' 141 | 58°19' 141 | 24°26' 216 | 18°48' 241 | 28°30' 268 | 50°15' 296 |            |            |            |            |            |       |       |           |         |       |     |       |     |
| 46       | 65°24' 067 | 59°10' 132 | 31°00' 215 | 3°00' 145  | 3°00' 145  | 20°43' 300 | 26°12' 353 | 46°38' 142 | 58°30' 142 | 24°01' 217 | 17°29' 242 | 27°11' 269 | 49°36' 297 |            |            |            |            |            |       |       |           |         |       |     |       |     |
| 47       | 66°05' 067 | 59°51' 133 | 31°00' 216 | 2°40' 146  | 2°40' 146  | 20°43' 300 | 26°12' 353 | 46°48' 143 | 58°41' 143 | 23°46' 218 | 16°10' 243 | 26°02' 270 | 48°57' 297 |            |            |            |            |            |       |       |           |         |       |     |       |     |
| 48       | 66°46' 067 | 60°32' 134 | 31°00' 217 | 2°20' 147  | 2°20' 147  | 20°43' 300 | 26°12' 353 | 46°58' 144 | 58°52' 144 | 23°21' 219 | 15°01' 244 | 25°03' 271 |            |            |            |            |            |            |       |       |           |         |       |     |       |     |



02/25/2017

4515 SEA-SLC

Fix L N44°50'  
BKE X W117°48'  
+

FL 370  
MH 116°  
MC 111°  
TAS 468kt  
GS 485kt  
SAT -47°  
MW<sub>m</sub> 257/18

Fix L N 43°22'  
λ W113°10'  
+ GS:40

Body Sirius Regulus  
DR L N44°23' N44°02'  
λ W116°58' W116°20'

+ GS:29:00 05:33:00

4 m @ 485kt = 32 Nm

hs 26°26' 48°54'  
R - 1  
IC - 7 - 10  
Refn - 6 - 4  
P

Ho 26°12' 48°40'

249 VOL 1

Z 8NmR 8NmR

Sirius Regulus

VH:M 23°51'6" 23°7'46"

23°51'6" 23°7'46"

M:S 2°15' 45'

2°15' 45'

SHA 258°31' 207°41'

GHAT 237°31' 238°31'

GHA 496°02' 446°12'

aλ 116°31' 116°31'

aλ W117°02' W116°12'

LHAT 121 - 122 -

LHA 379 - 330 -

aL N44 N44

(360) 360

LHA 19° 330°

aL N44° N44°

Dec S16°45' N11°53'

H 27°32' 48°05'

(d) (58) -44 (450) +44

Hc 26°48' 48°49'

Ho 26°12' 48°40'

a +36' +09'

26°41' 48°40'

26°12' 48°40'

+29 0

away

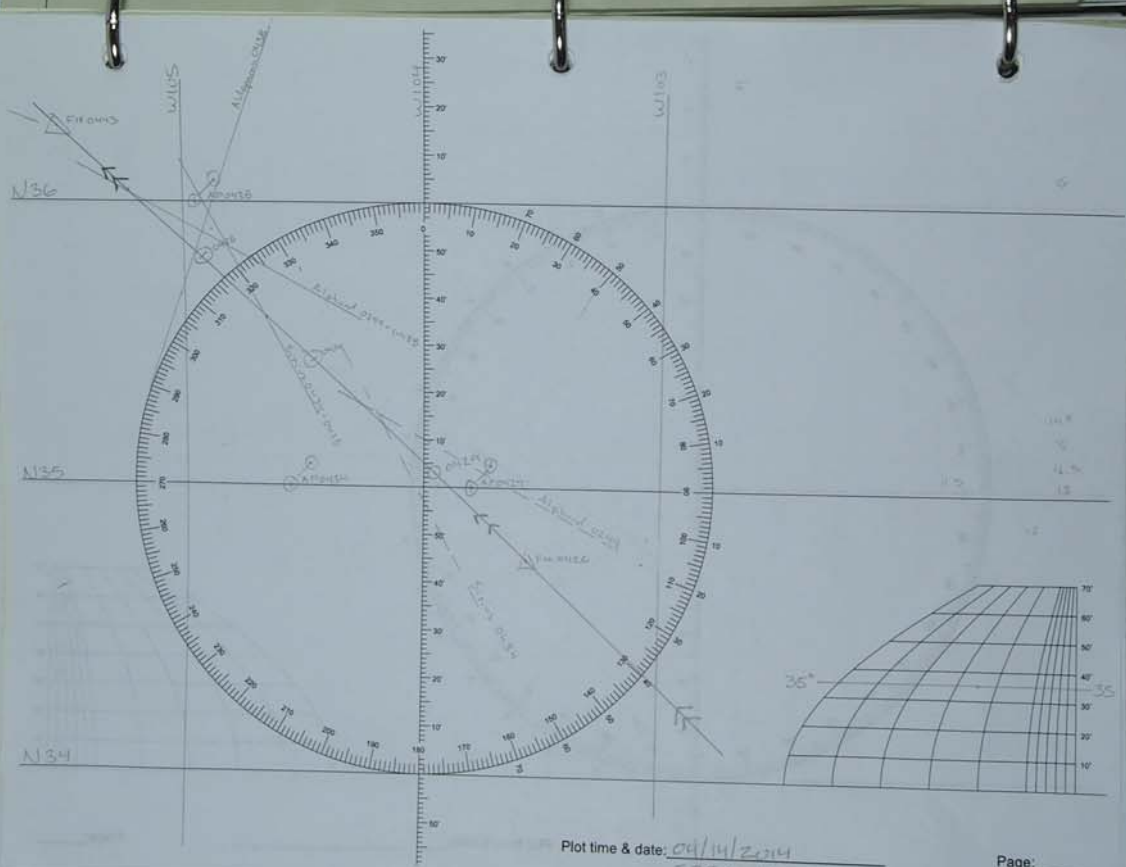
(360) 360

Z 159 133

Zn 201° 133°

201°

132°



Plot time & date: 04/14/2014  
 SZZC IAH-SLC

Page: \_\_\_\_\_

04/14/2015  
 FIX L N34°45'  
 ' X W103°34'  
 + 04:26

FIX L N36°05'  
 Z X W105°31'  
 + 04:43

Body: Alotted Stars Aldabern  
 DR L N35°03' U35°49'  
 W103°57' W104°27' W104°56'

h<sub>s</sub> 04:29:30 CH:34:00 04:38:30  
 R 4°01' 04'28' 03'36'  
 IC -2 -4  
 Refn -2 -1  
 P -5 -8

H<sub>o</sub> 40°46' 04'16' 05°23'

Zenith 6°R

H<sub>m</sub> 26°32' 27°03' 27°03'  
 M'S 223 100 204  
 SHA 217°55' 258°31' 29°04'46'

GHA 48°48' 52°49' 54°56'25.7'  
 a L N35°45' 04°34' 04°52'  
 LHA 384 425 438  
 (360) 360 360 360  
 LHA 24 65 98  
 N35 N36 N37  
 Dec 50°44' 51°45' 51°52'

H 41°24' 10°04' 03°05'  
 (a) 40 30 30  
 Hc 40 44 04 34 03 24  
 Ho 40 46 04 16 03 23

a -2 +18 +1  
 to 0007 0007 0007  
 (600) 360 360 360  
 Z 148 118 72  
 Zn 213 242 208

FL 360  
 MH 303  
 MC 305  
 TAS 463  
 GS 442  
 SAT -54  
 MW 266/27  
 Var 9°E

4300' 44241 = 35 mi  
 91000 44241 = 66 mi



# Sight Data Sheet

Date 4/14/2017

11065  
40.16  
42  
102

| Body             | Altitude | Sinus | Altitude |
|------------------|----------|-------|----------|
| Seat-<br>thru-FL | L        | L     | L        |
| W                | 400'     | 95.6' | 41° 58'  |
|                  | 349'     | 94.2' | 41° 38'  |
|                  | 344'     | 94.1' | 41° 25'  |
|                  | 412'     | 93.9' | 41° 11'  |
|                  | 424'     | 93.5' | 40° 58'  |
|                  | 411'     | 93.0' | 40° 24'  |
|                  | 381'     | 92.2' | 40° 17'  |
|                  | 371'     | 92.0' | 40° 16'  |
|                  | 336'     | 21    |          |
|                  | 23       | 20    |          |
|                  | 20       | 12    |          |
|                  | 314'     | 90.0' |          |
| VIA              | 306'     | 92.0' |          |
| n                | 12       | 13    | 8        |
| m                | 339      | 022'  |          |
| x                | 336      | 028'  | 41° 01'  |
| s                | 13       | 141   | 31       |
| n                |          |       |          |
| m                |          |       |          |
| x                |          |       |          |
| s                |          |       |          |
| Δ                | 71       | 50    | 102      |

|            |            |            |          |
|------------|------------|------------|----------|
| Object     | Altitude   | Object     | Sinus    |
| Time Start | 04:28:30   | Time Start | 04:33:00 |
| DR Lat     | N 34° 03'  | DR Lat     | 35° 27'  |
| DR Long    | W 103° 57' | DR Long    | 104° 27' |
| T duration | 2 min      | T duration | 2 min    |

|            |          |            |   |
|------------|----------|------------|---|
| Object     | Altitude | Object     |   |
| Time Start | 04:37:30 | Time Start | : |
| DR Lat     | 35° 49'  | DR Lat     | ° |
| DR Long    | 104° 56' | DR Long    | ° |
| T duration | 2 min    | T duration |   |

|            |   |            |   |
|------------|---|------------|---|
| Object     |   | Object     |   |
| Time Start | : | Time Start | : |
| DR Lat     | ° | DR Lat     | ° |
| DR Long    | ° | DR Long    | ° |
| T duration |   | T duration |   |

FIX L  
λ  
+

FIX L  
λ  
+

Body: Sun

Sun

-DR L N40°47'  
λW111°51'

