

**The first sight of the Crescent on earth according
to Yallop, SAAO and Odeh Criteria,, and the introduction
of the Hijri Date Line as the Sunset Terminator Line of the
opposite point of Mecca from its latitude**

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1# Introduction:

This article is a supportive document of the author's Arabic book: "The Crescent between sighting and calculating" (الهلال بين الرؤية والحساب).

In this book, we have discussed concepts related to crescent sighting and its calculation without going in depth to its' equations. Therefore, the purpose of this article is to provide in details the equations related to the sighting's equations.

There are three major concepts explained in the book, which we will discuss here in brief:

1# The introduction of the Hijri Date Line (HDL for short).

This is not a new concept; it has been suggested by Mohammed Ilyas (Ref: Ilyas) in 1986 and by Ahmad Ezzat (Ref: Ezzat) in 2016. However, our arguments here is that this HDL needs to be the Sunset Terminator Line (STL for short) at a point opposite to Mecca in its latitude line. We named this point N.Kamma (NK for short) located at 21.4225N 140.1738W.

The major reason for this argument is that the day in the Islamic culture starts from sunset (rather than midnight), therefore all the points in the STL will have a new Arabic day at the same moment (i.e. the moment of sunset).

To clarify the terminology here, the days (i.e. Saturday to Friday) will be regarded as Western days if it start from midnight, and Arabic days if it start from sunset.

To use the analogy of the International Date Line (IDL):

The western day starts on earth from a specific Line (which is the IDL) at specific time (which is midnight at that line). The same analogy should be applied for Arabic days: The Arabic day should start at a specific line on earth and a specific time.

But how to locate this line and choose this time?

The Time is clear, it should be the sunset time, as the day in Islamic culture starts from sunset (as mentioned before).

Therefore, the line should be the Sunset Terminator Line (STL), as all the points in that line will enter the new day at the same moment.

But the real question here is: which STL should we choose to be the HDL?

As it will be clear in this article, the location of the HDL has a direct effect on the start and end of the Hijri months. Therefore, The HDL location is an Islamic matter and should be treated as such.

In this regard, the Quran (in verse 6.92) has referred to Mecca as “the mother of towns” (أم القرى). Therefore, we argue that Mecca need to be regarded as the reference point, then we choose the location of HDL accordingly.

If Mecca was the reference point, then the HDL needs to be the parallel STL of Mecca at the opposite side of earth. This will be the STL passing through the point opposite to Mecca from its Latitude line, which is the point that we referred before as NK.

Note that HDL is not a fixed line, but the angle of HDL will vary slightly every day. But HDL is a solid line at a specific time. And at all times, HDL will pass through the point NK.

2# At any point on earth that confirms seeing the crescent (or the method of confirming the possibility of seeing the crescent at that point is proven and highly reliable) then the Arabic day at that point (after sunset) is the first day of the Hijri month. Afterward, we will determine the equivalent Western day accordingly.

3# The concept of the “Sight Line”: which is the STL at the point that has observed the crescent first time (or the method of confirming the possibilities of seeing the crescent first time at that point is proven and highly reliable).

Notice that the Sight Line will be parallel to HDL, as both are sunset terminator lines.

It is important to determine if the Sight Line is before or after HDL (i.e. if the sun sets at the Sight Line before or after setting at HDL), as this will determine the Arabic day of the Sight Line.

This article is about discussing the method of calculating the Sight Line.

2# Summary of findings:

There are many proposed equations for calculating the possibility of seeing the crescent at specific location and time (therefore determining the first point that can see the crescent).

But none of these equations has been proven; as it is very difficult to chase the crescent from one location to another every month.

All of these equations have been composed by analyzing and interpreting crescent sighting data.

The recent and widely accepted equations are for Yallop and SAAO (South African Astronomical Observatory).

There is also the equation of Odeh which is recognized and accepted in many Islamic institutions.

The results of obtaining the Sight Line (i.e the STL at the first point on earth that have seen the crescent first time) were not consistent in these three equations.

This demonstrate the need for all efforts to verify at least one of the above three equations.

However, the one thing that is consistent with all the three equations is T18.59, i.e at any lunar month; the crescent can be seen at one point on earth that the sun sets at it after 18.59 hours from the new moon (according to the three equations).

The conclusion of this article is that the Sight Line T19 (which is the round figure for 18.59) is the confirmed Sighting Line that is consistent with all the above three equations.

To clarify the terminology here: T19 is the Sight Line after 19 hours from the new moon. This is the sunset time at the observation site. Sighting the crescent will be few minutes after that (about 20 minutes later).

It should be noted here that our calculations have been made through a vb6/vba program that we have compiled. The algorithm for the Sun coordinates and the coordinate's transformation were taken from Duffett-Smith book: "Practical Astronomy with your calculator" (Ref: Duffett).

The Moon coordinates were taken from a vba code for Keith Burnett (Ref: Burnett). The New Moon Timings were taken from another vba code for Andreas Killer (Ref: Killer) which he has modified from a code for Michael Friedrich (Ref: Friedrich).

The results from our vb program were compared with data and tables available in different internet sites (as calsky.com, nasa.gov, etc.). The differences were very

minimal and acceptable for this article. Furthermore, we will provide our program in VB6 format at our website in due time.

3# The Discussion:

The Sight Line is the Sunset Terminator Line (STL for short) that passes through the point on earth where the first sighting of the crescent is expected.

For example: suppose the first confirmed sighting of the crescent was at a place A, then the STL that passes through A is the Sight Line. The STL is a line that represents all the points on earth that are at sunset.

This Sight Line is identified by the geocentric moon age. So if we say that the Sight Line for this lunar month is 18.45 (T18.45 for short) then it means that the observation site of the crescent is at STL after 18.45 hours from the new moon. If the new moon happened at 13.55 GMT then the Sight Line will be at 32 GMT (i.e. 8:00:00 Next Day GMT).

We will determine the Sight Line using Yallop, SAAO, and Odeh equations. It should be noted here that there are many other equations for sighting the crescent, recorded since the time of Babylon, but the latest of these equations and the most accepted ones (at the moment) are the three mentioned above.

#3.1 Yallop Equation:

BD Yallop (Ref: Yallop) has produced his equation and Criterion on 1997. He used available recorded data of sighting the crescent. The set of data that he used consisted of 295 recorded sighting attempts.

He introduced the concept of **Best Time** for viewing the crescent after sunset:

$$Bt = St + 4/9 * (Mt - St)$$

Where:

- Bt is the best time to view the crescent.
- St is the sunset time.
- Mt is the moonset time.

Note that the observation of the crescent cannot be taken just after sunset, but rather few minutes after that when the sky is dark enough. Also this observation cannot be taken just before moonset, but rather few minutes before; as far objects near the horizon are very difficult to observe due to the dust and humidity accumulated at the upper level of the horizon.

Therefore, the “Best Time” equation indicates the best time to view the crescent, which is about half the time between sunset and moonset.

Note that the time between sunset and moonset is just few minutes at the first few hours of the crescent. For example:

The sunset at point 0N 129E was at 09:12 GMT on 2017-10-20. The age of the moon at that time was 14 hours. The moonset was at 9:41 GMT. The difference between moonset and sunset (Lag) was just about 30 minutes. Therefore the “Best Time” is 09:25 GMT

Yallop has used the sighting recorded data, then identified the Best Time, then computed the moon data (ArcL, Daz, ArcV, etc). Afterwards, he analyzed the patterns emerged from these data and formalized his equation for the possibility of sighting the crescent at specific time and location:

$$Yq = (ARCV - (11 \cdot 8371 - 6 \cdot 3226 \text{ tWm} + 0 \cdot 7319 \text{ tWm}^2 - 0 \cdot 1018 \text{ tWm}^3)) / 10$$

Where:

- Yq: Yallop q test.
- ArcV: Geocentric Arc of Vision (in degrees): the difference in altitude between the center of the Sun and the center of the Moon for a given latitude and longitude, ignoring the effects of refraction.
- tWm: Topocentric width of the crescent in arc minutes. So if the width of the crescent is 0.002 degree then we need to transfer this value to arc minutes (0.12) then use it in the above equation.
- $\text{tWm}^3 = \text{tWm} * \text{tWm} * \text{tWm}$

The data required for this equation (i.e. ArcV and tWm) are calculated at Best Time at the location of the observation site.

The criterion for this test is:

- If $Yq > +0.216$ then the crescent is easily visible.
- If $+0.216 \geq Yq$ and $Yq > -0.014$ then the crescent is visible under perfect conditions.
- If $-0.014 \geq Yq$ and $Yq > -0.160$ then an optical aid (as a telescope) might be needed to see the crescent.
- If $-0.160 \geq Yq$ and $Yq > -0.232$ then an optical aid is needed to see the crescent.
- If $-0.232 \geq Yq$ then the crescent cannot be seen.

For the purpose of this article we need to check if the crescent is possible to be seen (with or without an optical aid). Therefore, we are only looking for this condition:

Sighting the crescent is possible (according to Yallop Criterion) if $Yq > -0.232$.

It should be noted that Yallop has provided the raw data of his equation (the coordination and moon data at the observation site).

#3.2 SAAO Equation:

SAAO stand for the South African Astronomical Observatory. The Equation and Criterion that was later named as the SAAO Criterion was developed by two astronomers in SAAO: John Caldwell and David Laney (Ref: Caldwell & Laney) in 2001.

The equation they have provided (based on their data analysis) is simple:

$$Sq = tAltR + (1/3) * ArcL$$

Where:

- Sq: the SAAO q test.
- tAltR: The topocentric altitude of the lower limb of the moon with refraction corrections.
- ArcL: The Arc of Light; the angle subtended at the center of the Earth by the center of the Sun and the center of the Moon.

The data required for this equation (i.e. tAltR and ArcL) are calculated at the moment of sunset at the location of the observation site.

The Criterion for this test is:

- If $Sq > 11$ then the crescent is easily visible.
- If $11 > Sq$ and $Sq > 9$ then an optical aid is needed to see the crescent.
- If $9 \geq Sq$ then the crescent cannot be seen.

Therefore: Sighting the crescent (according to SAAO Criterion) is possible if $Sq > 9$.

#3.3 Odeh Equation:

Odeh Criterion has been provided by Mohammad Odeh in 2005 (Ref: Odeh). He used data set consisted of 737 recorded sighting attempts, half of them has been obtained by the Islamic Crescent Observation Project (ICOP).

