



# PRINTABLE CELESTIAL NAVIGATION WORK FORMS

For detailed instructions and numerical examples, see the companion booklet listed below.

- FORM 104 — All bodies, using Pub 249 or Pub 229
- FORM 106 — All Bodies, Using NAO Tables
- FORM 108 — All Bodies, Almanac, and NAO Tables
- FORM 109 — Solar Index Correction
- FORM 107 — Latitude at LAN
- FORM 110 — Latitude by Polaris
- FORM 117 — Lat, Lon at LAN plus Polaris
- FORM 111 — Pub 249, Vol. 1 Selected Stars

## **Other Starpath publications on Celestial Navigation**

- Celestial Navigation*
- Starpath Celestial Navigation Work Forms*
- Hawaii by Sextant*
- How to Use Plastic Sextants*
- The Star Finder Book*
- GPS Backup with a Mark 3 Sextant*
- Emergency Navigation*
- Stark Tables for Clearing the Lunar Distance*
- Long Term Almanac 2000 to 2050*

**Form 104, All Sights, Pub. 249 or Pub. 229**

<b>1</b>	WT	h	m	s	date	body	Hs	°	'
	WE +S -F				DR Lat	log	index corr. + off - on		
	ZD +W -E				DR Lon	HE ft	DIP -		
	UTC	h	m	s	UTC date / LOP label			Ha	°
<b>2</b>	GHA hr.				v moon planets	Dec hr	°		
						d +			HP moon
<b>3</b>	GHA + m.s.				d corr.		+		
	SHA + or v corr.				stars or moon, planets	Dec	°	Dec min	
	GHA								additional altitude corr. moon, mars, venus
	a-Lon -W+E								altitude corr. all sights
<b>4</b>	LHA								upper limb moon subtract 30'
	Dec deg								Ho
	a-Lat								<b>T</b>
									Hc
<b>5</b>	tab Hc				d +				<b>A</b>
	d. corr.				Pub. 249	Dec min			a =
	Hc								Zn =
									a - Lat =
<b>6</b>									a - Lon =

North Latitudes
South Latitudes

LHA greater than 180° ..... Zn = Z                      LHA greater than 180° ..... Zn = 180° - Z  
 LHA less than 180° ..... Zn = 360° - Z                LHA less than 180° ..... Zn = 180° + Z

*(This section is a duplicate of the form above)*

**Form 106, All Sights, Using the NAO Tables**

Location on table pages  
**Top**                      **Sides**

Latitude N S	LHA
<b>1</b>	

SR Table →

		N S Declination		
		+ D°	D'	
		- B°	B'	+ Z <sub>1</sub>
A°	A'	- F°	F'	- Z <sub>1</sub>

sign B = sign Z<sub>1</sub>  
+ if LHA = 0 to 90  
- if LHA = 91 to 269  
+ if LHA = 270 to 360

bar top means rounded value  
30' or 0.5° rounds up

<b>2</b>	<b>3</b>
Ā	F̄
SR Table →	Aux →
H°	F'
H'	P̄
P°	Z <sub>2</sub>
P'	+
+	-
-	+
-	-

+ if F = 0 to 90  
- if F = 90 to 180

same sign as Z<sub>2</sub>  
but reverse sign if  
F' = 30 to 59

<b>4</b>	<b>5</b>
A'	Z̄ <sub>2</sub>
Aux →	Aux →
+	+
-	-
+	-
-	+

+ if A' = 30 to 59  
- if A' = 0 to 29

Hc =	A
------	---

Ho =	T
------	---

a =	
-----	--

T A	
-----	--

Zn =	
------	--

Location on table pages  
**Top**                      **Sides**

Latitude N S	LHA
<b>1</b>	

SR Table →

		N S Declination		
		+ D°	D'	
		- B°	B'	+ Z <sub>1</sub>
A°	A'	- F°	F'	- Z <sub>1</sub>

sign B = sign Z<sub>1</sub>  
+ if LHA = 0 to 90  
- if LHA = 91 to 269  
+ if LHA = 270 to 360

bar top means rounded value  
30' or 0.5° rounds up

<b>2</b>	<b>3</b>
Ā	F̄
SR Table →	Aux →
H°	F'
H'	P̄
P°	Z <sub>2</sub>
P'	+
+	-
-	+
-	-