+ 15:32:25

21:47:25

hs 38°12'  
R -1  
LC  
Dom  
P

56°05'  
-1

Ho 38°11'

56°04'

-Zcoriolis

H:M 52°24'  
M:S 36'

144°53'  
1°51'

SHA

GHA 53°00'

146°44'

-a λ W 112°00'

- 111°44'

LHA -59

35°

(360) 360

LHA 301°

35°

-aL N41

N41°

Dec N23°18'

N23°14'

H 37°53'  
(d) (34) +10'

55°38'  
(38) 12

Hc 38°03'

55°50'

Ho 38°11'

56°04'

-a - 8

-14

to

to

(360)

360

Z

111

-Zu 91°

249°

FL  
MH  
MC  
TAS  
GS  
SAT  
W



06/14/2016

Sun Lines

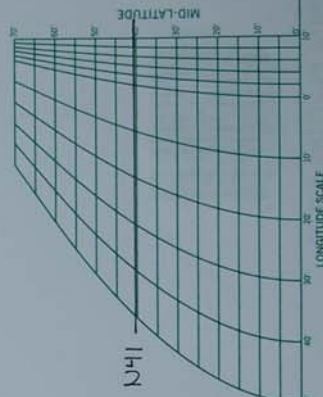
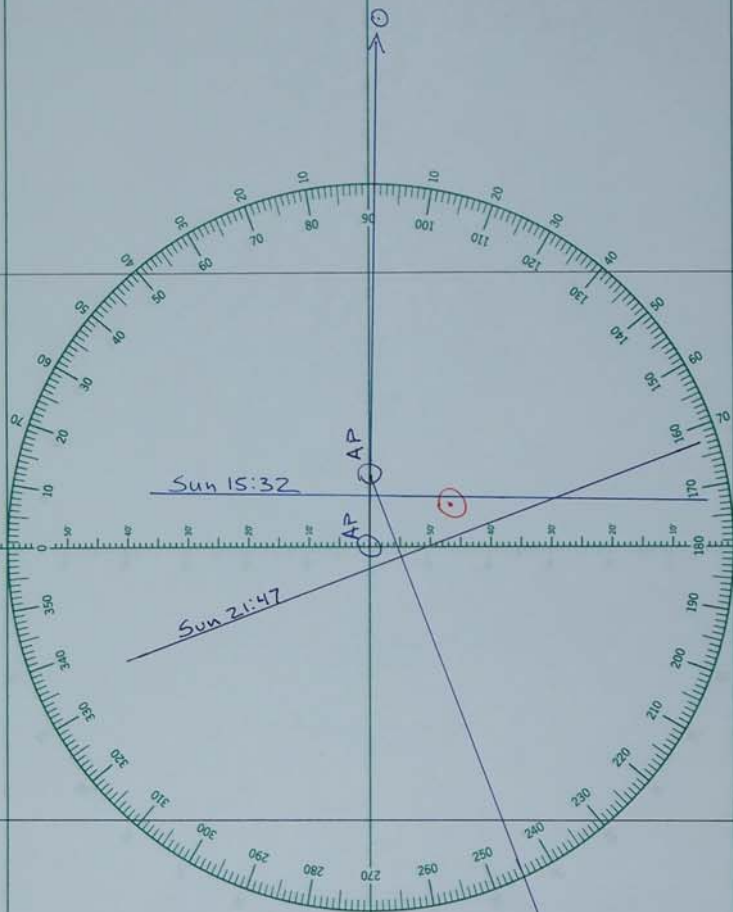
1113

1112

N42

N41

N40



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12/27/2016

SLC - PSP

FIX LN38°  
1 λ W 112°55'  
+

3 N 36°19'  
W 114°31'

FL 300  
MH  
MC  
TAS  
GS 417  
SAT  
W

FIX LN37°  
2 λ W 113°52'  
+

Body Sun

Sun

DR L N 37°37'  
λ W 113°15'

N 37°08'  
W 113°15'

+ 19:01:50

19:08:22

- 2 min sights  
visual average  
- from disc.

hs 29°04'

29°36'

R -01'

-01'

IC -08'

-08'

Refn -06'

-06'

P

Ho 29°03'

29°35'

- Z coriolis 7 Nm R7 Nm R

H:M 104°39' (19:00)

104°39' (19:00)

M:S 28' (01:50)

2°06' (08:22)

SHA

GHA 105°07'

106°45'

- a λ 113°07'113°45'

LHA -8°

-7°

(360) 360

360

LHA 352°

353°

- a L N38°N37°

Dec S23°16.6'

S23°16.6'

H 28°32'

29°38'

(d) -17' (-59)

-17' (-59)

Hc 28°15'

29°21'

Ho 29°03'

29°35'

- a -48 to-14 to

(360)

Z 172°

173°

- Z<sub>n</sub> 172°173°



12/27/2016

SLL-PSF

Sun Sight

N36

N37

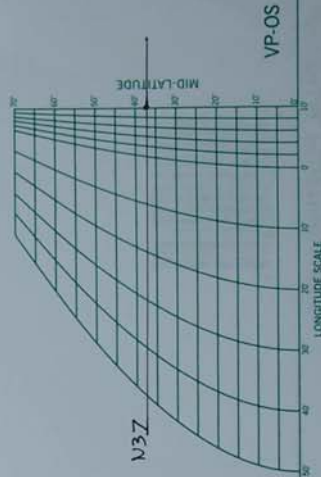
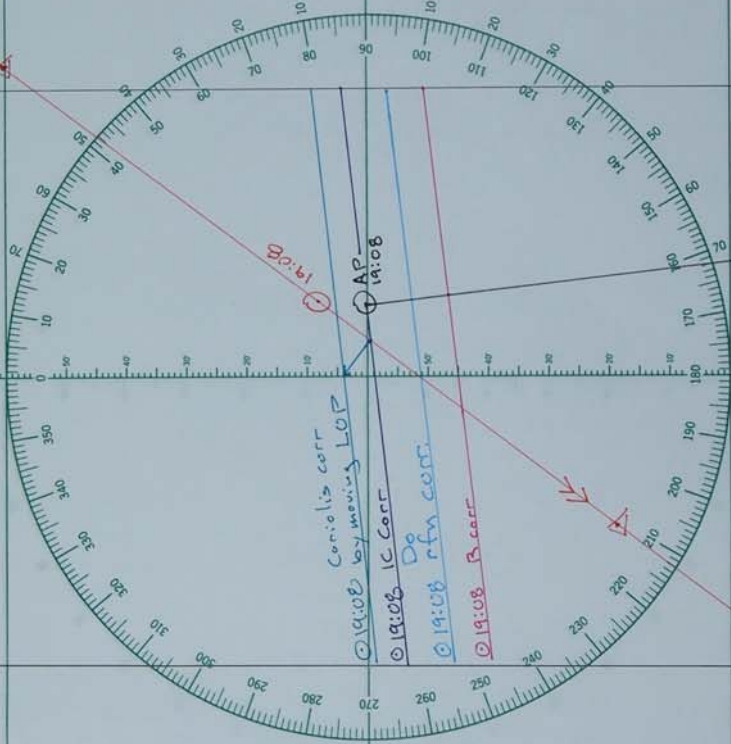
N36

W113

W114

W115

TR218



UNIVERSAL PLOTTING SHEET

12/28/2016

GTF-SLC

FIX LN 46°18'  
 λ W 111°42'  
 +

FIX LN 43°58'  
 λ W 111°52'  
 +

FL 310  
 MH 184  
 MC 169  
 TAS 453  
 GS 445  
 SAT -22  
 W

Body Formalhaut Rigel

DR LN 44°59' N 44°24'  
 λ W 111°47' W 111°50'

+ 01:45

01:50

- single sight

hs 11°55' fw

10°48' lsw

R -2'

-2'

IC -2'

-2'

Rfn -8'

-8'

P

Ho 11°43'

10°36'

- Z corrects 8 Nm R

8 Nm R

H:MY 121°58'

124°28'

M:S 1°15'

SHA 15°22'

281°10'

GHA 138°35'

405°38'

- a λ W - 111°35'

W - 111°38'

LHA 27°

294°

(360)

LHA 27°

294°

- a L N 45°

N 44°

Dec S 29°32'

S 08°11'

H 12°01'

11°08'

(d) -30

-08'

Hc 11°31'

11°00'

Ho 11°43'

10°36'

- a - 12 to

+ 24 away

(360) 360

Z 156

113°

- Zn 204°

113°



12/28/2016  
GTF-SLC  
FL310

Star Sights:  
Formalhaut  
Rigel

W 113

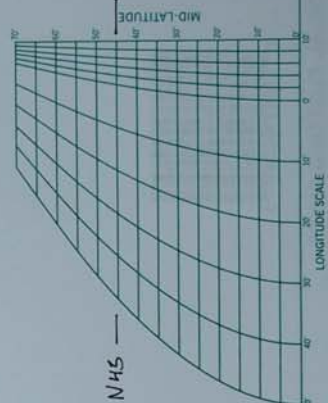
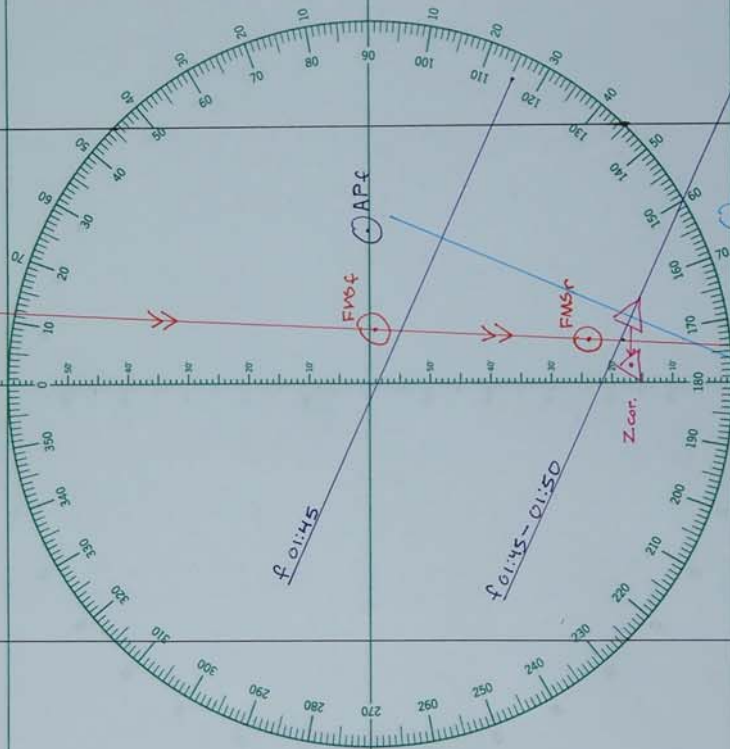
W 112