His equation and criterion are similar to Yallop:

$$Oq = tArcV - (-0.1018 tWm^3 + 0.7319 tWm^2 - 6.3226 tWm + 7.1651)$$

Where:

- Oq : Odeh q test.
- $tArcV$: Topocentric Arc of Vision (in degrees); the difference in altitude between the center of the Sun and the center of the Moon for a given latitude and longitude, ignoring the effects of refraction, and taking into account the parallax of the moon.
- Topocentric width of the crescent in arc minutes.

The data required for this equation (i.e. $tArcV$ and tWm) are calculated at Best Time at the location of the observation site.

The Criterion for this test is:

- If $Oq \geq 5.65$ then the crescent is easily visible.
- If $5.65 > Oq$ and $Oq \geq 2$ then an optical aid might be needed to see the crescent.
- If $2 > Oq$ and $Oq \geq -0.96$ then an optical aid is needed to see the crescent.
- If $-0.96 > Oq$ then the crescent cannot be seen.

Therefore: Sighting the crescent (according to Odeh Criterion) is possible if $Oq \geq -0.96$.

It should be noted that Odeh has provided the raw data of his equation (the coordination and moon data at the observation sight), however, care need to be taken when looking at these data:

- The observation date is the Local Date and not the GMT Date, therefore, it is normal that this date might be shorter one day than the JDay provided in the data set.
- The age of the moon in Odeh data set is the topocentric age and not geocentric.
- $ArcV$, $ArcL$, and Daz in Odeh data set are all topocentric values and not geocentric.
- Note that if the moon age, $ArcV$, $ArcL$, and Daz have been mentioned without any clarification then it is assumed to be geocentric and not topocentric.

#3.4 The approach of obtaining the Sight Line:

What we are trying to obtain here is: the first Sight Line of the crescent. As mentioned before, The Sight Line is the STL line at the first location where the crescent can be seen. Our objective here is to determine the Sight Line using the above equations.

We have provide here two approaches (Approach A and B). Approach A is very direct, while Approach B involves some numerical methods.

Approach A:

We used this approach as a starter, to familiarize ourselves with the problem in hand; as this approach is direct and doesn't need clarification. Figure 1 represents Earth between 60N to 60S, with 10 degrees intervals.

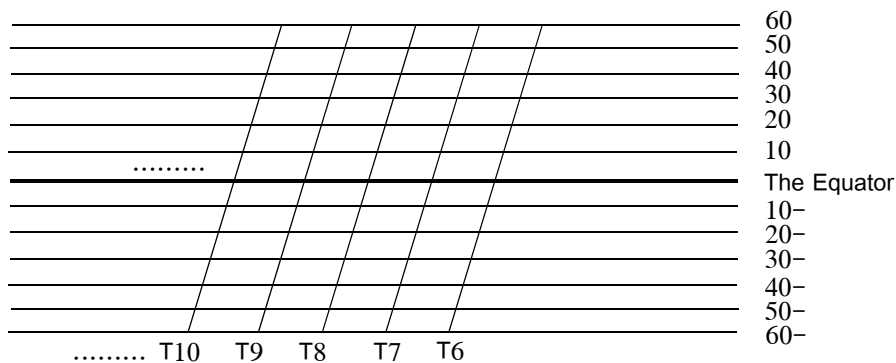


Figure 1

T6 is the Sunset Terminator Line after 6 hours from the new moon, T7 is the STL after 7 hours, and so forth.

We want to calculate Y_q (and later S_q and O_q) for each intersection between the latitude lines in the above figure for each STL starting from T6 upward.

If Y_q at any point in the STL line was positive (i.e. sighting the crescent is possible) then that STL will be the Sight Line.

Therefore, Approach A can be summarized as follows:

- 1- Define the time of the new moon
- 2- Add 6 hours to the new moon time to obtain T6.
- 3- Identify the longitude at 60N at which the sun will set after 6 hours from the new moon (i.e. Identify the longitude at the point of intersection between 60N and T6).
- 4- Calculate the needed data for Yq equation (for Yq it is ArcV and tWm).
- 5- If Yq is positive then save the STL (in this case T6) and exit the loop.
If Not then go to the next latitude (in this case 55N).
- 6- Continue until the end of the latitude set (i.e. 60S)
- 7- If there were no positive value for Yq then go to the next STL (in this case T7).
- 8- Continue until Yq is positive.

Then we do the same approach for Sq and Oq.

This approach has been applied for every lunar month from 2000 until 2038 (This set of years covers the two cycles (18.6 years each) of the Lunar Standstill, and four cycles (8.9 years each) of the moon apsidal precession.

The Minimum and Maximum values for the Sight Line are in the following table:

| Approach A | Ty | Ts | To |
|-----------------------------|-------------------------|-------------------------|-------------------------|
| Min Earliest Date | 11 2008-05-05 | 11 2005-01-10 | 7 2001-09-17 |
| Max Earliest Date | 19 2000-01-06 | 19 2015-09-13 | 15 2000-12-25 |

Where:

Ty: The Sight Line (the earliest STL) according to Yallop equation.

Ts: The Sight Line according to SAAO equation.

To: The Sight Line according to Odeh equation.

We have provided a sample of one page of these results (as this approach is just a starter and not the main approach) from 2000 to 2006. The results are in appendix A.

As it was mentioned before, this approach is very useful as it doesn't need clarifications or justifications; it is a direct method of finding the earliest STL (i.e. the Sight Line).

However, the margin of error in this approach is 10 degrees of latitude and One hour of time. This margin of error can be reduced by applying some numerical methods.

Approach B:

We used a simple approach with a margin of error of about 2 degrees of latitude, and 3 minutes of time, through using the Bracketing Method (i.e. Bolzano's Theorem):

The First Loop:

- We know from the data collected by the previous approach that sighting the crescent first time can vary between T6 (i.e. T7 minus one-hour margin of error) and T19. Before T6 the sighting is not likely, and after T19 the sighting is highly assured. However, as a precaution we decided to start our bracket from T5 to T20.
- So we can take T5 and T20 as the side parts of our bracket (i.e. [T5, T20]).
- We test the middle line between them (i.e. T12.5).
If Y_q is negative then our new bracket will be [T12.5, T20].
But if Y_q is positive then our new bracket will be [T5, T12.5].
- We continue this approach of reducing the size of the bracket until a reasonable size has been reached and we exit the loop.

Second Loop:

We can use another bracket, parallel to the previous one as the following:

- We obtain the latitude maximum and minimum at T20:
It is highly assumed that the first sighting of the crescent will happen at a particular point on earth, then it will propagate north and south as demonstrated in figure 2:

Suppose that the first sighting of the crescent was at point A. Afterward the area that can see the crescent will increase. This area is between curves B and C (so the area above B and below C will not be able to see the crescent at the first hours of it.).

Therefore, we first compute the maximum and minimum latitude in T20 by taking the first point (from 60N) that Y_q is positive (which is the nearest intersection point between T20 and curve B), then we take the first point from 60S, that Y_q is positive (which is the nearest intersection point between T20 and curve C). Therefore we have a bracket of LtMax & LtMin.

- Afterward, for every positive Line in the first loop we reduce the Bracket size for LtMax and LtMin.

We continue the first and second loop until we reach our desired margin of error (in our case it was 3 minutes time difference between the current line and the previous one).

The results obtained from Approach B (from 2000 to 2038) are provided in Appendix B.

The Minimum and Maximum values for the Sight Line are in the following table:

| Approach B | Ty | Ts | To |
|--------------------|----------------|----------------|---------------|
| Min Sight | 10.99 | 10.96 | 6.65 |
| Earliest Date | 2008-05-05 | 2005-01-10 | 2008-05-05 |
| Latitude at Sight | 52:39:00 N | 24:41:16.8 S | 60:00:00 N |
| Longitude at Sight | 55:46:13.83 W | 61:31:54.01 W | 17:46:54.11 E |
| Max Sight | 18.59 | 18.02 | 14.23 |
| Earliest Date | 2033-09-23 | 2015-09-13 | 2012-05-20 |
| Latitude at Sight | 23:09:36 S | 20:42:25.63 S | 09:30:00 N |
| Longitude at Sight | 145:35:53.63 E | 102:05:31.49 W | 63:23:32.53 E |

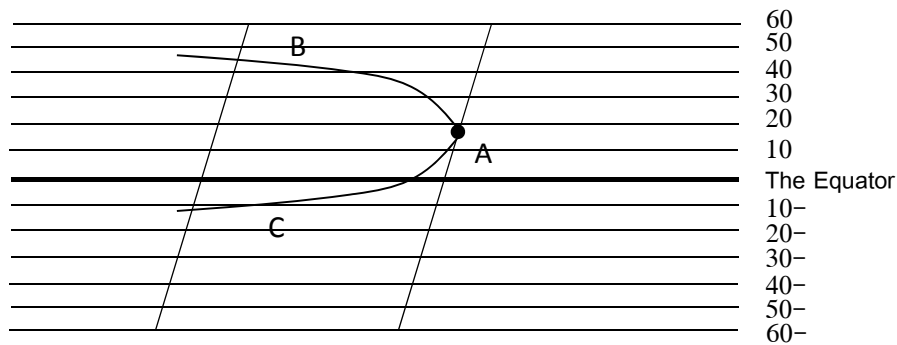


Figure 2 T20 Sight Line

#4. The Conclusion:

As we have explained in the introduction: we are looking for a confirmed method for calculating the sighting of the crescent to identify the starting date of the Hijri months.

By looking at the three highly accepted equations (Yallop, SAAO, and Odeh) we found that the results were not consistent with each other (except for Yallop and SAAO were the result are “generally” similar with a margin of difference of about 50 minutes maximum).

Furthermore, the minimum value of To is highly unlikely; as the earliest recorded sighting of the crescent was at T11.37 (Moon age at sighting was 11.7) by M.G. Mirsaeed in Iran in 2002-09-07 (Ref: ICOP). The second earliest recorded sighting was at T11.92 (Moon age at sighting was at 12.12) by James Stamm in 1996-01-21.

It should be noted that Mirsaeed sighting is not consistent with Yallop or SAAO equations but only with Odeh’s equation. But Stamm sighting is consistent with all the three equations.

Note that on 2002-9-7 the Sight Line for the three equations were as the following:

| | Ty | Ts | To |
|----------|-------|-------|----|
| 2002-9-7 | 11.32 | 11.21 | 7 |

But at Mirsaeed observation site (31:04N 56:28S) Yallop q test and SAAO q test were both negative.

As none of the above equations have been thoroughly tested and verified, and as the results of these equations are not consistent with each other, therefore the author conclusion is that these equations cannot be used for determining the starting dates of the Hijri months.

