# First occurrence prime gaps

**(including first known occurrence prime gaps less than 2000)**

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Last updated 0600 GMT 12 August 2019. Additional lists of prime gaps are maintained on this site.

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- Notes
- Instructions for submitting prime gaps
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- Discoverers and abbreviations
- Gaps from 1 to 1998
- Additional kilogaps below 5e16
- Other tables of prime gaps

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## NOTES

- The following table is believed to exhibit all first occurrence and maximal prime gaps conclusively established as of the date shown above. In addition, all first known occurrence gaps, less than 2000 in measure, are shown. A supplemental table exhibits all other prime gaps (not first occurrences), 1000 or greater in measure, lying below 5e16.
- More precisely, the tables include all such gaps known to me, and which I have been able to verify (to the extent practical), process, format, and post. Values for which no such gap is available are indicated by a missing entry.
- All prime gaps in $0 < x < 2**64$ have now been analyzed, where $2**64 = 2^{64} = 18446744073709551616$, the smallest positive integer requiring more than 64 bits in its binary representation (i.e., not representable in C as a uint64_t). Note that JavaScript, Python, Perl, FORTRAN, COBOL, ADA, and other languages prefer the double asterisk as the exponentiation operator. This is largely due to numerous ambiguous meanings of the caret character"^", ASCII 0x5E, and related chevron shaped Unicode characters, such as U+2038, U+2041, U+2227, and U+028C. The caret character "^" may also be parsed erroneously when used in numeric data entries, particularly in Windows or DOS command lines and applications.
- The final push from 18446744000000000000 to $2**64$ was carried out by the combined efforts of PGS members Jerry LaGrou, Dana Jacobsen, Robert Smith, and Robert Gerbicz. No gap

exceeding 898 was found in this interval.

- Calculations beyond 2\*\*64 will be hindered by the fact that their binary representations require more than 64 bits, exceeding the capacity of the hardware registers in most present-day numeric processor FPUs (supercomputers excepted) and forcing the computations into software. This can be expected to reduce speed and throughput by one or two orders of magnitude.
- The upper bound of exhaustive analysis of gaps has been extended successively, as follows. For the most recent results, see the Prime Gap Searches project at the Mersenne Forum (see PGS in the Bibliography for a list of the participants). Most of the calculations beyond 16000e15 were carried out by Thomas Ritschel.

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UPPER BOUND              ATTAINED BY                     DATE
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2**64                    PGS (Mersenne Forum)            25 Sep   2018
18446.744e15             PGS (Mersenne Forum)            13 Aug   2018
17000e15                 PGS (Mersenne Forum)            25 June  2018
16000e15                 PGS (Mersenne Forum)            29 Apr   2018
15200e15                 PGS (Mersenne Forum)            10 Apr   2018
14000e15                 PGS (Mersenne Forum)            10 Mar   2018
13000e15                 PGS (Mersenne Forum)            25 Feb   2018
12000e15                 PGS (Mersenne Forum)            17 Jan   2018
10000e15                 PGS (Mersenne Forum)            23 Nov   2017
 9250e15                 PGS (Mersenne Forum)            03 Nov   2017
 7000e15                 PGS (Mersenne Forum)            21 Sept  2017
 6000e15                 PGS (Mersenne Forum)            16 Aug   2017
 5500e15                 PGS (Mersenne Forum)            02 Aug   2017
 5000e15                 PGS (Mersenne Forum)            18 July  2017
 4500e15                 PGS (Mersenne Forum)            05 July  2017
 4000e15                 Silva & Herzog & Pardi          04 Apr   2012
 3600e15                 Silva & Herzog & Pardi          30 Mar   2012
 3400e15                 Silva & Herzog & Silvio Pardi   06 Feb   2012
 2608e15                 Silva & Herzog                  13 Sept  2011
 2222e15                 Silva & Herzog                  27 June  2011
 2200e15                 Silva & Herzog                  24 May   2011
 2188e15                 Silva & Herzog                  09 May   2011
 2168e15                 Silva & Herzog                  09 Apr   2011
 2133e15                 Silva & Herzog                  14 Feb   2011
 2020e15                 Silva & Herzog                  06 Nov   2010
 1610e15                 Silva & Herzog                  30 Aug   2010
 1609e15                 Silva & Herzog                  05 Jan   2010
 1600e15                 Silva & Herzog                  23 Dec   2009
 1500e15                 Silva & Herzog                  24 July  2009
 1e18                    Silva & Herzog                  26 Apr   2007
 524e15                  Silva & Herzog                  01 Mar   2007
 520e15                  Silva                           19 Feb   2007
 425e15                  Donald E. Knuth                 22 Oct   2006
 400e15                  Silva                           05 June  2006
 300e15                  Silva & Herzog                  26 Dec   2005
 200e15                  Siegfried "Zig" Herzog          02 Feb   2005
 150e15                  Silva                           17 Dec   2004
 110e15                  Nyman                           20 Jan   2004 (27 Oct 2
 100e15                  Silva & Herzog                  20 Jan   2004
 64.7e15                 James Fry                       17 Sep   2003
 60e15                   Tomás Oliveira e Silva          21 Feb   2003
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    50.003e15            Bertil Nyman                      22 Oct  2002
    1.598e15             Thomas R. Nicely                  16 Feb  1999
    72.63512e12          Young & Potler                            1989
    4.444e12             Richard P. Brent                          1980
    10.96e9              Lander & Parkin                           1967
    104395289            Gruenberger & Armerding & Baker           1961
    37e6                 D. H. Lehmer                              1957
    10e6                 A. E. Western                             1934
    3e6                  J. W. L. Glaisher                         1878
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Where two dates are given, the earlier one is the date of completion of computations for that interval; the later date is the point at which all other integers below that interval had also been exhaustively checked. See the bibliography below for full names and attribution.