W 113

N 46

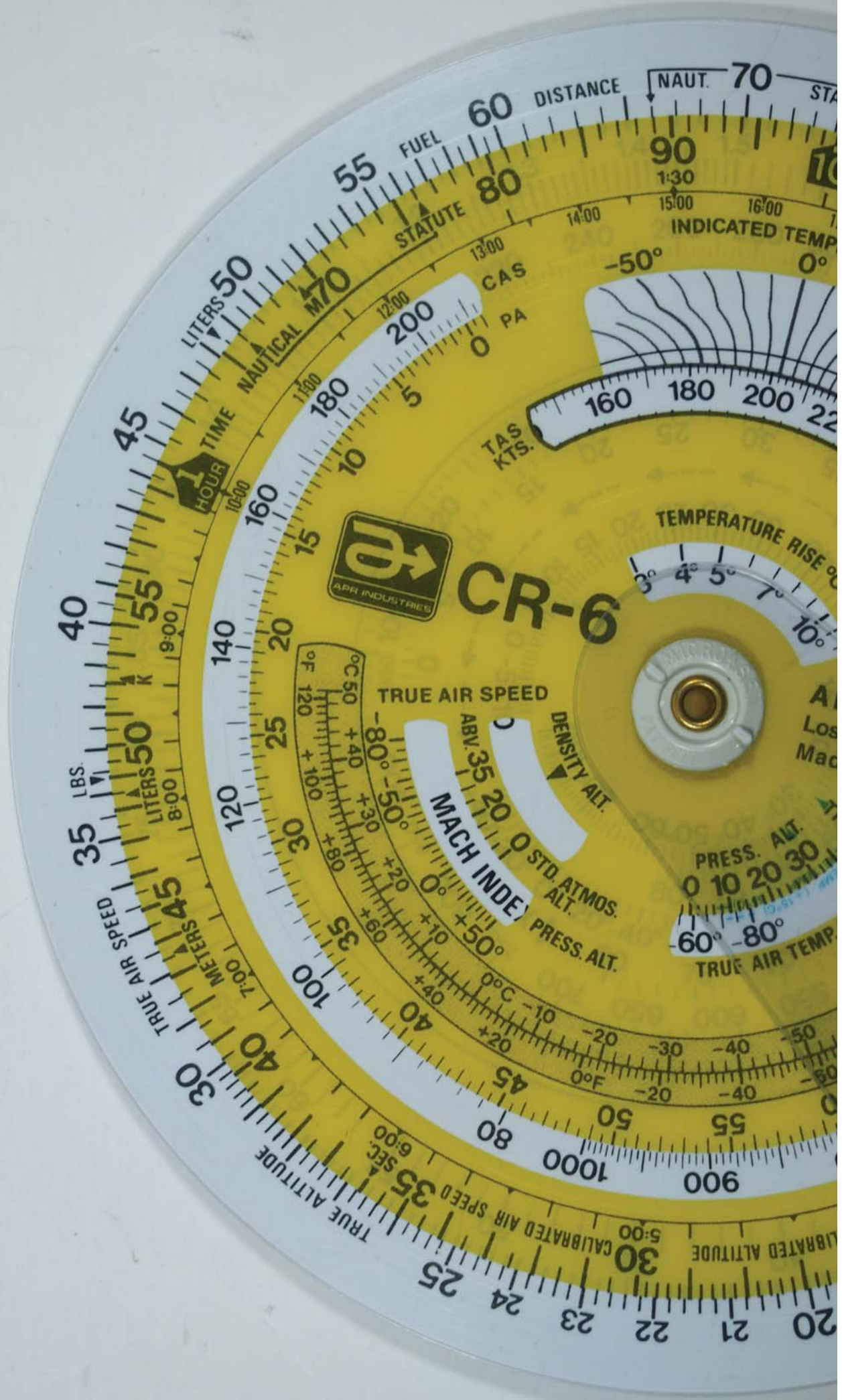
N 45

N 44



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02/09/2017

4649 B2n-SLC

Fix 1 N 44° 55'  
W 111° 45'  
+ 01:33:40

Fix 3 N 43° 31'  
10A W 112° 04'

FL 310

MH

MC

TAS

GS 400

SAT

MW /

Fix 2 N 44° 05'  
DBS W 112° 13'  
+

Fix 4

Venus

Moon

DR L N 44° 17'  
λ 112° 06'

N 43° 47'  
W 112° 07'

Hook @ 01:30 = 30"

t st. 01:39:00

01:43:30

dur. 02:00

02:00

t 01:40:00

01:44:30

hs hi

Lo

hs 30° 49'

30° 59'

R - 1'

- 1'

IC - 2'

- 9'

Refn - 6'

- 5'

Ho 30° 34'

+ 51' P: - A

Z corri. 7'R

31' 35'

7'R

H:M 161° 51'

47° 43'

M:S -

+ 1° 05'

GHA

SHA\*

GHA 161° 51'

48 48

a λ W 112° 51'

112 48

LHA + 49°

- 64 = 296

a L N 44°

N 44°

Dec N 04° 20'

N 17° 52'

H 31° 17'

30° 19'

(d) (446) 15

(429) 34

Hc 31° 32'

30° 53'

Ho 30° 34'

31° 35'

a + 58'

- 42'

away

to

(360)

360

Z

118°

95°

Zn 242°

95°

02/09/2017

BZN-SLC

All triggers over  
2 min sight

Moon

Venus

$30^{\circ}30'$   
 $30^{\circ}42'$   
 $30^{\circ}44'$   
 $30^{\circ}50'$   
 $30^{\circ}59'$   
 $31^{\circ}02'$   
 $31^{\circ}12'$   
 $31^{\circ}14'$   
 $31^{\circ}15'$   
 $31^{\circ}24'$

$30^{\circ}23'$   
 $30^{\circ}29'$   
 $30^{\circ}37'$   
 $30^{\circ}46'$   
 $30^{\circ}49'$   
 $30^{\circ}52'$   
 $30^{\circ}54'$   
 $31^{\circ}$   
 $31^{\circ}28'$   
 $32^{\circ}25'?$

10 shots/2 min  
 1 shot evy 12 sec

N 10  
 $\Delta$  54'  
 $\bar{m}$   $30^{\circ}57'$   
 $\bar{x}$   $30^{\circ}59.2'$   
 S 17.4'

9  
 62'  
 $30^{\circ}54'$   
 $30^{\circ}48.7'$   
 19'

Toss top &amp; bottom

N 8  
 $\Delta$  33'  
 $\bar{m}$   $30^{\circ}59.5'$   
 $\bar{x}$   $30^{\circ}59.7'$   
 S 13.4'

7  
 31'  
 $30^{\circ}44.5'$   
 $30^{\circ}46.7'$   
 10.6



02/09/2017

BZN-SLC

Venus

Moon

W112

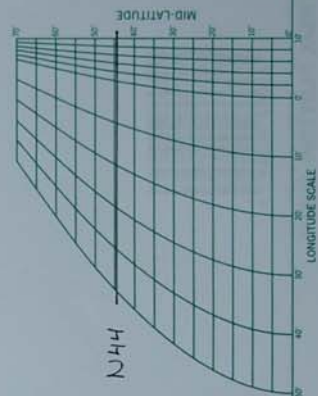
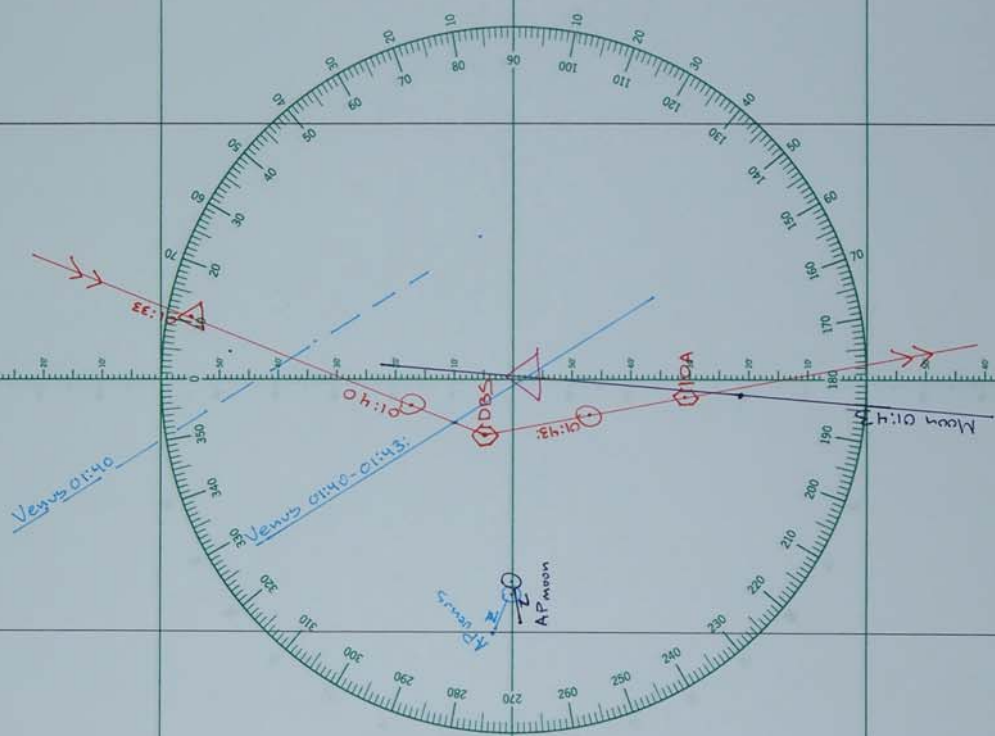
W112