This is not to disqualify the above three equations:

The above three equations have been composed through analyzing the available recorded sighting data. However, there are so little data regarding the first hours of sighting the crescent (before 14 hours from the new moon). Therefore, the crescent visibility might not behave according to these equations at its early hours.

However, all the three equations are consistent with the notion that the crescent is possible to be seen in every lunar month at a point in T19 (that is the STL after 19 hours from the new moon).

Therefore, our conclusion here is that T19 (or to be precise T18.59) is a line that the crescent will be visible at every lunar month.

Therefore, our recommendation is to calculate the Hijri months according to T19 (if it has not been sighted directly before that), **until** one of the above equations has been thoroughly tested and verified.

5# Calculating the First Hijri Date:

We have discussed this subject thoroughly in our book mentioned at the introduction, and we discuss it here in brief.

If the Sight Line of the crescent was before HDL (i.e. the sun sets at the Sight Line before setting at HDL) then the first dawn of the new Hijri month will be at the next day of the new moon, i.e. the day (Arabic and Western) of the geocentric conjunction.

If the Sight Line was after HDL (i.e. the sun sets at HDL before setting at the Sight Line) then the first dawn of the new Hijri month will be after two days from the new moon.

If we regarded the Sight Line to be T19 (unless the crescent has been sighted directly before that) then we need to obtain the GMT time of sunset at HDL.

The sunset time (GMT) of HDL is the sunset time (GMT) of the point NK at 21.4225N 140.1738W. This time can be easily calculated by available programs. It could also be calculated manually with a margin of error less than 30 seconds:

HDL Sunset GMT = Mecca Sunset GMT + 12

HDL Sunset GMT = Mecca Sunset Local + 9

Example: The new moon happened in Thursday 2017-10-19 at 19:12 GMT.
When is the first dawn of the new Hijri month?

The Sunset at the Sight Line was at 19 + 19:12 = 38:12 GMT

Mecca Sunset at 2017-10-19 was at 17:53 Local Time

HDL Sunset Time = 9 + 17:53 = 26:53 GMT

Therefore, HDL is before the Sight Line

Therefore, the first dawn of the new Hijri month is at Saturday (Western and Arabic) at 2017-10-21.

6# Recommendations:

We stress here on two recommendations:

- The need to test and verify an equation that represents the visibility of the crescent at a specific location and time. If this happened, then the Sight Line of the crescent can be obtained and used for every lunar month rather than depending on the generalized figure of T19.
- There is a well know argument between different schools in the Islamic world about the calculation of crescent sightings. Many schools of thoughts don't regard these calculations as an accepted method for determining the Hijri months (especially for Ramadan and Shawal).

But this argument can be put to rest (for both opposite schools) if the Islamic world authorities have decided and collaborated to create a research vessel with proper equipment, and to be stationed just westward of HDL (The Hijri Date Line).

Therefore, the crescent sighting calculation can be carried on and the results can be verified and confirmed by this research vessel.

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Appendix A:

Sample of the data calculated by Approach A (2000 to 2006)

#: order of the record

UDate UTime: the GMT date and time of the new moon.

Ty: The earliest Sight Line according to Yallop equation.

Ts: The earliest Sight Line according to SAAO equation.

To: The earliest Sight Line according to Odeh equation.

| # | UDate | UTime | Ty | Ts | To |
|----|------------|-------------|----|----|----|
| 1 | 1999-12-07 | 22:31:39.75 | 18 | 17 | 12 |
| 3 | 2000-02-05 | 13:03:17.68 | 18 | 17 | 14 |
| 5 | 2000-04-04 | 18:12:1.2 | 13 | 13 | 8 |
| 7 | 2000-06-02 | 12:13:57.33 | 14 | 14 | 10 |
| 9 | 2000-07-31 | 02:24:59.12 | 14 | 14 | 11 |
| 11 | 2000-09-27 | 19:52:59.56 | 13 | 13 | 8 |
| 13 | 2000-11-25 | 23:11:21.16 | 17 | 17 | 12 |
| 15 | 2001-01-24 | 13:06:48.9 | 18 | 18 | 14 |
| 17 | 2001-03-25 | 01:21:7.19 | 15 | 14 | 9 |
| 19 | 2001-05-23 | 02:46:3.26 | 16 | 15 | 12 |
| 21 | 2001-07-20 | 19:44:15.03 | 14 | 14 | 11 |
| 23 | 2001-09-17 | 10:27:16.21 | 12 | 12 | 7 |
| 25 | 2001-11-15 | 06:40:1.96 | 16 | 15 | 12 |
| 27 | 2002-01-13 | 13:28:42.26 | 17 | 17 | 13 |
| 29 | 2002-03-14 | 02:02:35.32 | 16 | 15 | 10 |
| 31 | 2002-05-12 | 10:45:6.6 | 18 | 17 | 14 |
| 33 | 2002-07-10 | 10:25:56.8 | 15 | 15 | 11 |
| 35 | 2002-09-07 | 03:10:6.97 | 12 | 12 | 8 |
| 37 | 2002-11-04 | 20:34:23.97 | 15 | 14 | 11 |
| 39 | 2003-01-02 | 20:22:47.5 | 15 | 15 | 11 |
| 41 | 2003-03-03 | 02:34:52.29 | 15 | 14 | 9 |
| 43 | 2003-05-01 | 12:14:41.65 | 19 | 18 | 15 |
| 45 | 2003-06-29 | 18:38:30.35 | 16 | 16 | 12 |
| 47 | 2003-08-27 | 17:26:15.07 | 13 | 13 | 9 |
| 49 | 2003-10-25 | 12:50:12.63 | 15 | 15 | 11 |
| 51 | 2003-12-23 | 09:42:57.61 | 13 | 13 | 9 |
| 53 | 2004-02-20 | 09:17:42.57 | 14 | 13 | 9 |
| 55 | 2004-04-19 | 13:21:12.08 | 18 | 18 | 14 |
| 57 | 2004-06-17 | 20:26:45.44 | 17 | 16 | 12 |
| 59 | 2004-08-16 | 01:23:45.49 | 15 | 15 | 10 |
| 61 | 2004-10-14 | 02:48:9.02 | 16 | 16 | 12 |
| 63 | 2004-12-12 | 01:28:55.8 | 13 | 12 | 9 |
| 65 | 2005-02-08 | 22:27:53.47 | 13 | 13 | 9 |
| 67 | 2005-04-08 | 20:31:55.54 | 16 | 16 | 13 |
| 69 | 2005-06-06 | 21:55:7.11 | 15 | 15 | 10 |
| 71 | 2005-08-05 | 03:04:43.19 | 17 | 16 | 11 |
| 73 | 2005-10-03 | 10:27:48.67 | 18 | 17 | 14 |
| 75 | 2005-12-01 | 15:00:48.84 | 13 | 13 | 9 |
| 77 | 2006-01-29 | 14:14:30.2 | 13 | 13 | 9 |
| 79 | 2006-03-29 | 10:15:11.45 | 15 | 15 | 11 |
| 81 | 2006-05-27 | 05:25:31.32 | 13 | 13 | 9 |
| 83 | 2006-07-25 | 04:30:53.25 | 16 | 16 | 11 |
| 85 | 2006-09-22 | 11:44:58.65 | 19 | 18 | 15 |
| 87 | 2006-11-20 | 22:17:52.84 | 15 | 14 | 10 |

| # | UDate | UTime | Ty | Ts | To |
|----|------------|-------------|----|----|----|
| 2 | 2000-01-06 | 18:13:41.22 | 19 | 18 | 14 |
| 4 | 2000-03-06 | 05:16:48.75 | 15 | 15 | 11 |
| 6 | 2000-05-04 | 04:12:0.04 | 13 | 13 | 8 |
| 8 | 2000-07-01 | 19:19:52.54 | 14 | 14 | 11 |
| 10 | 2000-08-29 | 10:19:12.65 | 13 | 13 | 10 |
| 12 | 2000-10-27 | 07:58:0.09 | 14 | 14 | 9 |
| 14 | 2000-12-25 | 17:21:43.35 | 19 | 18 | 15 |
| 16 | 2001-02-23 | 08:21:9.6 | 16 | 16 | 11 |
| 18 | 2001-04-23 | 15:25:36.68 | 15 | 14 | 10 |
| 20 | 2001-06-21 | 11:57:45.12 | 15 | 15 | 13 |
| 22 | 2001-08-19 | 02:55:06 | 12 | 12 | 9 |
| 24 | 2001-10-16 | 19:23:16.17 | 13 | 13 | 9 |
| 26 | 2001-12-14 | 20:47:31.6 | 17 | 17 | 13 |
| 28 | 2002-02-12 | 07:40:57.64 | 16 | 15 | 11 |
| 30 | 2002-04-12 | 19:21:10.27 | 17 | 16 | 12 |
| 32 | 2002-06-10 | 23:46:28.99 | 17 | 17 | 13 |
| 34 | 2002-08-08 | 19:15:5.48 | 13 | 12 | 9 |
| 36 | 2002-10-06 | 11:17:21.85 | 13 | 13 | 9 |
| 38 | 2002-12-04 | 07:34:21.43 | 15 | 15 | 12 |
| 40 | 2003-02-01 | 10:48:22.21 | 14 | 14 | 9 |
| 42 | 2003-04-01 | 19:18:32.06 | 17 | 17 | 12 |
| 44 | 2003-05-31 | 04:19:45.96 | 18 | 18 | 14 |
| 46 | 2003-07-29 | 06:52:36.67 | 14 | 13 | 9 |
| 48 | 2003-09-26 | 03:09:2.54 | 14 | 14 | 10 |
| 50 | 2003-11-23 | 22:58:54.98 | 14 | 14 | 11 |
| 52 | 2004-01-21 | 21:04:54.29 | 12 | 12 | 8 |
| 54 | 2004-03-20 | 22:41:20.43 | 16 | 16 | 12 |
| 56 | 2004-05-19 | 04:51:56.68 | 18 | 18 | 14 |
| 58 | 2004-07-17 | 11:23:40.84 | 15 | 15 | 10 |
| 60 | 2004-09-14 | 14:28:55.34 | 16 | 16 | 12 |
| 62 | 2004-11-12 | 14:27:4.21 | 15 | 14 | 11 |
| 64 | 2005-01-10 | 12:02:41.55 | 12 | 11 | 7 |
| 66 | 2005-03-10 | 09:10:14.2 | 15 | 15 | 11 |
| 68 | 2005-05-08 | 08:45:23.19 | 16 | 16 | 12 |
| 70 | 2005-07-06 | 12:02:31.37 | 15 | 14 | 9 |
| 72 | 2005-09-03 | 18:45:22.36 | 18 | 18 | 14 |
| 74 | 2005-11-02 | 01:24:28.91 | 16 | 16 | 12 |
| 76 | 2005-12-31 | 03:11:37.57 | 12 | 12 | 8 |
| 78 | 2006-02-28 | 00:30:40.05 | 14 | 14 | 11 |
| 80 | 2006-04-27 | 19:43:49.16 | 14 | 14 | 10 |
| 82 | 2006-06-25 | 16:05:13.36 | 14 | 14 | 9 |
| 84 | 2006-08-23 | 19:09:41.53 | 19 | 18 | 14 |
| 86 | 2006-10-22 | 05:13:59.58 | 17 | 17 | 12 |
| 88 | 2006-12-20 | 14:00:37.61 | 14 | 14 | 9 |

Appendix B

The data calculated by Approach B (from 2000 to 2038).