+ if F = 0 to 90  
- if F = 90 to 180

same sign as Z<sub>2</sub>  
but reverse sign if  
F' = 30 to 59

<b>4</b>	<b>5</b>
A'	Z̄ <sub>2</sub>
Aux →	Aux →
+	+
-	-
+	-
-	+

+ if A' = 30 to 59  
- if A' = 0 to 29

Hc =	A
------	---

Ho =	T
------	---

a =	
-----	--

T A	
-----	--

Zn =	
------	--

**Form 108, All Bodies, Almanac, and NAO Tables**

1	WT	h	m	s	date	body	Hs	o	'
	WE +S -F				DR Lat	log	index corr. + off - on		
	ZD +W -E				DR Lon	HE ft	DIP -		
	UTC	h	m	s	UTC date / LOP label		Ha	o	'

2	GHA hr.	o	'	v moon planets	Dec hr	o	'	d +	-	HP moon
---	------------	---	---	----------------------	-----------	---	---	--------	---	------------

3	GHA + m.s.	o	'		d corr.	+	-
	SHA + or v corr.	o	'	stars or moon, planets	Dec	o	Dec min

5	additional altitude corr. moon, mars, venus	
	altitude corr. all sights	
	upper limb moon subtract 30'	
	Ho	o
		'

4	a-Lon -W+E	o	'
	LHA	o	'

00' W / 60' E

Location on table pages  
**Top**      **Sides**

6	Latitude N S	LHA
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SR Table

	N	S	Declination	
	+	-	D°	D'
same contrary	+	-	B°	B'
	-	+	F°	F'

sign B = sign Z<sub>1</sub>  
+ if LHA = 0 to 90  
- if LHA = 91 to 269  
+ if LHA = 270 to 360

bar top means rounded  
value 30' or 0.5° rounds up

7	$\bar{A}$	$\bar{F}$
---	-----------	-----------

SR Table

H°	H'	P°	P'	+	-	Z <sub>2</sub>
----	----	----	----	---	---	----------------

+ if F = 0 to 90  
- if F = 90 to 180

8	F'	$\bar{P}$
---	----	-----------

Aux

same sign as Z<sub>2</sub>  
but reverse sign if  
F' = 30 to 59

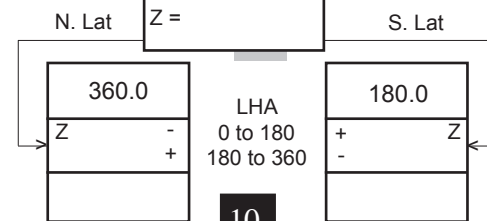
+	-	C <sub>1</sub>
---	---	----------------

9	A'	$\bar{Z}_2$
---	----	-------------

Aux

+ if A' = 30 to 59  
- if A' = 0 to 29

+	-	C <sub>2</sub>
---	---	----------------



Hc =		A
------	--	---

Ho =		T
------	--	---

take label  
of larger

a =	
-----	--

T	A
---	---

Zn =	
------	--

11

a-Lat =	a-Lon =
---------	---------

**Form 117, Short Forms for LAN and *Polaris* Sights**

Lat at LAN			
Find Ho		degrees	minutes
Hs-max =			
IC (+Off, - On) =	±		
Dip (from HE) =	-		
Ha =			
alt corr (UL-,LL+) =	±		
Ho =			
Find z (90°-Ho)		89°	60.0'
Ho =	-		
z =			
DR (Lat, Lon) =			
<i>Lat = sum or difference Dec and z</i>			
Dec or z =			
z or Dec =	±		
Lat =			

Date	hr	min	sec
UTC LAN =			

Declination in Nautical Almanac at UTC of LAN				
		degrees	minutes	d-value (±)
Dec (hr) =	N S			
d corr =	±			
Dec =	N S			

Lon at LAN = GHA sun at UTC of LAN				
		degrees	minutes	
GHA (hr) =				
GHA (m.s) =	+			
GHA =				
<i>If GHA between 0 and 180, Lon W = GHA</i>				
<i>If GHA between 180 and 360, Lon E = 360-GHA</i>				

**LAN Lat Rules:** For Contrary Name:  $Lat = z - Dec$ . For Same Name:  $DR-Lat > Dec, Lat = z + Dec$ ;  $DR-Lat < Dec, Lat = Dec - z$ . But don't forget the easy rule: add them, and if that is nonsense (compared to your DR Lat) then sub-tract them. **LAN Lon Reminder:** LAN Lon is only as accurate as the UTC you assign to the event. The Lon will be uncertain by 15' for each 1 minute of time uncertainty in your choice of peak Hs time.