W113

N45

N44

N43



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02/24/2017

4306 MSP-PSC

FIXIN 45°03' FIX 3  
W 097°38'  
+ 02157

FIX 2N 45°17' FIX 4  
W 100°22'  
+ 03:14

FL 340  
MH 264°  
MC 269  
TAS 267  
GS 426  
SAT -51°  
MW 202/48

Sirius Venus Deneb  
DRLN 45°05' 45°10' 45°15'  
λW 98°12' 99°06' 100°00'  
+ st : :  
dur

+ 03:01:30 03:07:00 03:12:30

hs hi

hs lo

hs 28°16' 04°43' 03°37'

R - 1 - 4 - 4'

IC - 7 - 2 - 1

Refn - 6 - 8 - 8

H<sub>o</sub> 28°02' 04°29' 03°24'

Z<sub>corri</sub> 8NmR 8NmR 8NmR

H:M 199°11' 190°30' 201°42'

M:S 0°23' 1°45' 38°

~~GHA~~

SHA 258°31' 49°30'

GHA 458°05' 192°15' 251°50'

a λ -W 98°05' -W 99°15' -W 100°50'

LHA 360 - 93 - 151 -

a L N45° N45° N45°

Dec 516°45' N09°47' N45°21'

H 29°00' 04°15' 03°36'

(d) (-60)-45 (+42)+33 (+56)+20

H<sub>c</sub> 28°15' 04°48' 03°56'

H<sub>o</sub> 28°02' 04°29' 03°24'

a +13' +18' +32'

away away away

(360) 360 360

Z 180 82 20°

Z<sub>n</sub> 180 278 340°

5:30 @ 426 = 39 nm

11:00 @ 426 = 78 nm



| Deneb  | Venus | S. r. v s |
|--------|-------|-----------|
| 04°04' | 4°49' | 29°01'    |
| 03°52' | 4°47' | 28°38'    |
| 03°51' | 4°46' | 28°35'    |
| 03°50' | 4°44' | 28°26'    |
| 03°48' | 4°43' | 28°22'    |
| 03°37' | 4°42' | 28°09'    |
| 03°30' | 4°40' | 28°00'    |
| 03°26' | 4°40' | 27°48'    |
| 03°20' |       | 27°28'    |
| 03°19' |       |           |
| 03°18' |       |           |

| R wshld | L wshld | L window |
|---------|---------|----------|
| f m     | f m     | f m      |
| L scat  | L scat  | L scat   |

|     |        |        |        |
|-----|--------|--------|--------|
| h i | 04°04' | 04°49' | 29°01' |
| L o | 03°18' | 04°40' | 27°28' |

|   |        |          |        |
|---|--------|----------|--------|
| m | 11     | 8        | 9      |
| m | 03°37' | 04°43.5' | 28°22' |
| X | 03°37' | 04°43'   | 28°16' |
| S | 16'03" | 3'16"    | 28'17" |
| Δ | 46'    | 9'       | 93'    |

\* Noticeable roll taking Deneb + Sirius -  
Venus straight ahead of plane - much more stable shots

02/24/2017  
 MSP-PSC  
 Sirius  
 Venus  
 Deneb

W 63

W 62

W 61

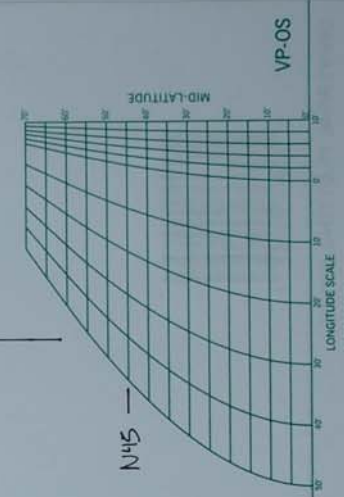
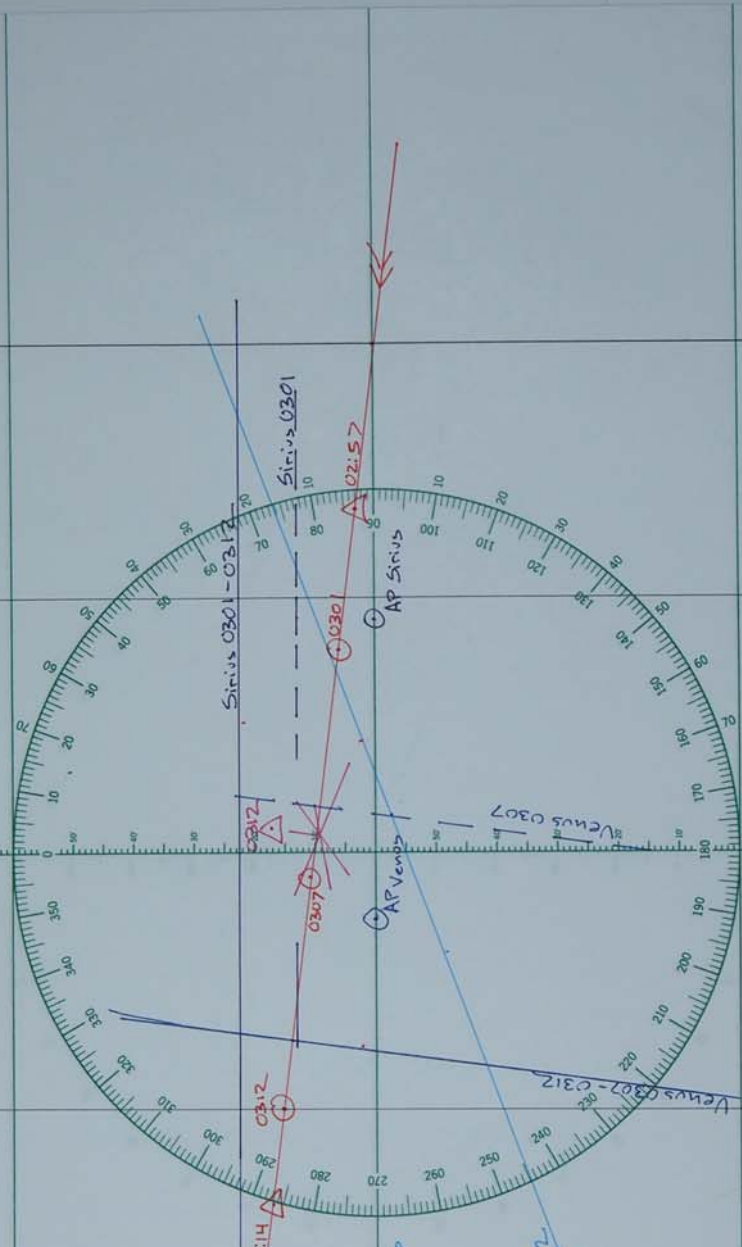
W 60

W 59

N46

N45

N44



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04/14/2015

IAH-SLC 5226

FIX L N34°45'  
1 X W103°34'  
+ 04:26

FIX L N36°15'  
2 X W105°31'  
+ 04:43

FL 360  
MH 303  
MC 305  
TAS 463  
GS 442  
SAT -54  
MW 266/27  
Var 9°E

Body Alphard Sirius Aldebaran  
DR L N35°03' N35°27' N33°49'  
λ W103°57' W104°27' W104°56'

⌘  
+ 04:29:30 04:34:00 04:38:30

4:30" @ 442 kt = 33 mi  
9:00 @ 442 kt = 66 mi

hs 41°01' 09°28' 03°36'  
R 0 -2 -4  
IC -10 -2 -1  
Refn -5 -8 -8  
P

H<sub>0</sub> 40°46' 09°16' 03°23'

Z<sub>coriolis</sub> 6'R " "

γ H:M 267°32' 270°03' 270°03'  
M:S 223' 1°00' 2°08'  
\* SHA 217°53' 258°31' 290°46'  
GHA 487°48' 529°34' 562°57'  
a λ W-103°48' -104°34' -104°57'

LHA 384 425 458  
(360) 360 360 360  
LHA 24° 65° 98°  
aL N35 N35 N36  
Dec S08°44' S16°45' N16°32'

H 41°24' 10°04' 03°05'  
(d) (-54)-40 (-40)-30 (36)+19  
Hc 4044 09°34' 03°24'  
H<sub>0</sub> 40°46' 09°16' 03°23'  
a -2 +18 +1'  
to away away