#: order of the record

UDate UTime: the GMT date and time of the new moon.

Ty: The earliest Sight Line according to Yallop equation.

Ts: The earliest Sight Line according to SAAO equation.

To: The earliest Sight Line according to Odeh equation.

| # | UDate | UTime | Ty | Ts | To |
|----|------------|-------------|-------|-------|-------|
| 1 | 1999-12-07 | 22:31:39.75 | 17.11 | 16.42 | 11.94 |
| 3 | 2000-02-05 | 13:03:17.68 | 17.17 | 16.70 | 13.06 |
| 5 | 2000-04-04 | 18:12:1.2 | 12.56 | 12.24 | 7.91 |
| 7 | 2000-06-02 | 12:13:57.33 | 13.29 | 13.24 | 9.75 |
| 9 | 2000-07-31 | 02:24:59.12 | 13.66 | 13.62 | 10.52 |
| 11 | 2000-09-27 | 19:52:59.56 | 12.38 | 12.04 | 7.73 |
| 13 | 2000-11-25 | 23:11:21.16 | 16.61 | 16.05 | 11.95 |
| 15 | 2001-01-24 | 13:06:48.9 | 17.92 | 17.30 | 13.41 |
| 17 | 2001-03-25 | 01:21:7.19 | 14.17 | 13.53 | 8.65 |
| 19 | 2001-05-23 | 02:46:3.26 | 15 | 14.78 | 11.22 |
| 21 | 2001-07-20 | 19:44:15.03 | 13.36 | 13.31 | 10.13 |
| 23 | 2001-09-17 | 10:27:16.21 | 11.17 | 11.04 | 6.88 |
| 25 | 2001-11-15 | 06:40:1.96 | 15.08 | 14.80 | 11.21 |
| 27 | 2002-01-13 | 13:28:42.26 | 16.65 | 16.14 | 12.30 |
| 29 | 2002-03-14 | 02:02:35.32 | 15.05 | 14.23 | 9.06 |
| 31 | 2002-05-12 | 10:45:6.6 | 17.24 | 16.77 | 13.02 |
| 33 | 2002-07-10 | 10:25:56.8 | 14.26 | 14.04 | 10.54 |
| 35 | 2002-09-07 | 03:10:6.97 | 11.32 | 11.21 | 7.01 |
| 37 | 2002-11-04 | 20:34:23.97 | 14 | 13.93 | 10.69 |
| 39 | 2003-01-02 | 20:22:47.5 | 14.26 | 14 | 10.41 |
| 41 | 2003-03-03 | 02:34:52.29 | 14.52 | 13.83 | 8.90 |
| 43 | 2003-05-01 | 12:14:41.65 | 18.55 | 17.95 | 14.09 |
| 45 | 2003-06-29 | 18:38:30.35 | 15.63 | 15.14 | 11.14 |
| 47 | 2003-08-27 | 17:26:15.07 | 12.71 | 12.41 | 8 |
| 49 | 2003-10-25 | 12:50:12.63 | 14.13 | 14.09 | 10.95 |
| 51 | 2003-12-23 | 09:42:57.61 | 12.46 | 12.39 | 8.89 |
| 53 | 2004-02-20 | 09:17:42.57 | 13.14 | 12.77 | 8.38 |
| 55 | 2004-04-19 | 13:21:12.08 | 17.90 | 17.37 | 13.70 |
| 57 | 2004-06-17 | 20:26:45.44 | 16.12 | 15.46 | 11.05 |
| 59 | 2004-08-16 | 01:23:45.49 | 14.73 | 14.13 | 9.46 |
| 61 | 2004-10-14 | 02:48:9.02 | 15.46 | 15.26 | 11.98 |
| 63 | 2004-12-12 | 01:28:55.8 | 12.03 | 11.99 | 8.34 |
| 65 | 2005-02-08 | 22:27:53.47 | 12.20 | 12.07 | 8.13 |
| 67 | 2005-04-08 | 20:31:55.54 | 15.87 | 15.61 | 12.26 |
| 69 | 2005-06-06 | 21:55:7.11 | 14.96 | 14.40 | 9.92 |
| 71 | 2005-08-05 | 03:04:43.19 | 16.09 | 15.33 | 10.56 |
| 73 | 2005-10-03 | 10:27:48.67 | 17.39 | 16.96 | 13.40 |
| 75 | 2005-12-01 | 15:00:48.84 | 12.84 | 12.67 | 8.57 |
| 77 | 2006-01-29 | 14:14:30.2 | 12.50 | 12.41 | 8.67 |
| 79 | 2006-03-29 | 10:15:11.45 | 14.09 | 14.04 | 10.92 |
| 81 | 2006-05-27 | 05:25:31.32 | 12.85 | 12.59 | 8.24 |
| 83 | 2006-07-25 | 04:30:53.25 | 15.85 | 15.22 | 10.80 |

| # | UDate | UTime | Ty | Ts | To |
|----|------------|-------------|-------|-------|-------|
| 2 | 2000-01-06 | 18:13:41.22 | 18.34 | 17.77 | 13.96 |
| 4 | 2000-03-06 | 05:16:48.75 | 14.60 | 14.19 | 10.31 |
| 6 | 2000-05-04 | 04:12:0.04 | 12.33 | 12.15 | 7.99 |
| 8 | 2000-07-01 | 19:19:52.54 | 13.96 | 13.93 | 10.83 |
| 10 | 2000-08-29 | 10:19:12.65 | 12.77 | 12.60 | 9.06 |
| 12 | 2000-10-27 | 07:58:0.09 | 13.79 | 13.29 | 8.73 |
| 14 | 2000-12-25 | 17:21:43.35 | 18.50 | 17.96 | 14.14 |
| 16 | 2001-02-23 | 08:21:9.6 | 15.72 | 15.03 | 10.62 |
| 18 | 2001-04-23 | 15:25:36.68 | 14.36 | 13.93 | 9.58 |
| 20 | 2001-06-21 | 11:57:45.12 | 14.70 | 14.61 | 11.44 |
| 22 | 2001-08-19 | 02:55:06 | 11.77 | 11.69 | 8.09 |
| 24 | 2001-10-16 | 19:23:16.17 | 12.56 | 12.37 | 8.33 |
| 26 | 2001-12-14 | 20:47:31.6 | 16.77 | 16.40 | 12.93 |
| 28 | 2002-02-12 | 07:40:57.64 | 15.40 | 14.69 | 10.06 |
| 30 | 2002-04-12 | 19:21:10.27 | 16.34 | 15.65 | 11.13 |
| 32 | 2002-06-10 | 23:46:28.99 | 16.39 | 16.09 | 12.67 |
| 34 | 2002-08-08 | 19:15:5.48 | 12.11 | 11.94 | 8.04 |
| 36 | 2002-10-06 | 11:17:21.85 | 12.38 | 12.28 | 8.56 |
| 38 | 2002-12-04 | 07:34:21.43 | 14.71 | 14.60 | 11.39 |
| 40 | 2003-02-01 | 10:48:22.21 | 13.66 | 13.16 | 8.69 |
| 42 | 2003-04-01 | 19:18:32.06 | 16.92 | 16.21 | 11.83 |
| 44 | 2003-05-31 | 04:19:45.96 | 17.92 | 17.37 | 13.64 |
| 46 | 2003-07-29 | 06:52:36.67 | 13.40 | 12.97 | 8.52 |
| 48 | 2003-09-26 | 03:09:2.54 | 13.46 | 13.29 | 9.63 |
| 50 | 2003-11-23 | 22:58:54.98 | 13.70 | 13.70 | 10.61 |
| 52 | 2004-01-21 | 21:04:54.29 | 11.78 | 11.57 | 7.34 |
| 54 | 2004-03-20 | 22:41:20.43 | 15.90 | 15.44 | 11.52 |
| 56 | 2004-05-19 | 04:51:56.68 | 17.80 | 17.23 | 13.37 |
| 58 | 2004-07-17 | 11:23:40.84 | 14.66 | 13.96 | 8.93 |
| 60 | 2004-09-14 | 14:28:55.34 | 15.55 | 15.16 | 11.35 |
| 62 | 2004-11-12 | 14:27:4.21 | 14.02 | 13.96 | 10.71 |
| 64 | 2005-01-10 | 12:02:41.55 | 11.04 | 10.96 | 6.78 |
| 66 | 2005-03-10 | 09:10:14.2 | 14.41 | 14.23 | 10.78 |
| 68 | 2005-05-08 | 08:45:23.19 | 15.86 | 15.51 | 11.77 |
| 70 | 2005-07-06 | 12:02:31.37 | 14.71 | 13.96 | 8.78 |
| 72 | 2005-09-03 | 18:45:22.36 | 17.62 | 17.02 | 13.06 |
| 74 | 2005-11-02 | 01:24:28.91 | 15.33 | 15.08 | 11.42 |
| 76 | 2005-12-31 | 03:11:37.57 | 11.68 | 11.56 | 7.22 |
| 78 | 2006-02-28 | 00:30:40.05 | 13.74 | 13.70 | 10.52 |
| 80 | 2006-04-27 | 19:43:49.16 | 13.49 | 13.37 | 9.81 |
| 82 | 2006-06-25 | 16:05:13.36 | 13.54 | 13.06 | 8.21 |
| 84 | 2006-08-23 | 19:09:41.53 | 18.12 | 17.52 | 13.58 |