Find LHA $\Upsilon$			
UTC <i>Polaris</i> sight	hr	min	sec
Date			
DR (Lat, Lon) =			

LHA $\Upsilon$ = GHA $\Upsilon$ - Lon W (or + Lon E)			
		degrees	minutes
GHA $\Upsilon$ (hr) =			
GHA $\Upsilon$ (m.s) =	+		
GHA $\Upsilon$ =			
DR Lon (-W,+E) =	±		
LHA $\Upsilon$ =			
<i>Use LHA <math>\Upsilon</math> in <i>Polaris</i> Tables to find a0, a1, a2</i>			

Lat by <i>Polaris</i>			
		degrees	minutes
Hs of <i>Polaris</i> =			
IC (+Off, - On) =	±		
Dip (from HE) =	-		
Ha =			
alt corr =	-		
Ho =			
subtract 1°	-	-1°	
+a0 =	+		
+a1 =	+		
+a2 =	+		
Lat =			

**Form 109, for Solar Index Correction**

Toward or Away		Date	
On	Off	Diff	Check SD
sight #	-	-	+
	=	= ÷2	= ÷4
SD=		=	=

Toward or Away		Date	
On	Off	Diff	Check SD
sight #	-	-	+
	=	= ÷2	= ÷4
SD=		=	=

Toward or Away		Date	
On	Off	Diff	Check SD
sight #	-	-	+
	=	= ÷2	= ÷4
SD=		=	=

Toward or Away		Date	
On	Off	Diff	Check SD
sight #	-	-	+
	=	= ÷2	= ÷4
SD=		=	=

Toward or Away		Date	
On	Off	Diff	Check SD
sight #	-	-	+
	=	= ÷2	= ÷4
SD=		=	=

Toward or Away		Date	
On	Off	Diff	Check SD
sight #	-	-	+
	=	= ÷2	= ÷4
SD=		=	=

Toward or Away		Date	
On	Off	Diff	Check SD
sight #	-	-	+
	=	= ÷2	= ÷4
SD=		=	=

Toward or Away		Date	
On	Off	Diff	Check SD
sight #	-	-	+
	=	= ÷2	= ÷4
SD=		=	=

Toward or Away		Date	
On	Off	Diff	Check SD
sight #	-	-	+
	=	= ÷2	= ÷4
SD=		=	=

Toward or Away		Date	
On	Off	Diff	Check SD
sight #	-	-	+
	=	= ÷2	= ÷4
SD=		=	=

*This form covers 12 sights.*

**Form 107, for Latitude at LAN**

<b>Step 1 Correct Hs to get Ho</b>			
1-1	Record Maximum Sextant Height (Hs = peak height of the sun at noon), and mark limb	Lower Upper	Hs ° ' "
1-2	Record Index Correction (mark sign + if off, - if on)	IC	Off On + -
1-3	Record eye height (HE) and Look up Dip Correction on the right-hand side of Table A2, front of the Almanac (correction depends on HE)	Dip HE (ft)	- ° ' "
1-4	Sum the above three numbers to get Apparent Height	Ha	° ' "
1-5	Look up altitude correction on lefthand side of Table A2, front of the Almanac (correction depends on Ha, Limb, and month) (mark sign + for lower limb, - for upper limb)	Alt corr.	+ - ° ' "
1-6	Sum the above two numbers to get Observed Height	Ho	° ' "

<b>Step 2 Determine the Zenith Distance</b>			89°	60.0'
2-1	Record Ho from Step 1, above, and then subtract it from 90° to get the zenith distance	Ho	-	° ' "
2-2	Zenith distance	z		° ' "

<b>Step 3 Use the Almanac to Find Sun's Declination</b>		GMT date =		
3-1	Record the date and GMT of the sight (the time the sun reached its peak height)	GMT (hr) =	GMT (min) =	
3-2	Turn to the daily page of the Almanac for the date of the sight, and find the sun's declination (dec) for the hour of the sight (line 3-1) and record it here.	Dec (hr)	N S	° ' "
3-3	Record the d-value from the bottom of the dec column in the Almanac. Mark the signs of the d-value and d-corr + if the dec for the next hour is larger, or - if it is smaller.	d-value = +-	d-corr = +-	° ' "
3-4	Turn to the Increments and Corrections pages at the back of the Almanac (T-9 to 12, in the notes) and find the minutes table for the GMT minutes (line 3-1). On the right-hand side of the double line in the table, find the d-corr corresponding to the d-value of line 3-3.	Declination =	N S	° ' "
		3-5 Apply the d-corr to the dec(hr) and record it above.		

**Step 4 Find Latitude from Zenith Distance and Declination**

Record DR Latitude to use as a guide, and then take the sum or difference of zenith distance and declination to find your true Latitude at LAN.