(360) 360 360 360  
Z 148 118 72°  
Zn 212 242 288°



| Body              | Aldebaran | Sirius   | Alphard  |
|-------------------|-----------|----------|----------|
| Seat - L          |           | L        | L        |
| thru - F L window |           | L window | L window |

|     |        |        |         |
|-----|--------|--------|---------|
| h s | 4° 00' | 9° 50' | 41° 58' |
|     | 3° 49' | 9° 42' | 41° 38' |
|     | 3° 44' | 9° 41' | 41° 25' |
|     | 42'    | 9° 39' | 41° 11' |
|     | 42'    | 9° 35' | 40° 58' |
|     | 41'    | 9° 30' | 40° 24' |
|     | 38'    | 9° 22' | 40° 17' |
|     | 37'    | 20°    | 40° 16' |
|     | 3° 30' | 21     |         |
|     | 23'    | 20     |         |
|     | 20'    | 12     |         |
|     | 3° 10' | 4      |         |

|         |        |        |  |
|---------|--------|--------|--|
| Vis Avg | 3° 06' | 9° 00' |  |
|         |        | 9° 20' |  |

|   |        |        |         |
|---|--------|--------|---------|
| n | 12     | 13     | 8       |
| m | 3° 39' | 9° 22' |         |
| x | 3° 36' | 9° 28' | 41° 01' |
| s | 13'    | 14'    | 39'     |

n  
m  
x  
s

|   |     |     |      |
|---|-----|-----|------|
| Δ | 71' | 50' | 102' |
|---|-----|-----|------|



04/14/2017  
IAH - SLC

Alphard  
Sirius  
Aldebaran

W103

W104

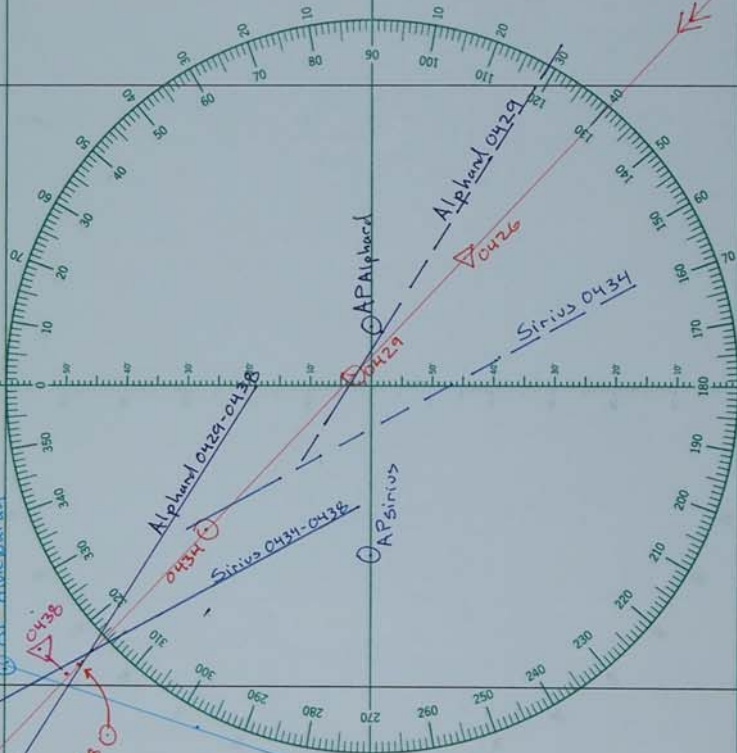
W105

W106

N36

N35

N34



UNIVERSAL PLOTTING SHEET

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VP-OS



04/11/2017

SLC-1A4

FIX L N35°03'  
ABQ λ W106°49'  
+

CMEN33°20'  
W104°37'

FL 370  
MH 136  
MC 130  
TAS 442  
GS 485  
SAT -59  
W 261/75

FIX L N34°22'  
CNX λ W105°41'  
+

Body: SUN SUN

DR L N34°50' N33°26'  
λ W106°27' W104°43'

+ 18:03:30 18:18:15

hs 59°51' 63°31'

R

IC -10 -10

Do -4 -4

P

Ho 59°37' 63°17'

Z coriolis 7R 7R

H:M 29°46' 92°16'

M:S 53' 2°04'

SHA

GHA 90°39' 94°20'

a λ W106°39' W105°20'

LHA -16 -11

(360) 360 360

LHA 344° 349°

aL N35° N33°  
same same

Dec N08°35' N08°35'

H 59°16' 63°00'

(d) (54) 32 (56) 33

Hc 59°48' 63°33'

Ho 59°37' 63°17'

a +11 +16

away

away

(360)

Z 148° 155°

Zn 148° 155°

- Elapsed Time 14:45

- Sun Line Distance 142 Nm

- Sun Line GS - 572kt

1803 Sun 22'/Nm error

1818 Sun 3'/Nm error



Body Sun 1 Sun 2

Seat - L  
thru - F-L

|    |        |        |
|----|--------|--------|
| hs | 60°19' | 63°39' |
|    | 60°10' | 38'    |
|    | 60°02' | 34'    |
|    | 60°01' | 30'    |
|    | 59°59' | 24'    |
|    | 57'    | 23'    |
|    | 56'    |        |
|    | 30'    |        |
|    | 5852'  |        |

V. > Avg 59°33' 63°30'

Δ 87' 16'

|          |        |        |
|----------|--------|--------|
| n        | 9      | 6      |
| m        | 59°59' | 63°32' |
| <u>x</u> | 59°51' | 63°31' |
| s        | 26'    | 7'     |

N  
m  
x  
s

04/11/2017  
SLC-1AH

Sun

N35

N34

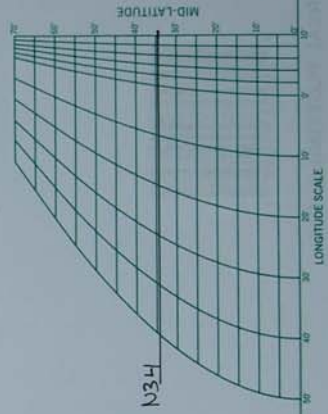
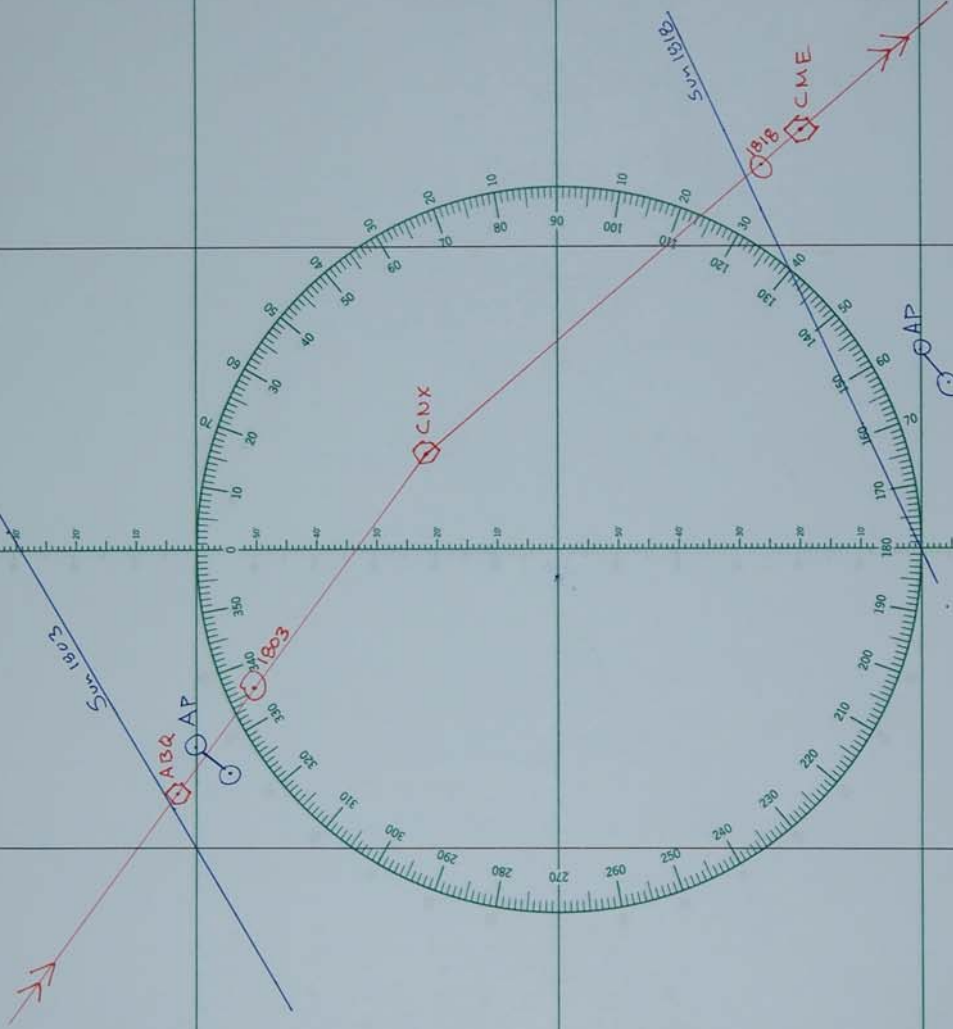
N33