| # | UDate | UTime | Ty | Ts | To |
|-----|------------|-------------|-------|-------|-------|
| 85 | 2006-09-22 | 11:44:58.65 | 18.43 | 17.86 | 14.09 |
| 87 | 2006-11-20 | 22:17:52.84 | 14.23 | 13.79 | 9.03 |
| 89 | 2007-01-19 | 04:00:35.65 | 14.06 | 13.83 | 10.09 |
| 91 | 2007-03-19 | 02:42:26.22 | 13.58 | 13.58 | 10.52 |
| 93 | 2007-05-16 | 19:27:14.63 | 11.25 | 11.25 | 6.93 |
| 95 | 2007-07-14 | 12:03:42.3 | 14.65 | 14.28 | 10.41 |
| 97 | 2007-09-11 | 12:44:12.58 | 17.43 | 16.95 | 13.23 |
| 99 | 2007-11-09 | 23:03:3.36 | 14.97 | 14.35 | 9.06 |
| 101 | 2008-01-08 | 11:36:58.73 | 16.36 | 15.89 | 11.90 |
| 103 | 2008-03-07 | 17:14:3.99 | 14.40 | 14.28 | 10.91 |
| 105 | 2008-05-05 | 12:18:13.17 | 10.99 | 11.05 | 6.65 |
| 107 | 2008-07-03 | 02:18:32.91 | 13.63 | 13.53 | 10.11 |
| 109 | 2008-08-30 | 19:57:59.83 | 15.12 | 14.88 | 11.38 |
| 111 | 2008-10-28 | 23:13:52.73 | 14.22 | 13.70 | 8.56 |
| 113 | 2008-12-27 | 12:22:25.25 | 18.03 | 17.39 | 13.29 |
| 115 | 2009-02-25 | 01:34:59.22 | 15.94 | 15.56 | 11.74 |
| 117 | 2009-04-25 | 03:22:27.76 | 12.07 | 11.99 | 7.43 |
| 119 | 2009-06-22 | 19:34:55.62 | 13.71 | 13.67 | 10.44 |
| 121 | 2009-08-20 | 10:01:24.21 | 13.14 | 13.12 | 9.77 |
| 123 | 2009-10-18 | 05:32:59.65 | 12.56 | 12.37 | 7.74 |
| 125 | 2009-12-16 | 12:02:7.66 | 17.80 | 17.23 | 13.36 |
| 127 | 2010-02-14 | 02:51:16.72 | 16.81 | 16.27 | 12.05 |
| 129 | 2010-04-14 | 12:28:51.38 | 13.96 | 13.57 | 8.73 |
| 131 | 2010-06-12 | 11:14:31.82 | 15.03 | 14.87 | 11.55 |
| 133 | 2010-08-10 | 03:07:56.58 | 12.47 | 12.50 | 9.07 |
| 135 | 2010-10-07 | 18:44:20.26 | 11.38 | 11.43 | 7.26 |
| 137 | 2010-12-05 | 17:35:38.88 | 16.08 | 15.78 | 12.29 |
| 139 | 2011-02-03 | 02:30:36.66 | 16.02 | 15.42 | 11.14 |
| 141 | 2011-04-03 | 14:32:12.82 | 15.42 | 14.82 | 9.79 |
| 143 | 2011-06-01 | 21:02:28.95 | 17.08 | 16.69 | 13.14 |
| 145 | 2011-07-30 | 18:39:41.71 | 13.07 | 12.97 | 9.19 |
| 147 | 2011-09-27 | 11:08:29.66 | 11.48 | 11.57 | 7.53 |
| 149 | 2011-11-25 | 06:09:37.1 | 14.49 | 14.43 | 11.26 |
| 151 | 2012-01-23 | 07:39:14.51 | 13.75 | 13.49 | 9.37 |
| 153 | 2012-03-22 | 14:37:4.12 | 15.46 | 14.90 | 10.09 |
| 155 | 2012-05-20 | 23:47:0.06 | 18.55 | 17.98 | 14.23 |
| 157 | 2012-07-19 | 04:23:56.48 | 14.39 | 14 | 9.67 |
| 159 | 2012-09-16 | 02:10:31.52 | 12.86 | 12.77 | 8.60 |
| 161 | 2012-11-13 | 22:07:53.97 | 14.10 | 14.06 | 11.01 |
| 163 | 2013-01-11 | 19:43:25.93 | 11.85 | 11.78 | 7.83 |
| 165 | 2013-03-11 | 19:50:54.26 | 14.30 | 14.01 | 9.71 |
| 167 | 2013-05-10 | 00:28:25.13 | 18.11 | 17.56 | 13.87 |
| 169 | 2013-07-08 | 07:14:18.38 | 15.22 | 14.57 | 9.75 |
| 171 | 2013-09-05 | 11:36:8.43 | 15.08 | 14.69 | 10.27 |
| 173 | 2013-11-03 | 12:49:52.17 | 14.99 | 14.83 | 11.64 |
| 175 | 2014-01-01 | 11:14:2.81 | 11.27 | 11.26 | 7.27 |
| 177 | 2014-03-01 | 07:59:30.96 | 13.19 | 13.11 | 9.34 |
| 179 | 2014-04-29 | 06:14:10.16 | 16.03 | 15.70 | 12.26 |
| 181 | 2014-06-27 | 08:08:24.74 | 14.60 | 13.96 | 9.03 |
| 183 | 2014-08-25 | 14:12:43.45 | 16.87 | 16.27 | 11.81 |
| 185 | 2014-10-23 | 21:56:32.77 | 16.64 | 16.25 | 12.72 |
| 187 | 2014-12-22 | 01:35:42.98 | 12.07 | 11.90 | 7.60 |
| 189 | 2015-02-18 | 23:47:4.84 | 13.12 | 13.14 | 9.64 |
| 191 | 2015-04-18 | 18:56:42.72 | 13.92 | 13.79 | 10.58 |

| # | UDate | UTime | Ty | Ts | To |
|-----|------------|-------------|-------|-------|-------|
| 86 | 2006-10-22 | 05:13:59.58 | 16.58 | 16.06 | 11.95 |
| 88 | 2006-12-20 | 14:00:37.61 | 13.40 | 13.03 | 8.37 |
| 90 | 2007-02-17 | 16:14:10.75 | 14.43 | 14.32 | 11.14 |
| 92 | 2007-04-17 | 11:36:1.36 | 12.08 | 12.15 | 8.56 |
| 94 | 2007-06-15 | 03:13:3.23 | 12.24 | 12.04 | 7.70 |
| 96 | 2007-08-12 | 23:02:28.75 | 16.80 | 16.39 | 12.80 |
| 98 | 2007-10-11 | 05:00:40.94 | 16.33 | 15.78 | 11.42 |
| 100 | 2007-12-09 | 17:40:16.9 | 15.25 | 14.65 | 9.62 |
| 102 | 2008-02-07 | 03:44:19.48 | 16.17 | 15.89 | 12.50 |
| 104 | 2008-04-06 | 03:55:13.2 | 12.12 | 12.15 | 8.33 |
| 106 | 2008-06-03 | 19:22:34.15 | 11.82 | 11.79 | 7.77 |
| 108 | 2008-08-01 | 10:12:28.08 | 14.95 | 14.79 | 11.55 |
| 110 | 2008-09-29 | 08:12:18.08 | 14.41 | 14.09 | 9.81 |
| 112 | 2008-11-27 | 16:54:37.67 | 15.99 | 15.22 | 10.27 |
| 114 | 2009-01-26 | 07:55:11 | 18.08 | 17.58 | 13.88 |
| 116 | 2009-03-26 | 16:05:54.07 | 13.27 | 13.10 | 8.87 |
| 118 | 2009-05-24 | 12:10:56.13 | 12.71 | 12.64 | 8.73 |
| 120 | 2009-07-22 | 02:34:26.41 | 13.92 | 13.88 | 10.82 |
| 122 | 2009-09-18 | 18:44:14.93 | 12.20 | 12.15 | 8.17 |
| 124 | 2009-11-16 | 19:13:36.4 | 15.03 | 14.58 | 10.11 |
| 126 | 2010-01-15 | 07:11:22.16 | 18.52 | 17.94 | 14.15 |
| 128 | 2010-03-15 | 21:01:9.03 | 14.56 | 14.10 | 9.46 |
| 130 | 2010-05-14 | 01:04:16.17 | 14.71 | 14.43 | 10.44 |
| 132 | 2010-07-11 | 19:40:19.35 | 14.15 | 14.09 | 10.96 |
| 134 | 2010-09-08 | 10:29:40.23 | 11.05 | 11.17 | 7.28 |
| 136 | 2010-11-06 | 04:51:38.27 | 13.70 | 13.54 | 9.66 |
| 138 | 2011-01-04 | 09:02:34.79 | 16.89 | 16.48 | 12.88 |
| 140 | 2011-03-04 | 20:45:48.7 | 14.78 | 14.19 | 9.36 |
| 142 | 2011-05-03 | 06:50:34.39 | 16.93 | 16.40 | 12.24 |
| 144 | 2011-07-01 | 08:53:46.24 | 15.46 | 15.22 | 11.78 |
| 146 | 2011-08-29 | 03:03:58.58 | 11.29 | 11.36 | 7.30 |
| 148 | 2011-10-26 | 19:55:40.62 | 13.19 | 13.19 | 9.63 |
| 150 | 2011-12-24 | 18:06:15.62 | 14.57 | 14.39 | 11.05 |
| 152 | 2012-02-21 | 22:34:38.07 | 13.59 | 13.20 | 8.47 |
| 154 | 2012-04-21 | 07:18:21.93 | 17.95 | 17.30 | 13.16 |
| 156 | 2012-06-19 | 15:02:0.35 | 16.94 | 16.43 | 12.60 |
| 158 | 2012-08-17 | 15:54:23.51 | 12.68 | 12.47 | 8.13 |
| 160 | 2012-10-15 | 12:02:23.06 | 13.87 | 13.83 | 10.41 |
| 162 | 2012-12-13 | 08:41:26.98 | 13.11 | 13.08 | 9.85 |
| 164 | 2013-02-10 | 07:19:58.97 | 11.98 | 11.85 | 7.36 |
| 166 | 2013-04-10 | 09:35:15.23 | 17.03 | 16.59 | 12.80 |
| 168 | 2013-06-08 | 15:56:22.39 | 17.11 | 16.46 | 12.41 |
| 170 | 2013-08-06 | 21:50:42.69 | 14.39 | 13.83 | 8.69 |
| 172 | 2013-10-05 | 00:34:29.66 | 15.69 | 15.46 | 11.90 |
| 174 | 2013-12-03 | 00:22:15.03 | 13.10 | 13.01 | 9.66 |
| 176 | 2014-01-30 | 21:38:23.89 | 11.21 | 11.25 | 6.92 |
| 178 | 2014-03-30 | 18:44:31.8 | 15.26 | 15.08 | 11.70 |
| 180 | 2014-05-28 | 18:40:4.88 | 15.46 | 14.96 | 10.97 |
| 182 | 2014-07-26 | 22:41:43.38 | 15.08 | 14.39 | 9.10 |
| 184 | 2014-09-24 | 06:13:43.77 | 17.80 | 17.30 | 13.54 |
| 186 | 2014-11-22 | 12:32:6.35 | 14.17 | 13.87 | 10.11 |
| 188 | 2015-01-20 | 13:13:33.17 | 11.85 | 11.82 | 7.60 |
| 190 | 2015-03-20 | 09:36:1.87 | 14.06 | 14.02 | 10.92 |
| 192 | 2015-05-18 | 04:13:2.82 | 13.15 | 12.90 | 9.10 |