Declination or Zenith distance		°	'	"
Zenith distance or Declination		°	'	"
Latitude =		°	'	"

**Form 110, for *Polaris* Sights**

Step 1. Correct Hs to get Ho				
1-1	Record Sextant Height of <i>Polaris</i>	Hs	°	'
1-2	Record Index Correction <i>"If it's off, put it on; if it's on, take it off."</i>		Off + On -	'
1-3	Record height of eye (HE=____) and look up Dip Correction on the right-hand side of Table A2, front of Almanac		Dip -	'
1-4	Sum the above to get the Apparent Height of <i>Polaris</i>	Ha	°	'
1-5	Look up the Altitude Correction (always minus)	alt corr.	-	'
1-6	Sum the above two numbers to get Observed Height	Ho	°	'

Step 2. Find LHA Aries ( $\Upsilon$ )		UTC Date =		
2-1	UTC Time in Hours, Minutes and Seconds	UTC Time =		
2-2	Find GHA $\Upsilon$ on left-hand side of daily pages of the Nautical Almanac	GHA $\Upsilon$ (hr) =	°	'
2-3	Find GHA Aries minutes and seconds correction from Increments and Corrections pages	GHA $\Upsilon$ (m, s) =	°	'
2-4	Sum the above two numbers to get GHA Aries	GHA $\Upsilon$ =	°	'
	<i>Extra spaces to adjust angles as needed</i>			
2-5	DR Lon: -West; +East	-W, +E	°	'
2-6	Combine 2-4 and 2-5 to get LHA $\Upsilon$	LHA $\Upsilon$ =	°	'

Step 3. Latitude Determination				
3-1	Ho from 1-6	Ho	°	'
3-2	Subtract 1°		-1 °	
3-3	Add a0 from <i>Polaris</i> Table (using LHA Aries)	+a0	°	'
3-4	Add a1 from <i>Polaris</i> Table (using DR Latitude)	+a1		'
3-5	Add a2 from <i>Polaris</i> Table (using Month)	+a2		'
3-6	Sum the above to find Latitude	Latitude =	°	'
<i>Note that this procedure for finding Lat from <i>Polaris</i> is explained in the Nautical Almanac.</i>				



**Form 111, for Pub. 249, Volume 1, Selected Stars**

<b>1</b>	WT	h	m	s	date	body	Hs	°	'
	WE +S -F				DR Lat	log	index corr. + off - on		
	ZD +W -E				DR Lon	HE ft	DIP	-	
	UTC	h	m	s	UTC date / LOP label			Ha	°

$\Upsilon$

<b>2</b>	GHA $\Upsilon$ hr.	°	'
	GHA $\Upsilon$ m.s.	+	°
	GHA $\Upsilon$	°	'
	a-Lon -W+E	°	'
	LHA $\Upsilon$	°	'

00' W / 60' E

North Latitudes  
 LHA greater than 180° .....  $Z_n = Z$   
 LHA less than 180° .....  $Z_n = 360^\circ - Z$

South Latitudes  
 LHA greater than 180° .....  $Z_n = 180^\circ - Z$   
 LHA less than 180° .....  $Z_n = 180^\circ + Z$

<b>4</b>	altitude corr. (refraction)	-	°	'
	Ho	°	'	
	Hc	°	'	

<b>3</b>	LHA $\Upsilon$	°	'
	a-Lat	°	'
	Star	N S	

Pub. 249, Vol. 1

a =	TA
Zn =	
a - Lat =	
a - Lon =	

**5**

<b>1</b>	WT	h	m	s	date	body	Hs	°	'
	WE +S -F				DR Lat	log	index corr. + off - on		
	ZD +W -E				DR Lon	HE ft	DIP	-	
	UTC	h	m	s	UTC date / LOP label			Ha	°

$\Upsilon$

<b>2</b>	GHA $\Upsilon$ hr.	°	'
	GHA $\Upsilon$ m.s.	+	°
	GHA $\Upsilon$	°	'
	a-Lon -W+E	°	'
	LHA $\Upsilon$	°	'

00' W / 60' E

North Latitudes  
 LHA greater than 180° .....  $Z_n = Z$   
 LHA less than 180° .....  $Z_n = 360^\circ - Z$

South Latitudes  
 LHA greater than 180° .....  $Z_n = 180^\circ - Z$   
 LHA less than 180° .....  $Z_n = 180^\circ + Z$

<b>4</b>	altitude corr. (refraction)	-	°	'
	Ho	°	'	
	Hc	°	'	

<b>3</b>	LHA $\Upsilon$	°	'
	a-Lat	°	'
	Star	N S	

Pub. 249, Vol. 1

a =	TA
Zn =	
a - Lat =	
a - Lon =	

**5**