W107

W106

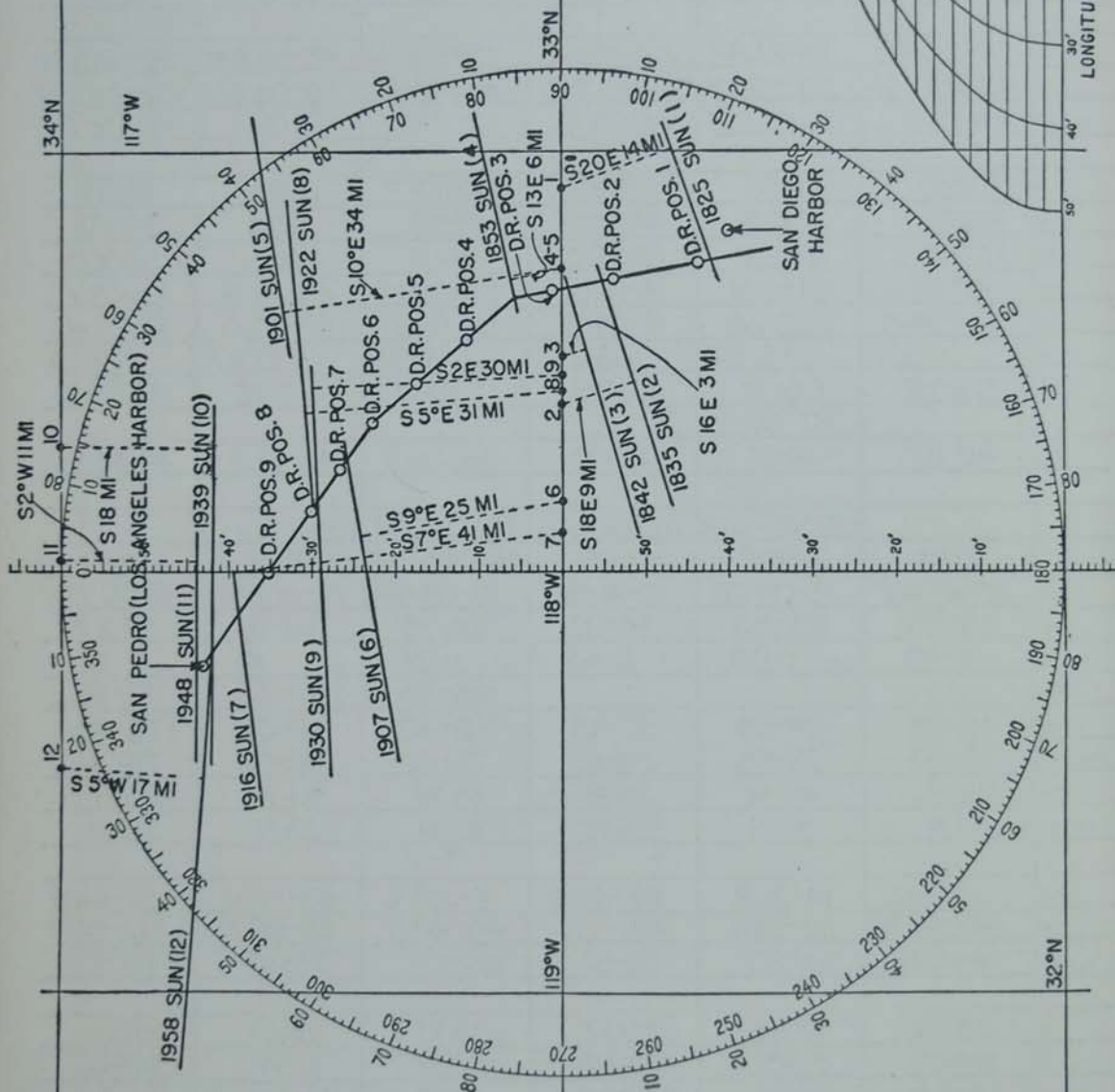
W105

W104

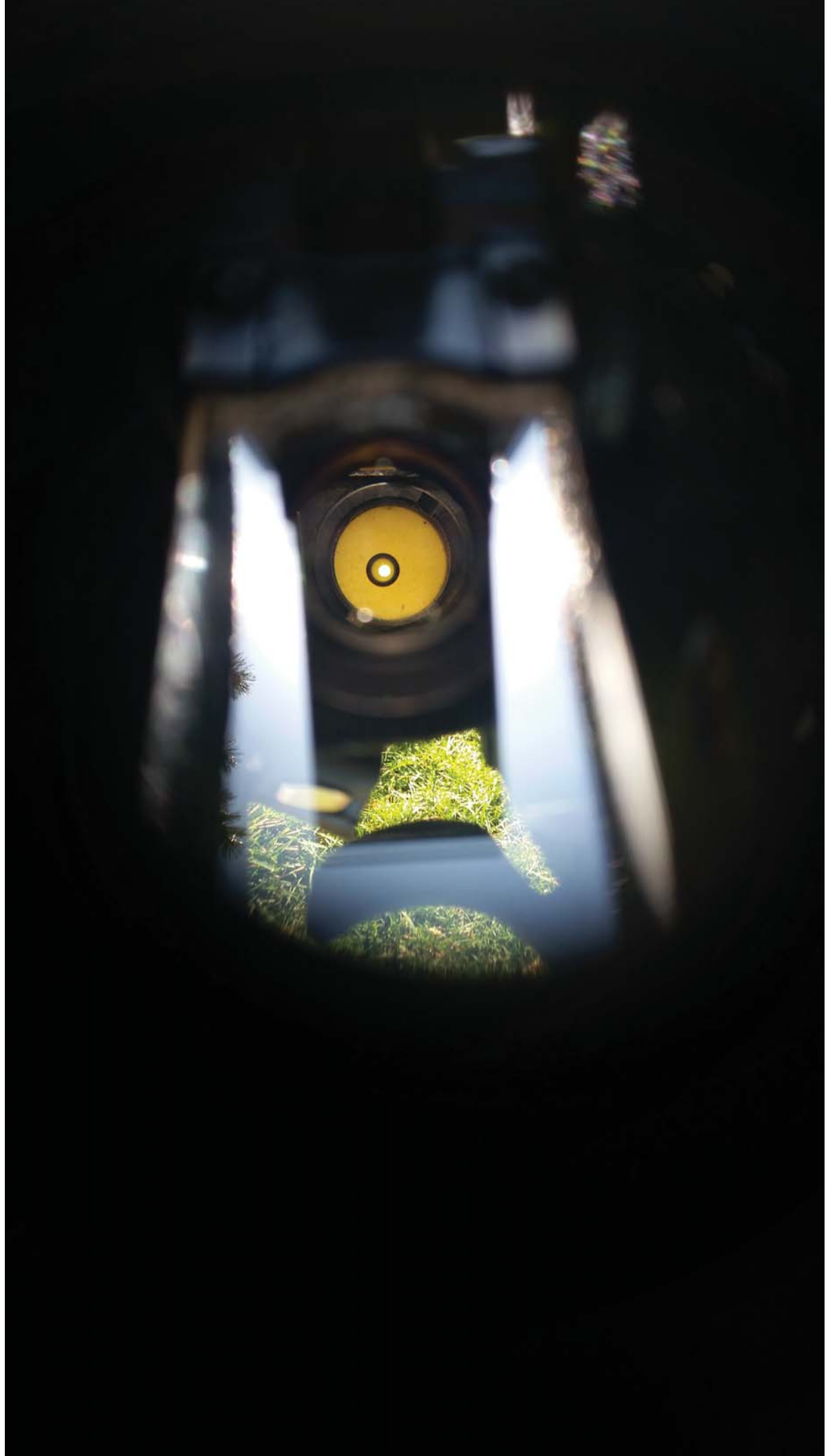




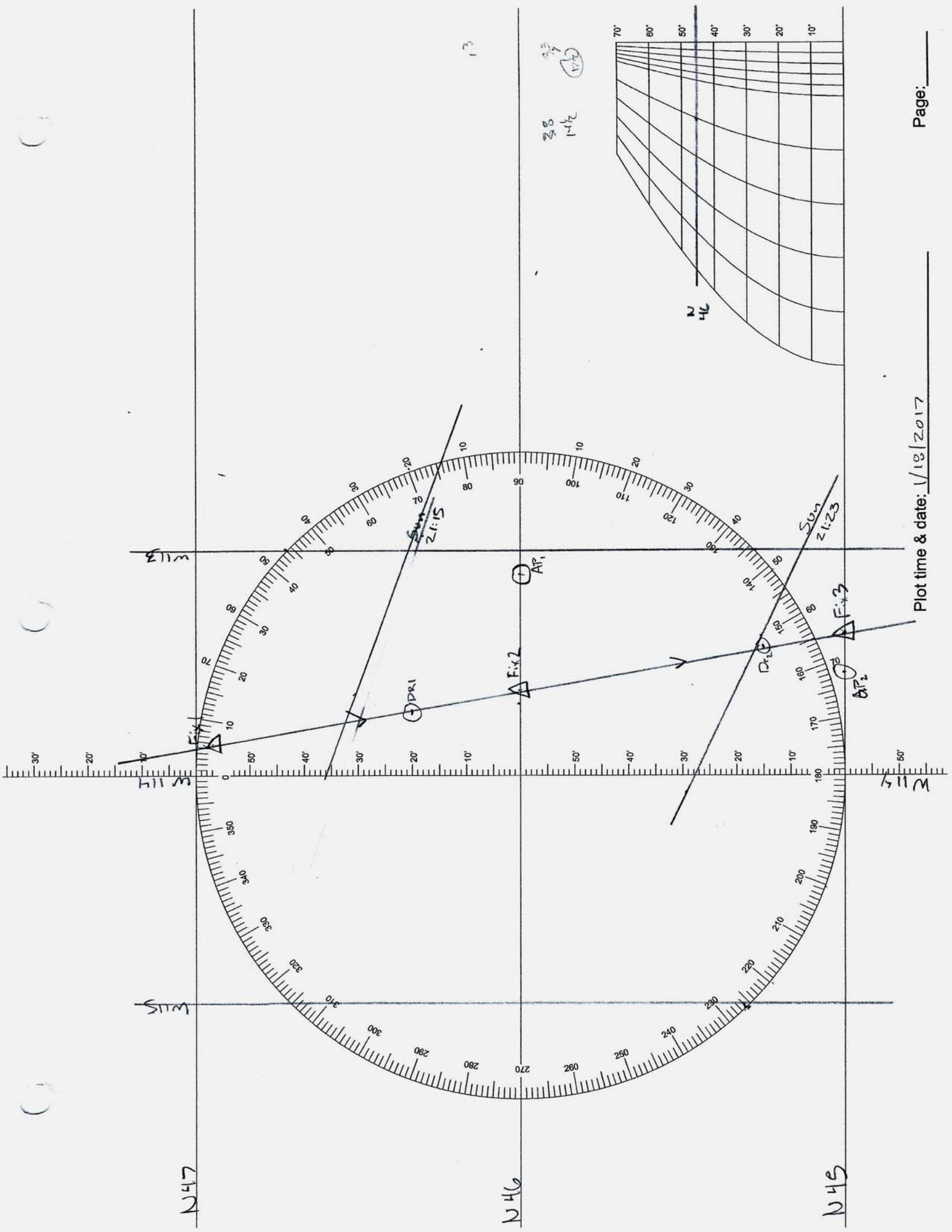
## PLOT OF SUN LINES 28 NOV. 1940



|         |  |             |    |
|---------|--|-------------|----|
| 1       |  | 18° 24' 32" | 18 |
| GCT     |  | 97° 58'     | 10 |
| GHA     |  | 1-08        |    |
| CORR    |  | 99° 06'     | 10 |
| GHA     |  | 117-06      | 11 |
| LONG(A) |  | 18 E        |    |
| LHA     |  | 33 N        |    |
| LAT(A)  |  |             |    |
| DEC     |  | 21-23 S     | 21 |
| K       |  | 34-20 N     | 34 |
| K-DEC   |  | 55-43       | 55 |
| A       |  | 1510        |    |
| B       |  | 24927       | 24 |
| LOG Hc  |  | 26437       | 25 |
| Hc      |  | 32° 58'     | 33 |
| Hc      |  | 33 12       | 33 |
| G       |  | 14T         |    |
| Z       |  | S 20° E     | S  |
| 7       |  | 19° 15' 42" | 19 |
| GCT     |  | 110° 28'    | 1  |
| GHA     |  | 1-26        |    |
| CORR    |  | 111°-54'    | 1  |
| GHA     |  | 117-54      | 1  |
| LONG(A) |  | 6 E         |    |
| LHA     |  | 33 N        |    |
| LAT(A)  |  |             |    |
| DEC     |  | 21-23-S     | 21 |
| K       |  | 33-09 N     | 33 |
| K-DEC   |  | 54-32       | 54 |
| A       |  | 168         |    |
| B       |  | 23640       | 2  |
| LOG Hc  |  | 23808       | 2  |
| Hc      |  | 35° 19'     |    |
| Hc      |  | 34-38       |    |
| G       |  | 41A         |    |
| Z       |  | S 7° E      | S  |







1/18/2017

4775 FCA-SLC

Fix 1 N 46° 50'   
 W 113° 53'   
 21:09   
 Fix 2 N 46° 00'   
 W 113° 37'   
 21:18

Fix 3 N 45° 00'   
 W 113° 21'

FL 330   
 MC 164   
 MH 155   
 TAS 424   
 GS 410   
 OAT -50

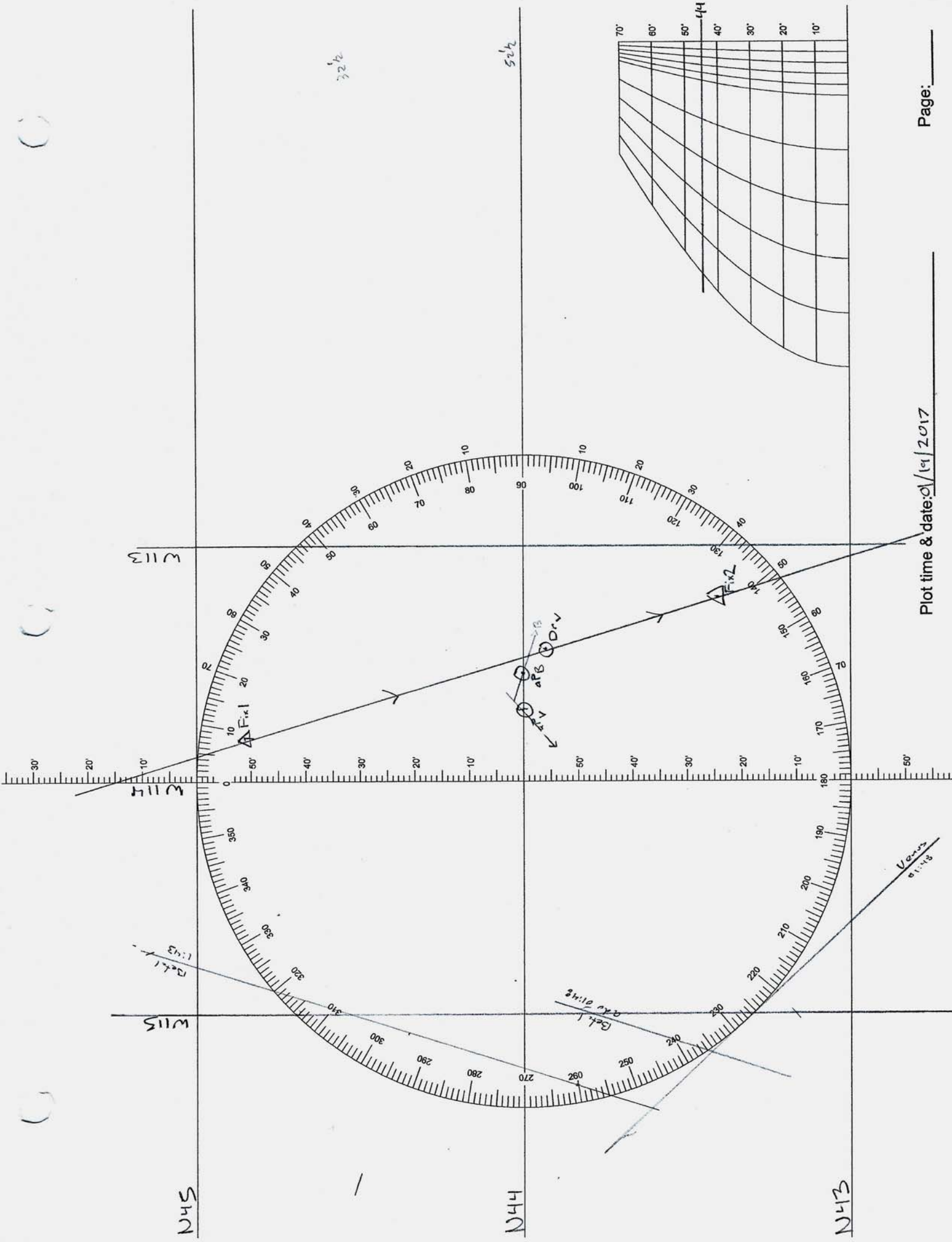
|           |            |            |
|-----------|------------|------------|
|           | from       | tracey     |
| 249:      | SUN        | Sun        |
| DR L      | N 46° 20'  | N 45° 15'  |
| X         | W 113° 43' | W 113° 24' |
| + et      | 21:14:00   | 21:23:45   |
| dur       | 02:00      | 02:00      |
| +         | 21:15:00   | 21:24:45   |
| hsk       | 20° 40'    | 20° 35'    |
| hsl       | 20° 19'    | 20° 14'    |
| hs        | 20° 30'    | 20° 25'    |
| R         | -1'        | -1'        |
| IC        | -5'        | -5'        |
| Refn      | -6'        | -6'        |