| # | UDate | UTime | Ty | Ts | To |
|-----|------------|-------------|-------|-------|-------|
| 193 | 2015-06-16 | 14:05:10.81 | 12.94 | 12.54 | 7.90 |
| 195 | 2015-08-14 | 14:53:23.78 | 17 | 16.43 | 12.24 |
| 197 | 2015-10-13 | 00:05:45.4 | 17.81 | 17.20 | 13.37 |
| 199 | 2015-12-11 | 10:29:13.92 | 13.66 | 13.19 | 8.38 |
| 201 | 2016-02-08 | 14:38:44.99 | 14.36 | 14.26 | 10.78 |
| 203 | 2016-04-07 | 11:23:30.51 | 12.97 | 12.90 | 9.72 |
| 205 | 2016-06-05 | 02:59:28.06 | 11.51 | 11.38 | 7.36 |
| 207 | 2016-08-02 | 20:44:31.25 | 15.72 | 15.38 | 11.66 |
| 209 | 2016-10-01 | 00:11:28.24 | 17.12 | 16.53 | 12.67 |
| 211 | 2016-11-29 | 12:18:17.92 | 14.99 | 14.23 | 9.03 |
| 213 | 2017-01-28 | 00:06:56.37 | 16.52 | 16.17 | 12.51 |
| 215 | 2017-03-28 | 02:56:59.48 | 13.41 | 13.27 | 9.83 |
| 217 | 2017-05-25 | 19:44:18.64 | 11.26 | 11.21 | 7.04 |
| 219 | 2017-07-23 | 09:45:27.32 | 14.32 | 14.23 | 10.92 |
| 221 | 2017-09-20 | 05:29:47.67 | 14.88 | 14.52 | 10.82 |
| 223 | 2017-11-18 | 11:42:00.05 | 14.92 | 14.18 | 9.12 |
| 225 | 2018-01-17 | 02:17:10.01 | 18.39 | 17.83 | 13.98 |
| 227 | 2018-03-17 | 13:11:29.19 | 14.74 | 14.31 | 10.41 |
| 229 | 2018-05-15 | 11:47:32.34 | 12.37 | 12.17 | 7.99 |
| 231 | 2018-07-13 | 02:47:42.99 | 13.93 | 13.89 | 10.79 |
| 233 | 2018-09-09 | 18:01:19.15 | 12.76 | 12.58 | 9.06 |
| 235 | 2018-11-07 | 16:01:55.41 | 13.70 | 13.24 | 8.67 |
| 237 | 2019-01-06 | 01:28:11.25 | 18.45 | 17.89 | 14.10 |
| 239 | 2019-03-06 | 16:03:49.38 | 15.77 | 15.09 | 10.69 |
| 241 | 2019-05-04 | 22:45:12.66 | 14.41 | 13.96 | 9.58 |
| 243 | 2019-07-02 | 19:15:59.62 | 14.75 | 14.65 | 11.48 |
| 245 | 2019-08-30 | 10:36:50.47 | 11.81 | 11.74 | 8.16 |
| 247 | 2019-10-28 | 03:38:17.66 | 12.51 | 12.33 | 8.29 |
| 249 | 2019-12-26 | 05:13:4.54 | 16.67 | 16.33 | 12.85 |
| 251 | 2020-02-23 | 15:31:48.05 | 15.38 | 14.65 | 10.09 |
| 253 | 2020-04-23 | 02:25:32.36 | 16.34 | 15.63 | 11.08 |
| 255 | 2020-06-21 | 06:41:9.69 | 16.49 | 16.17 | 12.73 |
| 257 | 2020-08-19 | 02:41:21.02 | 12.21 | 12.03 | 8.13 |
| 259 | 2020-10-16 | 19:30:43.89 | 12.38 | 12.29 | 8.56 |
| 261 | 2020-12-14 | 16:16:25.87 | 14.65 | 14.53 | 11.35 |
| 263 | 2021-02-11 | 19:05:32.11 | 13.57 | 13.10 | 8.65 |
| 265 | 2021-04-12 | 02:30:36.58 | 16.83 | 16.14 | 11.74 |
| 267 | 2021-06-10 | 10:52:28.19 | 18 | 17.43 | 13.70 |
| 269 | 2021-08-08 | 13:49:56.2 | 13.51 | 13.07 | 8.61 |
| 271 | 2021-10-06 | 11:05:7.27 | 13.53 | 13.36 | 9.66 |
| 273 | 2021-12-04 | 07:42:52.28 | 13.71 | 13.70 | 10.62 |
| 275 | 2022-02-01 | 05:45:51.26 | 11.72 | 11.52 | 7.31 |
| 277 | 2022-04-01 | 06:24:7.05 | 15.77 | 15.33 | 11.42 |
| 279 | 2022-05-30 | 11:29:57.96 | 17.74 | 17.18 | 13.36 |
| 281 | 2022-07-28 | 17:54:40.24 | 14.69 | 13.96 | 8.94 |
| 283 | 2022-09-25 | 21:54:15.3 | 15.63 | 15.22 | 11.38 |
| 285 | 2022-11-23 | 22:56:57.57 | 14.13 | 14.04 | 10.79 |
| 287 | 2023-01-21 | 20:53:0.89 | 11.05 | 10.97 | 6.83 |
| 289 | 2023-03-21 | 17:22:53.57 | 14.35 | 14.15 | 10.74 |
| 291 | 2023-05-19 | 15:53:0.11 | 15.76 | 15.39 | 11.72 |
| 293 | 2023-07-17 | 18:31:33.05 | 14.62 | 13.87 | 8.73 |
| 295 | 2023-09-15 | 01:39:37.6 | 17.65 | 17.03 | 13.03 |
| 297 | 2023-11-13 | 09:27:10.02 | 15.48 | 15.18 | 11.53 |
| 299 | 2024-01-11 | 11:57:8.9 | 11.77 | 11.61 | 7.30 |

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| 194 | 2015-07-16 | 01:24:17.24 | 14.40 | 13.89 | 9.11 |
| 196 | 2015-09-13 | 06:41:18.93 | 18.58 | 18.02 | 14.18 |
| 198 | 2015-11-11 | 17:47:4.48 | 15.48 | 14.90 | 10.61 |
| 200 | 2016-01-10 | 01:30:21.31 | 13.66 | 13.40 | 9.06 |
| 202 | 2016-03-09 | 01:54:15.99 | 14.18 | 14.13 | 11.05 |
| 204 | 2016-05-06 | 19:29:26.78 | 11.64 | 11.55 | 7.79 |
| 206 | 2016-07-04 | 11:00:52.85 | 13.27 | 12.99 | 8.85 |
| 208 | 2016-09-01 | 09:03:8.17 | 17.33 | 16.86 | 13.28 |
| 210 | 2016-10-30 | 17:38:18.85 | 15.70 | 14.96 | 10.36 |
| 212 | 2016-12-29 | 06:53:9.86 | 15.89 | 15.33 | 10.82 |
| 214 | 2017-02-26 | 14:58:11.62 | 15.55 | 15.30 | 11.99 |
| 216 | 2017-04-26 | 12:15:57.34 | 11.55 | 11.43 | 7.51 |
| 218 | 2017-06-24 | 02:30:35.11 | 12.64 | 12.58 | 8.89 |
| 220 | 2017-08-21 | 18:30:3.06 | 15.16 | 14.95 | 11.68 |
| 222 | 2017-10-19 | 19:11:58.02 | 14.30 | 13.70 | 9.15 |
| 224 | 2017-12-18 | 06:30:21.99 | 17.09 | 16.40 | 11.92 |
| 226 | 2018-02-15 | 21:05:5.17 | 17.28 | 16.80 | 13.14 |
| 228 | 2018-04-16 | 01:56:56.16 | 12.68 | 12.34 | 8 |
| 230 | 2018-06-13 | 19:43:6.15 | 13.27 | 13.20 | 9.68 |
| 232 | 2018-08-11 | 09:57:30.47 | 13.63 | 13.58 | 10.52 |
| 234 | 2018-10-09 | 03:46:46.09 | 12.33 | 12 | 7.73 |
| 236 | 2018-12-07 | 07:20:19.75 | 16.52 | 16.02 | 11.90 |
| 238 | 2019-02-04 | 21:03:24.41 | 17.92 | 17.30 | 13.42 |
| 240 | 2019-04-05 | 08:50:18.89 | 14.26 | 13.59 | 8.69 |
| 242 | 2019-06-03 | 10:01:43.51 | 15.03 | 14.79 | 11.21 |
| 244 | 2019-08-01 | 03:11:35.03 | 13.42 | 13.37 | 10.23 |
| 246 | 2019-09-28 | 18:26:9.61 | 11.17 | 11.04 | 6.91 |
| 248 | 2019-11-26 | 15:05:29.54 | 14.99 | 14.74 | 11.17 |
| 250 | 2020-01-24 | 21:41:52.11 | 16.58 | 16.05 | 12.25 |
| 252 | 2020-03-24 | 09:27:55.74 | 15.03 | 14.22 | 9.03 |
| 254 | 2020-05-22 | 17:38:34.99 | 17.30 | 16.80 | 13.01 |
| 256 | 2020-07-20 | 17:32:38.18 | 14.39 | 14.15 | 10.65 |
| 258 | 2020-09-17 | 10:59:50.51 | 11.38 | 11.23 | 7.05 |
| 260 | 2020-11-15 | 05:07:2.09 | 13.97 | 13.92 | 10.67 |
| 262 | 2021-01-13 | 04:59:59.02 | 14.17 | 13.93 | 10.32 |
| 264 | 2021-03-13 | 10:20:57.35 | 14.43 | 13.74 | 8.85 |
| 266 | 2021-05-11 | 18:59:39.53 | 18.53 | 17.93 | 14.04 |
| 268 | 2021-07-10 | 01:16:22.58 | 15.76 | 15.25 | 11.25 |
| 270 | 2021-09-07 | 00:51:32.82 | 12.80 | 12.46 | 8.03 |
| 272 | 2021-11-04 | 21:14:24.64 | 14.18 | 14.13 | 10.99 |
| 274 | 2022-01-02 | 18:33:19.15 | 12.42 | 12.37 | 8.86 |
| 276 | 2022-03-02 | 17:34:33.78 | 13.06 | 12.68 | 8.34 |
| 278 | 2022-04-30 | 20:27:48.14 | 17.77 | 17.27 | 13.62 |
| 280 | 2022-06-29 | 02:51:54.3 | 16.14 | 15.47 | 11.10 |
| 282 | 2022-08-27 | 08:16:47.78 | 14.78 | 14.14 | 9.42 |
| 284 | 2022-10-25 | 10:48:24.98 | 15.59 | 15.38 | 12.07 |
| 286 | 2022-12-23 | 10:16:38.11 | 12.08 | 12.04 | 8.39 |
| 288 | 2023-02-20 | 07:05:34.68 | 12.15 | 12.03 | 8.12 |
| 290 | 2023-04-20 | 04:12:16.96 | 15.76 | 15.52 | 12.17 |
| 292 | 2023-06-18 | 04:36:53.05 | 14.87 | 14.32 | 9.89 |
| 294 | 2023-08-16 | 09:37:54.34 | 16.02 | 15.25 | 10.48 |
| 296 | 2023-10-14 | 17:54:59.61 | 17.52 | 17.08 | 13.49 |
| 298 | 2023-12-12 | 23:31:47.16 | 12.95 | 12.76 | 8.67 |
| 300 | 2024-02-09 | 22:58:52.73 | 12.52 | 12.42 | 8.72 |