- No gap exceeding 1550 has been definitively established as a first occurrence; larger gaps included in these lists are instead first known occurrence prime gaps. Additional lists of first known occurrence prime gaps are maintained on this site.

- The smallest gap whose first occurrence remains uncertain is the gap of 1432.

- The smallest gap for which no occurrence is yet known is the gap of 112738.

- The convention is followed here that the size (or measure) G of a prime gap is the difference of its two bounding primes; consequently a gap G contains (G - 1) consecutive composite integers. Some authorities (e.g., J. W. L. Glaisher, Daniel Shanks) have taken (G - 1) itself as the size of the gap, while others (e.g., Richard P. Brent) have specified the size of a gap by the parameter r = G/2. Furthermore, some authorities (e.g., Hans Riesel, Paul Leyland) have specified a gap by the terminating prime $p_2$, rather than the initiating prime $p_1$ as employed herein.

- Note that the term first occurrence prime gap (of measure G) refers to that interval p <= x <= p+G for which (1) p and p+G are primes, (2) p+t is composite for each integer t=1,...,G-1, and (3) no smaller positive prime p possesses these properties. The entity might be more accurately described as the earliest or smallest occurrence of the gap G, but the terminology first occurrence prime gap is well established in the literature. It does not imply historical precedence; a gap of equal measure, bounded by larger primes, may have been previously known.

- The term first known occurrence prime gap refers to a gap which satisfies conditions (1) and (2) above, but for which condition (3) has not been verified; there may exist a gap (at this time undiscovered, or at least unknown to me) of the same size at some unknown location between the current upper bound of exhaustive computation and the listed gap. For prime gap measures whose first occurrence is not yet known, first known occurrences serve as upper bounds; the current upper limit of exhaustive scans serves as the lower bound. Additional lists of first known occurrence prime gaps are maintained on this site; this is the only list which contains first occurrence or maximal prime gaps. Furthermore, I have written, and made available for download, a powerful UBASIC computer code designed for the discovery of new first known occurrence prime gaps.

- In these tables, the size or measure of the gap (difference of the bounding primes) is shown in the first column (positions 1-6).

- The second column (positions 7-11) indicates the classification of the gap, as explained below.