|           | -12'       | -12'       |
| Ho        | 20° 18'    | 20° 13'    |
| Z correct | 7 Nm R     | 7 Nm R     |

LOP:

|       |             |             |
|-------|-------------|-------------|
| H:    | 134° 51'    | 137° 21'    |
| M:    | 1° 15'      | 1° 11'      |
| GHA   | 136° 06'    | 138° 32'    |
| SHA*  |             |             |
| GHA   | 136° 06'    | 138° 32'    |
| λ     | W 113° 06'  | W 113° 32'  |
| LHA   | 23°         | 25°         |
| αL    | N 46°       | N 45°       |
| Dec   | S 20° 21.6' | S 20° 21.6' |
| H     | 20° 47'     | 21° 07'     |
| (d)   | (-57) -21   | (-57) -21   |
| Hc    | 20° 46'     | 20° 46'     |
| Ho    | 20° 18'     | 20° 13'     |
| a     | +28         | +33         |
|       | away        | away        |
| (360) | 360         | 360         |
| Z     | 157         | 155         |
| Zn    | 203°        | 205°        |

|         |            |            |
|---------|------------|------------|
| LOP:    | Sun        | Sun        |
|         | 21:15:00   | 21:24:45   |
| GHA     | 136° 06'   | 138° 32'   |
| Long A  | W 113° 06' | W 113° 32' |
| LHA(t)  | W 23       | W 25       |
| Lat A   | N 46       | N 45       |
| Dec     | S 20° 22'  | S 20° 22'  |
| K       | N 48° 22'  | N 47° 49'  |
| K ~ Dec | 68° 44'    | 68° 11'    |
| A       | 1662       | 2031       |
| B       | 44044      | 42988      |
| Log Hc  | 45706      | 45619      |
| Hc      | 20° 46'    | 20° 46'    |
| Ho      | 20° 18'    | 20° 13'    |
|         | +28        | +33        |
|         | S 23 W     | S 23 W     |
|         | 203°       | 205°       |





1/19/2017

4764 MSO-SLC

Fix 1 N44° 51'  
W113° 49'Fix 2 N43° 24'  
W113° 13'  
01:54FL 290  
MH 158  
MC 149  
TAS 420  
GS 404  
SAT -41°

Betelgeuse  
DRL N44° 29'  
W113° 40'  
t start 01:42:45  
dur. 02:00  
+ 01:43:45  
hs hi 26° 48'  
hs low 26° 07'  
hs 26° 27'  
R -1  
LC -6  
Refn -7  
-14  
Ho 26° 13'  
Z corriebs 7Nm R

H:M 143° 39'  
M:S 0° 56'  
GHA 144° 35'  
SHA\* 270° 58'  
GHA 415° 33'  
aλ W113° 33'  
LHA 302  
aL N44°  
Dec N07° 24'

H 27° 35'  
(d) (+43) +17  
Hc 27° 52'  
Ho 26° 13'  
a +1° 39'  
away 99'

(360)  
Z 108  
Zn 108°

Venus  
N43° 36'  
W113° 26'  
01:48:00  
200  
01:49:00  
28° 30'  
27° 12'  
27° 51'  
-1  
-7  
-6  
-14  
27° 37'  
7Nm R

156° 27'  
2° 15'  
V150° 42'

W113° 42'  
45°  
N44°  
S05° 20'