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| 301 | 2024-03-10 | 09:00:9.71 | 13.74 | 13.70 | 10.52 |
| 303 | 2024-05-08 | 03:21:42.02 | 13.44 | 13.33 | 9.81 |
| 305 | 2024-07-05 | 22:57:8.59 | 13.40 | 12.90 | 8.12 |
| 307 | 2024-09-03 | 01:55:20.28 | 18.05 | 17.43 | 13.51 |
| 309 | 2024-11-01 | 12:47:6.1 | 16.69 | 16.17 | 12.07 |
| 311 | 2024-12-30 | 22:26:36.6 | 13.53 | 13.11 | 8.46 |
| 313 | 2025-02-28 | 00:44:30.4 | 14.49 | 14.39 | 11.21 |
| 315 | 2025-04-27 | 19:30:55.59 | 12.13 | 12.20 | 8.63 |
| 317 | 2025-06-25 | 10:31:17.93 | 12.09 | 11.91 | 7.60 |
| 319 | 2025-08-23 | 06:06:14 | 16.64 | 16.24 | 12.67 |
| 321 | 2025-10-21 | 12:24:54.74 | 16.34 | 15.81 | 11.47 |
| 323 | 2025-12-20 | 01:43:12.1 | 15.33 | 14.66 | 9.66 |
| 325 | 2026-02-17 | 12:00:59.35 | 16.30 | 16.02 | 12.59 |
| 327 | 2026-04-17 | 11:51:32.67 | 12.26 | 12.28 | 8.42 |
| 329 | 2026-06-15 | 02:53:53.85 | 11.77 | 11.72 | 7.73 |
| 331 | 2026-08-12 | 17:36:26.21 | 14.83 | 14.69 | 11.47 |
| 333 | 2026-10-10 | 15:49:47.16 | 14.36 | 14.04 | 9.79 |
| 335 | 2026-12-09 | 00:51:36.93 | 15.90 | 15.21 | 10.27 |
| 337 | 2027-02-06 | 15:55:53.52 | 18.16 | 17.64 | 13.94 |
| 339 | 2027-04-06 | 23:50:57.52 | 13.41 | 13.20 | 8.91 |
| 341 | 2027-06-04 | 19:40:3.13 | 12.72 | 12.64 | 8.72 |
| 343 | 2027-08-02 | 10:04:50.55 | 13.88 | 13.87 | 10.82 |
| 345 | 2027-09-30 | 02:35:51.37 | 12.17 | 12.15 | 8.16 |
| 347 | 2027-11-28 | 03:24:6.42 | 14.96 | 14.52 | 10.09 |
| 349 | 2028-01-26 | 15:12:17.35 | 18.48 | 17.92 | 14.13 |
| 351 | 2028-03-26 | 04:31:13.58 | 14.65 | 14.17 | 9.49 |
| 353 | 2028-05-24 | 08:16:2.71 | 14.78 | 14.47 | 10.52 |
| 355 | 2028-07-22 | 03:01:20.92 | 14.22 | 14.15 | 11.04 |
| 357 | 2028-09-18 | 18:23:25.39 | 11.08 | 11.19 | 7.34 |
| 359 | 2028-11-16 | 13:17:43.4 | 13.63 | 13.49 | 9.62 |
| 361 | 2029-01-14 | 17:24:14.52 | 16.78 | 16.39 | 12.80 |
| 363 | 2029-03-15 | 04:19:4.47 | 14.75 | 14.18 | 9.40 |
| 365 | 2029-05-13 | 13:41:59.61 | 16.97 | 16.42 | 12.24 |
| 367 | 2029-07-11 | 15:50:50.31 | 15.60 | 15.33 | 11.90 |
| 369 | 2029-09-08 | 10:44:8.98 | 11.38 | 11.43 | 7.43 |
| 371 | 2029-11-06 | 04:23:51.71 | 13.15 | 13.15 | 9.63 |
| 373 | 2030-01-04 | 02:49:15.01 | 14.47 | 14.30 | 10.97 |
| 375 | 2030-03-04 | 06:34:29.92 | 13.49 | 13.12 | 8.52 |
| 377 | 2030-05-02 | 14:11:53.64 | 17.84 | 17.23 | 13.10 |
| 379 | 2030-06-30 | 21:34:6.67 | 17.02 | 16.52 | 12.68 |
| 381 | 2030-08-28 | 23:07:10.26 | 12.76 | 12.54 | 8.08 |
| 383 | 2030-10-26 | 20:16:42.11 | 13.96 | 13.89 | 10.52 |
| 385 | 2030-12-24 | 17:31:53.39 | 13.10 | 13.07 | 9.83 |
| 387 | 2031-02-21 | 15:48:38.28 | 11.86 | 11.78 | 7.44 |
| 389 | 2031-04-21 | 16:56:52.27 | 16.89 | 16.45 | 12.67 |
| 391 | 2031-06-19 | 22:24:24.79 | 17.08 | 16.45 | 12.41 |
| 393 | 2031-08-18 | 04:32:6.56 | 14.39 | 13.84 | 8.81 |
| 395 | 2031-10-16 | 08:20:36.21 | 15.82 | 15.56 | 11.98 |
| 397 | 2031-12-14 | 09:05:30.49 | 13.19 | 13.07 | 9.68 |
| 399 | 2032-02-11 | 06:23:55.68 | 11.17 | 11.22 | 7 |
| 401 | 2032-04-10 | 02:39:13.45 | 15.13 | 14.96 | 11.61 |
| 403 | 2032-06-08 | 01:31:50.05 | 15.34 | 14.87 | 10.92 |
| 405 | 2032-08-06 | 05:11:19.71 | 14.97 | 14.31 | 9.06 |
| 407 | 2032-10-04 | 13:26:19.35 | 17.91 | 17.39 | 13.62 |

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| 304 | 2024-06-06 | 12:37:27.33 | 12.77 | 12.51 | 8.22 |
| 306 | 2024-08-04 | 11:12:47.42 | 15.68 | 15.08 | 10.65 |
| 308 | 2024-10-02 | 18:49:9.83 | 18.48 | 17.92 | 14.13 |
| 310 | 2024-12-01 | 06:21:19.46 | 14.36 | 13.87 | 9.15 |
| 312 | 2025-01-29 | 12:35:44.75 | 14.15 | 13.92 | 10.11 |
| 314 | 2025-03-29 | 10:57:30.02 | 13.66 | 13.66 | 10.52 |
| 316 | 2025-05-27 | 03:02:6.77 | 11.25 | 11.21 | 7 |
| 318 | 2025-07-24 | 19:10:53.64 | 14.43 | 14.10 | 10.26 |
| 320 | 2025-09-21 | 19:53:47.36 | 17.37 | 16.90 | 13.20 |
| 322 | 2025-11-20 | 06:47:5.8 | 15.03 | 14.36 | 9.15 |
| 324 | 2026-01-18 | 19:51:51.55 | 16.46 | 15.99 | 11.98 |
| 326 | 2026-03-19 | 01:23:14.81 | 14.53 | 14.40 | 11.01 |
| 328 | 2026-05-16 | 20:00:46.99 | 11.05 | 11.09 | 6.71 |
| 330 | 2026-07-14 | 09:43:20 | 13.50 | 13.41 | 9.98 |
| 332 | 2026-09-11 | 03:26:41.07 | 15.03 | 14.82 | 11.34 |
| 334 | 2026-11-09 | 07:01:47.76 | 14.19 | 13.67 | 8.46 |
| 336 | 2027-01-07 | 20:24:13.37 | 18.05 | 17.42 | 13.31 |
| 338 | 2027-03-08 | 09:29:17.36 | 16.05 | 15.68 | 11.85 |
| 340 | 2027-05-06 | 10:58:19.19 | 12.17 | 12.07 | 7.38 |
| 342 | 2027-07-04 | 03:01:46.94 | 13.70 | 13.66 | 10.40 |
| 344 | 2027-08-31 | 17:40:50.27 | 13.12 | 13.12 | 9.79 |
| 346 | 2027-10-29 | 13:36:16.65 | 12.52 | 12.33 | 7.57 |
| 348 | 2027-12-27 | 20:12:7.32 | 17.72 | 17.18 | 13.29 |
| 350 | 2028-02-25 | 10:37:12.66 | 16.84 | 16.30 | 12.08 |
| 352 | 2028-04-24 | 19:46:43.11 | 14.04 | 13.63 | 8.64 |
| 354 | 2028-06-22 | 18:27:19.55 | 15.09 | 14.92 | 11.60 |
| 356 | 2028-08-20 | 10:43:25.15 | 12.54 | 12.58 | 9.15 |
| 358 | 2028-10-18 | 02:56:31.28 | 11.47 | 11.42 | 7.69 |
| 360 | 2028-12-16 | 02:06:3.13 | 16.02 | 15.69 | 12.24 |
| 362 | 2029-02-13 | 10:31:16.62 | 15.87 | 15.38 | 11.09 |
| 364 | 2029-04-13 | 21:40:0.38 | 15.42 | 14.79 | 9.67 |
| 366 | 2029-06-12 | 03:50:22.34 | 17.17 | 16.77 | 13.20 |
| 368 | 2029-08-10 | 01:55:35.45 | 13.20 | 13.07 | 9.29 |
| 370 | 2029-10-07 | 19:14:14.14 | 11.51 | 11.60 | 7.49 |
| 372 | 2029-12-05 | 14:51:53.58 | 14.44 | 14.36 | 11.22 |
| 374 | 2030-02-02 | 16:07:18.1 | 13.63 | 13.40 | 9.28 |
| 376 | 2030-04-02 | 22:02:16.45 | 15.35 | 14.82 | 9.96 |
| 378 | 2030-06-01 | 06:21:4.14 | 18.56 | 18.02 | 14.23 |
| 380 | 2030-07-30 | 11:10:42.76 | 14.47 | 14.09 | 9.75 |
| 382 | 2030-09-27 | 09:54:24.83 | 12.93 | 12.84 | 8.63 |
| 384 | 2030-11-25 | 06:46:12.61 | 14.13 | 14.10 | 11.05 |
| 386 | 2031-01-23 | 04:30:42.62 | 11.77 | 11.74 | 7.77 |
| 388 | 2031-03-23 | 03:48:51.18 | 14.17 | 13.92 | 9.62 |
| 390 | 2031-05-21 | 07:17:0.29 | 18.02 | 17.46 | 13.79 |
| 392 | 2031-07-19 | 13:39:57.45 | 15.22 | 14.58 | 9.75 |
| 394 | 2031-09-16 | 18:46:45.92 | 15.14 | 14.74 | 10.28 |
| 396 | 2031-11-14 | 21:09:24.41 | 15.09 | 14.95 | 11.72 |
| 398 | 2032-01-12 | 20:06:23.01 | 11.25 | 11.27 | 7.22 |
| 400 | 2032-03-11 | 16:24:21.73 | 13.10 | 13.06 | 9.28 |
| 402 | 2032-05-09 | 13:35:26.4 | 15.94 | 15.59 | 12.17 |
| 404 | 2032-07-07 | 14:41:18.29 | 14.49 | 13.87 | 8.97 |
| 406 | 2032-09-04 | 20:56:28.35 | 16.86 | 16.25 | 11.74 |
| 408 | 2032-11-03 | 05:44:51.63 | 16.80 | 16.39 | 12.85 |

