**Longitude by Calculator-theodolite \*\*\* RE :** [**http://fer3.com/arc/m2.aspx/Longitude-calculator-theodolite-Pennino-jun-2013-g24454**](http://fer3.com/arc/m2.aspx/Longitude-calculator-theodolite-Pennino-jun-2013-g24454)

**UPDATED VERSION : Rev 1 JUNE 26th, 2013**

Date of Observations: June 20th, 2013 \*\*\* TT-UT = +68.3s

Observer’s Position (WGS84): **N42°20’3 W071°48’5** \*\*\* Altitude = +241m above WGS84 Ellipsoid Height of Eye = 0m \*\*\* P = 990 mb = 29.23 “Hg \*\*\* T = 20°C = 68°F

The Longitude is determined through the following Formulae:

* First derive the cosine of Body Local Hour Angle through : "sin(Height)=sin(Lat)\*sin(Dec) + cos(Lat)\*cos(Dec)\*cos(Body Local Hour Angle)"
* Then derive Observer’s Longitude through : Longitude = Body GHA + sign[sin(Body Azimuth)] \* cos-1[cos(Body Local Hour Angle)] with Longitudes being reckoned POSITIVELY to the WEST of Greenwich

The computation of the Moon Augmented Semi-Diameter and Parallax is very accurately carried out in 3D Space from the Earth WGS84 Ellipsoid (Equatorial Radius 6378.137 km and f=1/298.257) and with the Moon assumed to be perfectly spherical with Radius = 1738 km. In other words these derived values fully match - to all digits published - their Ephemeris “parent/source values”.

**1st set of Computations with “*approximate Ephemeris*”** Moon Center Apparent Coordinates accurate to +/- 4” and GHA Arietis accurate to +/- 0.0015” (+/-0.’000025)

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **UT** | UL Zenith Distance | **UL Height** | GHA Arietis | MOON RA | MOON GHA | MOON Dec | MOON HP | Refraction  Correction | Augmented Semi-Diameter Correction | Parallax  Correction | Sum of Refraction + Augm.SD + Parallax Correction | Geocentric Height derived from Sextant | Geocentric Height derived from Position | Intercept | Topocentric Azimuth | **Longitude determination from Latitude and Sextant Height** | **Δ Long.** |
| **00h27m02.0s** | 59°53’44” | **-30°06’267** | 275°08’825 | 217°55’071 | 57°13’754 | S-15°27’192 | 59’673 | -1’5716 | -16’4038 | 51’6077 | 33’6322 | 30°39’8992 | 30°40’0732 | -0’1739 | 163.6° | **W071°49’334** | **-0’834** |
| **00h28m36.0s** | 59°48’51” | **-30°11’150** | 275°32’389 | 217°56’019 | 57°36’370 | S-15°27’405 | 59’674 | -1’5665 | -16’4044 | 51’5659 | 33’5949 | 30°44’7449 | 30°44’5225 | +0’2224 | 164.0° | **W071°47’406** | **1’094** |
| **00h30m23.0s** | 59°43’54” | **-30°16’100** | 275°59’212 | 217°57’085 | 58°02’114 | S-15°27’648 | 59’675 | -1’5614 | -16’4051 | 51’5235 | 33’5570 | 30°49’6570 | 30°49’4455 | +0’2115 | 164.5° | **W071°47’429** | **1’071** |
| **00h31m35.0s** | 59°40’30” | **-30°19’500** | 276°17’262 | 217°57’824 | 58°19’437 | S-15°27’811 | 59’676 | -1’5579 | -16’4055 | 51’4943 | 33’5309 | 30°53’0309 | 30°52’6730 | +0’3579 | 164.8° | **W071°46’649** | **1’851** |
| **00h32m26.0s** | 59°38’27” | **-30°21’550** | 276°30’046 | 217°58’339 | 58°31’707 | S-15°27’926 | 59’677 | -1’5558 | -16’4058 | 51’4767 | 33’5152 | 30°55’0652 | 30°54’9176 | +0’1475 | 165.0° | **W071°47’726** | **0’774** |
| **Δ Long. /Intercept increasing ratios** as Body closes up to the South: 1st Observation : **4.796** \* 2nd Observation: **4.919** \* 3rd Observation: **5.064** \* 4th Observation: **5.172** \* 5th Observation: **5.247** | | | | | | | | | | | | | | | | | |
| **Computations here-under from the averaged observed values here-above, i.e. with UT = 00h30m00.4S and UL Height = -30°14’9134** | | | | | | | | | | | | | | | | | |
| **00h30m00.4s** |  | **-30°14’9134** | 275°53’547 | 217°56’870 |  | S-15°27’596 | 59’675 | -1’5626 | -16’4049 | 51’5337 | 33’5661 | 30°48’4795 | 30°48’4183 | +0’0612 | 164.4° | **W71°48’192** | **0’308** |

**2nd Computation on the averaged observed values with Accurate Ephemeris INPOP10a** from the IMCCE Server (<http://www.imcce.fr/fr/ephemerides/formulaire/form_ephepos.php>)

From “Averaged UT“= 00h30m00.4s with TT-UT = + 68.3s, derive “Averaged TT” = 00h31m08.7s as an entry time argument to INPOP10a

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **TT = 00h31m08.7s** | **-30°14’9134** | 275°53’547 | 217°56’915 |  | S-15°27’584 | 59’669 | -1’5626 | -16’4031 | 51’5281 | 33’5623 | 30°48’4757 | 30°48’4215 | +0’0542 | 164.4° | **W71°48’227** | **0’273** |

Note : From comparison with INPOP10a, the “*approximate Ephemeris*” used in the first set of Calculations shows the following errors: RA -2”.70 , Dec -0”.72, HP +0”.36, i.e. within the +/- 4” claimed

In La Bernerie en Retz, France

On June 27th, 2013

Antoine M. “Kermit” Couëtte