26° 30'  
(-50) -17  
26° 13'  
27° 51'  
-1° 38'  
toward 98°  
360  
128°  
232°

|        | B         | V         |
|--------|-----------|-----------|
| aλ     | W113° 33' | W113° 42' |
| t      | E58       | W45       |
| aL     | N44       | N44       |
| Dec    | N07° 24'  | S05° 20'  |
| K      | N61° 15'  | N53° 47'  |
| KuDec  | 53° 51'   | 59° 07'   |
| A      | 10107     | 8501      |
| B      | 22922     | 28964     |
| Log Hc | 33029     | 35465     |
| Hc     | 27° 51'   | 26° 14'   |
| Ho     | 26° 13'   | 27° 51'   |
| a      | +1° 38'   | -1° 37'   |
| Z      | S72E      | S51W      |
| Zn     | 108°      | 231°      |

\* Cont. Lt/int Mod Chop while sighting

01:48:60

01:43:45

5:15 x 404 K = 35.5 Nm

Table 52  
PUHA 82  
506.82





02/24/2017

HSCG MSP-PSC

FIX 1 N 45° 47'  
W 107° 32'  
t 03:57

FIX 2 N 45° 56'  
W 110° 37'  
t 04:14

FL 340  
MH 2570  
MC 260°  
TAS 455K  
GS 444K  
SAT -49  
MW 203/20

DRL      Eltanin      Mars      Rigel  
λ      N 45° 48'      N 45° 50'      N 45° 54'  
         W 107° 57'      W 108° 44'      W 109° 47'

t<sub>st</sub>  
dur

t      03:59:30      04:10:00      04:16:00

hs hi

hs lo

hs      08° 04'      07° 03'      30° 38'

R      -2      -2      -1

IC      -2      -2      -8

Refn      -8      -8      -6

Ho      07° 57'      06° 51'      30° 23'

Z<sub>cor</sub>      8nm R      8nm R      8nm R

H:M      21 10 43'      19 50 49'      21 6 44'

M:S      2 23'      1 00'      0

GHA

SHA

90° 45'

231° 09'

GHA      304 51      196 49'      497° 53'

aλ      107° 51'      108 49'      109 53'

LHA      197 —      88 —      338 —

aL      N 46      N 46      N 28 46

Dec      N 51° 29'      N 07° 45'      S 08° 11'

H      08° 06'      06° 25'      30° 29'

(d)      (+59)+29      (+43)+31      (-56)-10

Hc      08° 35'      06° 56'      30 19'

Ho      07° 57'      06° 51'      30° 23'

a      +38      +5      -4

away

away

to

(360)

360

360

Z

11

87

147

Zn

11°

273

213°

330      60°

Deneb Az ~ 330 would have given better cut than Eltanin



| Rigel  | Mars   | Eltanin |
|--------|--------|---------|
| 35°58' | 07°06' | 08°25'  |
| 35°56' | 07°04' | 08°24'  |
| 35°53' | 07°04' | 08°22'  |
| 35°45' | 07°03' | 08°20'  |
| 35°35' | 07°02' | 08°19'  |
| 35°33' | 07°00' | 08°11'  |
| 35°32' | 06°59' | 08°08'  |
| 35°27' | 06°58' | 08°07'  |
| 35°24' | 06°58' | 08°06'  |
| 35°23' | 06°57' | 07°52'  |
|        | 06°54' | 07°33'  |

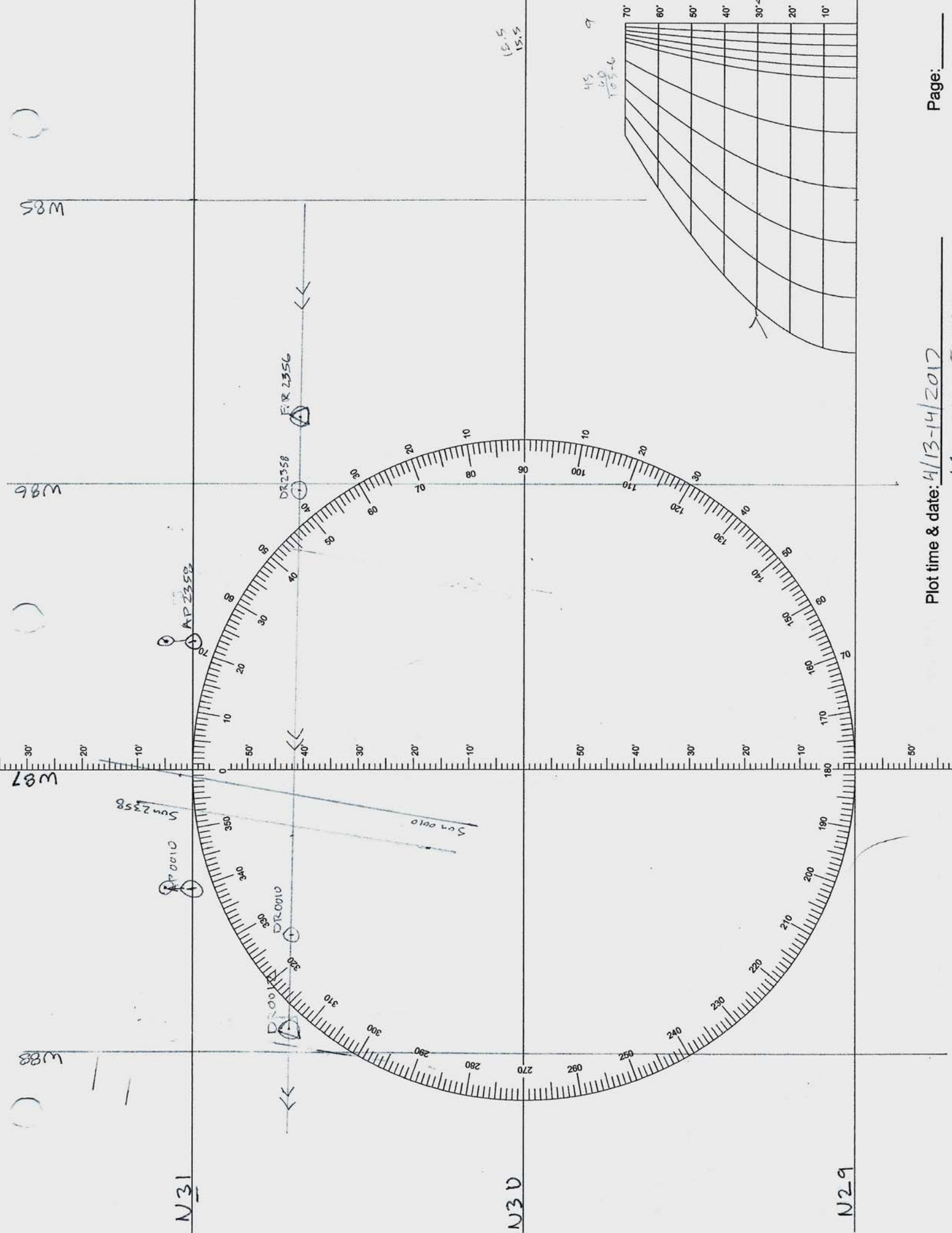
| L window | L Wskld | R window |
|----------|---------|----------|
| fm       | fm      | fm       |
| L seat   | L seat  | L seat   |

|        |        |        |        |
|--------|--------|--------|--------|
| 10     | n      | 11     | 11     |
| 35°58' | hi     | 07°06' | 08°25' |
| 35°23' | Lo     | 06°54' | 07°33' |
| 35°34' | median | 07°00' | 08°11' |
| 35°38' | X      | 07°03' | 08°09' |
|        | std.   | 3'39"  | 15'43" |

\* readings  
50 hi -  
30° X"

\* Mars straight ahead, very stable shots  
Rigel & Eltanin L & R of plane - noticeable  
roll taking shots - chasing motion till stable at ends  
of roll - Elt had noticeable ~~in~~ end groupings.







4/13-14/2017

JAX - IAH 5255

FIX N 30°40'  
 1 W 85°46'  
 + 23:56:00

N 3043  
 3 W 8755  
 + 00:12

FL 340  
 MH 280°  
 MC 278°  
 TAS 449  
 GS 426  
 SAT -55°  
 W 303/26  
 Var 5° W

FIX N 3043 TAS 440 N  
 2 W 0709 GS 418 4 W  
 + 06:00 T

DR L Sun 23:58 Sun 00:00  
 N 30°41' N 30°43'  
 λ W 86°01' W 87°35'

+ 23:58:30 00:00:00

Speed

|      |       |       |       |
|------|-------|-------|-------|
| h s  | 2°59' | 0°30' | R x f |
| R    | -5'   | -10   | 12.1  |
| IC   | -1'   |       |       |
| Refn | -8'   | -8    |       |
| P    |       |       |       |

Hto 2°45' 0°12'

Z 5'R 5'R

H:M 177°25' 182°25'  
 M:S 2°08'

SHA

GHA 179°33' 182°25'  
 a λ - W 86°33' - 87°25'  
 LHA 93 95  
 (360)

LHA 93° 95°  
 aL N31° N31°  
 Dec N9°24' N9°24'

H 2°05' 0°23'  
 (d) (31) 12 (32) 13  
 Hc 217 36'  
 Ho 2°45' 0°12'  
 a - 28' + 24'  
 +0 away

(360) 360 360

Z 81 80  
 Zn 279 280



Body 023:57 00:09

Scat- L  
thru- LW

L  
LW

hs

3° 14'  
10'  
06'  
03'  
2° 59'  
58'  
50'  
50'  
2° 44'

0° 53'  
52'  
49'  
44'  
43'  
41'  
14'  
10'  
10'  
9'  
3'

Vis Avg

0° 28'

n  
m  
x  
s

9  
2° 59'  
2° 59'  
10'

11  
0° 41'  
0° 30'  
20'

n  
m  
x  
s