- Position 7 will ordinarily be blank. If an asterisk (*) should appear, it indicates that the gap is a maximal gap, strictly exceeding in measure all the prime gaps preceding it (those between consecutive prime numbers smaller in magnitude). In this case, it will in addition always be a definite first occurrence and certified prime gap.
- Position 8 is blank.
- The character in position 9 is the type of the gap; all of the gaps in this document are conventional (common, classic, standard, regular, ordinary, normal) prime gaps, indicated by the letter "C"; in other words, consecutive prime numbers differing by the measure of the gap, as defined by conditions (1) and (2) alone from the above definition of first occurrence prime gaps. This is the default; if the term prime gap is used without further qualification or elaboration, it refers to a conventional prime gap. Additional lists are anticipated, enumerating other types of prime gaps.
- The character in position 10 indicates the first occurrence status of the prime gap. The character "F" signifies that the gap has definitely been established (by an exhaustive scan to or beyond that point) as a first occurrence prime gap. The character "N" signifies that the gap is definitely not a first occurrence (a prior occurrence is known, with smaller bounding primes). The character "?" signifies that the gap is a first known occurrence (no such gap with smaller bounding primes has yet been found), but that it is not presently known if it is the first occurrence (i.e., whether or not a gap of equal measure with smaller bounding primes exists).
- The character in position 11 indicates whether the bounding integers of the gap are certified primes ("C") or probabilistic primes ("P"). The bounding integers of certified gaps (also titled confirmed, conclusive, deterministic, definite, definitive, or proven) have been conclusively proven prime, using trial prime divisors to the square root of the prime, or some test such as APRCL2 (Adleman-Pomerance-Rumely-Cohen-Lenstra-Lenstra) or ECPP. The gap is probabilistic (also titled "Monte Carlo") if the bounding integers have only been shown statistically prime (with a probability extremely close to one), using, for example, the Miller-Rabin test with multiple bases, or the strong Baillie-PSW primality test. For even larger integers (several hundred digits or more), probabilistic tests are orders of magnitude faster than deterministic tests, but all tests become computationally expensive for primes having thousands of digits. I attempt to personally certify the endpoint primes of smaller gaps (up to 200 digits), and to verify probabilistically (BPSW test) the endpoint integers of gaps up to about 10,000 digits. For gaps with more than about 10,000 digits, I employ Fermat's Test with base 2 to verify that the endpoint integers are either primes or base-2 pseudoprimes.

  The interior integers of each gap have been certified composite, deterministically (by myself, the discoverer, or a third party), usually by means of trial divisors, a Fermat test, or a Miller-Rabin test. However, if the character in position 11 is a "?" (classification code "C??"), the bounding integers are probable primes (using at least Fermat's Test, base 2), but the interior integers of the gap have not been verified all composite to the satisfaction of Thomas R. Nicely; consequently, there remains a significant possibility that such a gap may in fact be smaller in measure than indicated, due to the as yet undetected presence of an interior prime.

  In all cases, ultimate responsibility for the verification of a gap rests with the discoverer(s).

- The listed discoverers (abbreviation in the third column) and dates (year in the fourth column) reflect my best knowledge or estimate. If the actual date of discovery is not known, the date of publication or the date of the preprint is shown; if this is not known, an estimate is given. Some or all of the gaps occurring below 1e5 were almost certainly known prior to the indicated discovery, and the attribution of some of the other gaps below 1e8 is in doubt; for example, Appel and Rosser published significant (but incomplete) results for the gaps below 1e8 in 1961, the same year that Gruenberger and Armerding published definitive results to 104395289 from data generated by Baker and Gruenberger in 1959. In general, attribution is not provided for certification of a gap already established probabilistically; and in any case, the discovery date corresponds to the probabilistic verification of the gap.

- The fifth column (positions 26-32) states a so-called <u>figure of merit</u> for the gap. This indicates how much larger the gap is than the average gap (approximately ln(x), as a consequence of the Prime Number Theorem) between primes near that point; the greater the merit, the more unusual the gap. The merit is computed as $G/\ln(p\_1)$; variations in use (and at one time employed in these tables) include $G/\ln(p\_2)$ and $G/\ln((p\_1 + p\_2)/2)$, where $p\_1$ and $p\_2$ are the initiating and terminating primes of the gap. For all but the first few gaps, the differences among these formulas are trivial; indeed, if the results are rounded to two decimal places, I have found no discrepancies in the resulting values for any gap exceeding 112.

  NOTE: As a general rule, gaps with merits less than 1.000000 will not be included in these tables. Such gaps would be smaller than the average gap in that region.

- The sixth column in the tables (positions 33-38) indicates the number of decimal digits in the initiating prime.