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| 411 | 2033-01-30 | 21:59:33.47 | 11.87 | 11.86 | 7.57 |
| 413 | 2033-03-30 | 17:51:20.81 | 14.04 | 14 | 10.91 |
| 415 | 2033-05-28 | 11:36:13.37 | 13.06 | 12.84 | 9.04 |
| 417 | 2033-07-26 | 08:12:19.92 | 14.19 | 13.72 | 8.90 |
| 419 | 2033-09-23 | 13:39:33.63 | 18.58 | 18.02 | 14.17 |
| 421 | 2033-11-22 | 01:39:1.97 | 15.59 | 14.99 | 10.67 |
| 423 | 2034-01-20 | 10:01:25.73 | 13.74 | 13.46 | 9.10 |
| 425 | 2034-03-20 | 10:14:12.95 | 14.26 | 14.19 | 11.12 |
| 427 | 2034-05-18 | 03:12:18.6 | 11.61 | 11.55 | 7.81 |
| 429 | 2034-07-15 | 18:14:56.23 | 13.01 | 12.81 | 8.63 |
| 431 | 2034-09-12 | 16:13:29.23 | 17.21 | 16.77 | 13.24 |
| 433 | 2034-11-11 | 01:16:1.51 | 15.72 | 14.99 | 10.45 |
| 435 | 2035-01-09 | 15:02:55.26 | 16.02 | 15.39 | 10.84 |
| 437 | 2035-03-09 | 23:09:5.01 | 15.65 | 15.42 | 12.09 |
| 439 | 2035-05-07 | 20:03:29.69 | 11.60 | 11.48 | 7.56 |
| 441 | 2035-07-05 | 09:58:58.57 | 12.51 | 12.47 | 8.74 |
| 443 | 2035-09-02 | 01:59:11.84 | 15.05 | 14.86 | 11.61 |
| 445 | 2035-10-31 | 02:58:26.02 | 14.26 | 13.67 | 9.15 |
| 447 | 2035-12-29 | 14:30:48.37 | 17.09 | 16.42 | 11.91 |
| 449 | 2036-02-27 | 04:59:7.44 | 17.39 | 16.89 | 13.24 |
| 451 | 2036-04-26 | 09:32:54.66 | 12.77 | 12.43 | 8.07 |
| 453 | 2036-06-24 | 03:09:19.39 | 13.24 | 13.20 | 9.62 |
| 455 | 2036-08-21 | 17:34:51.33 | 13.63 | 13.57 | 10.52 |
| 457 | 2036-10-19 | 11:49:40.46 | 12.26 | 11.96 | 7.70 |
| 459 | 2036-12-17 | 15:34:12.07 | 16.42 | 15.94 | 11.85 |
| 461 | 2037-02-15 | 04:53:47.84 | 17.98 | 17.31 | 13.44 |
| 463 | 2037-04-15 | 16:07:28.91 | 14.35 | 13.67 | 8.76 |
| 465 | 2037-06-13 | 17:09:57.02 | 15.09 | 14.83 | 11.21 |
| 467 | 2037-08-11 | 10:41:6.64 | 13.50 | 13.44 | 10.27 |
| 469 | 2037-10-09 | 02:34:5.92 | 11.17 | 11.04 | 6.91 |
| 471 | 2037-12-06 | 23:38:2.86 | 14.90 | 14.66 | 11.09 |
| 473 | 2038-02-04 | 05:52:1.34 | 16.50 | 16.02 | 12.21 |
| 475 | 2038-04-04 | 16:42:43.33 | 15.03 | 14.22 | 9.03 |
| 477 | 2038-06-03 | 00:23:51.78 | 17.33 | 16.83 | 13.01 |
| 479 | 2038-08-01 | 00:39:55.38 | 14.52 | 14.26 | 10.75 |
| 481 | 2038-09-28 | 18:57:7.01 | 11.42 | 11.27 | 7.08 |
| 483 | 2038-11-26 | 13:46:23.29 | 13.94 | 13.88 | 10.65 |

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| 410 | 2033-01-01 | 10:16:48.8 | 12.11 | 11.96 | 7.61 |
| 412 | 2033-03-01 | 08:23:10.13 | 13.11 | 13.12 | 9.63 |
| 414 | 2033-04-29 | 02:45:55.13 | 13.85 | 13.74 | 10.54 |
| 416 | 2033-06-26 | 21:06:45.64 | 12.77 | 12.41 | 7.78 |
| 418 | 2033-08-24 | 21:39:32.38 | 16.86 | 16.30 | 12.08 |
| 420 | 2033-10-23 | 07:28:18.05 | 17.92 | 17.30 | 13.45 |
| 422 | 2033-12-21 | 18:46:22.94 | 13.74 | 13.27 | 8.42 |
| 424 | 2034-02-18 | 23:10:1.96 | 14.44 | 14.32 | 10.83 |
| 426 | 2034-04-18 | 19:25:33.38 | 13.01 | 12.97 | 9.76 |
| 428 | 2034-06-16 | 10:25:37 | 11.38 | 11.26 | 6.92 |
| 430 | 2034-08-14 | 03:52:45.97 | 15.52 | 15.21 | 11.48 |
| 432 | 2034-10-12 | 07:32:21.33 | 17.11 | 16.52 | 12.67 |
| 434 | 2034-12-10 | 20:14:14.92 | 15.01 | 14.26 | 9.03 |
| 436 | 2035-02-08 | 08:21:53.08 | 16.64 | 16.27 | 12.58 |
| 438 | 2035-04-08 | 10:57:21.34 | 13.53 | 13.36 | 9.92 |
| 440 | 2035-06-06 | 03:20:21.65 | 11.21 | 11.14 | 6.97 |
| 442 | 2035-08-03 | 17:11:27.28 | 14.18 | 14.10 | 10.82 |
| 444 | 2035-10-01 | 13:06:31.9 | 14.83 | 14.47 | 10.80 |
| 446 | 2035-11-29 | 19:37:20.73 | 14.90 | 14.17 | 9.08 |
| 448 | 2036-01-28 | 10:17:4.97 | 18.45 | 17.87 | 14.02 |
| 450 | 2036-03-27 | 20:56:34.36 | 14.87 | 14.44 | 10.52 |
| 452 | 2036-05-25 | 19:16:36.67 | 12.39 | 12.20 | 7.95 |
| 454 | 2036-07-23 | 10:16:35.97 | 13.88 | 13.87 | 10.75 |
| 456 | 2036-09-20 | 01:51:11 | 12.72 | 12.58 | 9.07 |
| 458 | 2036-11-18 | 00:14:7.9 | 13.62 | 13.16 | 8.63 |
| 460 | 2037-01-16 | 09:34:12.23 | 18.39 | 17.84 | 14.06 |
| 462 | 2037-03-16 | 23:36:1.96 | 15.86 | 15.16 | 10.75 |
| 464 | 2037-05-15 | 05:53:59.07 | 14.47 | 14 | 9.58 |
| 466 | 2037-07-13 | 02:31:28.04 | 14.82 | 14.70 | 11.51 |
| 468 | 2037-09-09 | 18:25:0.38 | 11.85 | 11.78 | 8.22 |
| 470 | 2037-11-07 | 12:02:42.27 | 12.46 | 12.28 | 8.24 |
| 472 | 2038-01-05 | 13:41:10.79 | 16.58 | 16.23 | 12.77 |
| 474 | 2038-03-05 | 23:14:48.41 | 15.34 | 14.65 | 10.09 |
| 476 | 2038-05-04 | 09:19:18.77 | 16.33 | 15.63 | 11.04 |
| 478 | 2038-07-02 | 13:31:44.32 | 16.59 | 16.27 | 12.80 |
| 480 | 2038-08-30 | 10:12:23.42 | 12.30 | 12.11 | 8.22 |
| 482 | 2038-10-28 | 03:52:22.96 | 12.39 | 12.30 | 8.56 |
| 484 | 2038-12-26 | 01:01:39.93 | 14.58 | 14.47 | 11.31 |