- The seventh column (positions 41 and beyond) shows the initiating prime (smaller bounding integer) of the gap. <u>initiating primes longer than 200 characters are abbreviated</u>; as the lists grow, additional restrictions of this nature (such as a minimum acceptable merit) may eventually become necessary. Abbreviated primes are shown in the form 12345678901234567890123456789 0..., with a few (usually 25 or more) of the most significant digits shown, followed by an ellipsis "...". In addition, the file <u>allgaps.dat</u> is available for download. This contains the complete (no truncation or abbreviation of primes) specification of each and every recorded first occurrence, maximal, and first known occurrence prime gaps. It is a text file (WinDOS format), with one line per gap in standard format. Note that this file is nearly 10 MB in size, and contains extremely long lines which will challenge most editors and file utilities (it is intended primarily for software input or output). Furthermore, I have also made available for download the zipfile <u>merits.zip</u>, which contains a text file specifying the measure G and the merit $M=G/\ln(p\_1)$ for all known first occurrence and first known occurrence prime gaps. This much smaller file (less than 1 MB) should be of additional assistance in determining whether or not some newly discovered gap constitutes a new first known occurrence.

- **<u>INSTRUCTIONS FOR SUBMITTING PRIME GAPS:</u>** If you wish to submit lists of gaps for inclusion in this document, please send them as attachments consisting of <u>zipped plain text</u> files. **Avoid proprietary formats such as Word, WordPerfect, Excel, TeX, PDF, or PostScript. Avoid embedding data in formats such as "rich text", HTML, XHTML, or XML. Multimedia submissions (video, audio, images, etc.) and social media submissions**

**(Twitter, YouTube, Facebook, instant messaging, etc.) will not be accepted.** Note that word processors and ordinary e-mail will usually destroy any formatting, and may corrupt very long lines (127 characters or more). Click here for my current e-mail address.

Note, however, that if your zipfiles exceed several MB in size, it is not advisable to send them as attachments, as you will risk mailbox overflow or bounceback, depending on restrictions enforced by the e-mail providers. For such large files, furnish instead a pointer to a Website from which I can download the file.

If possible, use the exact format employed for the gaps in this document, with the exception that you <u>must</u> specify the initating prime in its entirety, either by use of a simple formula (such as 10^999 + 7, using BASIC syntax; the factorial [!] and primorial [#] operators are also available) or by the complete decimal expansion of the integer. If line continuation is employed, use a trailing backslash "\" as the line continuation character. Even though the initiating prime may be abbreviated in some of the posted listings, complete specifications of the primes are necessary for validation of the gaps.

As an aternative, you may simply submit your gaps in the form of one gap (two entries) per line, gap size first, <u>initiating</u> prime p_1 following, separated by two or more spaces:

```
ggggg    ppppppppppppppppppppp
ggggg    ppppppppppppppppppppp
ggggg    ppppppppppppppppppppp
.....    .....................
```

with the size of the gap and initiating prime each as an unbroken sequence of decimal digits (no commas, decimal points, spaces, or other internal grouping symbols embedded within a sequence of digits); one gap per line; no other symbols on the line. The initiating prime may be specified, as above, by a recognizable expression (e.g., 10^999 + 348957 or 2843# - 4759).

Be aware that there may be a delay of several days before your gaps are posted, while I am combining and processing multiple submissions.

- Additional instructions are provided for the formatting and submission of gaps of one million or greater (or having initiating primes of 100000 or more characters), which would otherwise overflow the standard format descibed above.
- I have made available for download the zipfile cglp4.zip, featuring a DOS/Wintel executable which will check gap listings for validity, using probabilistic primality tests of extremely high reliability. Included are sample input and output files, source code (GNU C with GMP), and support routines. I strongly recommend the use of this code to check your listings prior to submission.
- Notification of any errors or omissions will be appreciated.

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# Abbreviations for Discoverers

```
ANair_MF---Anand S. Nair (PGS).
APinhTOS---Armando Pinho. Computer codes by Tomás Oliveira e Silva.
A.Walker---Andrew John Walker.
AEWestrn---A. E. Western.
Andersen---Jens Kruse Andersen.
ApplRssr---Kenneth I. Appel and J. Barkley Rosser.
ATeixTOS---António Teixera. Computer codes by Tomás Oliveira e Silva.
Be.Nyman---Bertil Nyman.
Blnchtte---Gilles Blanchette.
CBastTOS---Carlos Bastos. Computer codes by Tomás Oliveira e Silva.
CKernTOS---Cristian Kern. Computer codes by Tomás Oliveira e Silva.
ColeStev---Steve Cole (PGS).
DanielH.---Daniel Hermle.
DBgh&FOH---D. Baugh and F. O'Hara.
DHLehmer---Derrick Henry Lehmer.
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DonKnuth---Donald Ervin Knuth.
Erickson---Eddie Erickson.
Euclid  ---Euclid.
Fougeron---Jim Fougeron.
GABandAR---F. J. Gruenberger, G. Armerding, and C. L. Baker (1959, 1961),
           and independently, Kenneth I. Appel and J. Barkley Rosser (1961).
Gapcoin----The Gapcoin network,
           a Bitcoin derivative, employs a hashing algorithm which searches
           for prime gaps of high merit. Jonnie Frey, developer.
Glaisher---J. W. L. Glaisher.
H.Dubner---Harvey Dubner.
HrzogTOS---Siegfried "Zig" Herzog. Computer codes by Tomás Oliveira e Silva.
Jacobsen---Dana Jacobsen, running code using C and Perl.
JamesFry---James Fry.
JdeGroot---Jeroen de Groot.
JFNSTOeS---John Fettig and Nahil Sobh, NCSA. Computer codes by Tomás Oliveira e Si
JLGPardo---Jose Luis Gomez Pardo.
JRdrgTOS---João Manuel Rodrigues. Computer codes by Tomás Oliveira e Silva.
K.Conrow---Kenneth Conrow.
KOGrndln---Kjell-Olav Grøndalen.
_Kokales---David Kokales. Also contributed deterministic primality proofs.
LLnhardy---Leif Leonhardy.
LMorelli---Luigi Morelli (PGS).
LndrPrkn---L. J. Lander and Thomas R. Parkin.
M.Jansen---Michiel Jansen.
MJandJKA---Michiel Jansen and Jens Kruse Andersen.
MJPC&JKA---Michiel Jansen, Pierre Cami, and Jens Kruse Andersen.
ML.Brown---Milton L. Brown.
MrtnRaab---Martin Raab.
NicelyHD---Thomas R. Nicely. Computer codes inspired by Harvey Dubner's work.
NoAttrib---Anonymous contributors who do not wish attribution.
NuuKuosa---Nuutti Kuosa.
PardiTOS---Silvio Pardi. Computer codes by Tomás Oliveira e Silva.
PDeGeest---Patrick De Geest.
PierCami---Pierre Cami.
Pinho_MF---Carlos Eduardo Leal de Pinho (PGS).
R.Athale---Rahul Ramesh Athale.
RFischer---Richard Fischer.
Ritschel---Thomas Ritschel (PGS).
RobSmith---Robert W. Smith. Some of Smith's results after 2014 employ
           Perl code written by Dana Jacobsen. Coordinator, PGS.
Rosnthal---Hans Rosenthal.
RosntlJA---Hans Rosenthal. Computer codes by Jens Kruse Andersen.
RosntlJF---Hans Rosenthal. Computer codes by Jim Fougeron.
RP.Brent---Richard P. Brent.
Shepherd---Rick L. Shepherd.
Spielaur---Helmut Spielauer.
TAlmFMJA---Torbjörn Alm. Computer codes by Jens Kruse Andersen.
           Deterministic primality proofs by François Morain.
T.Hadley---Thomas Hadley.
TOeSilva---Tomás Oliveira e Silva.
Toni_Key---Antonio Key, using Perl codes developed by Dana Jacobsen.
TorAlmJA---Torbjörn Alm. Computer codes by Jens Kruse Andersen.
TRNicely---Thomas R. Nicely.
Weslwski---Arkadiusz Wesołowski.
Yng&Ptlr---Jeff Young and Aaron Potler.
YPPauloR---Jeff Young and Aaron Potler, as reported by Paulo Ribenboim.
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===============================================================================
   Gap   Cls Discvrer Year   Merit Digts   Following the prime
===============================================================================
     1*  CFC Euclid    -300   1.44      1   2
     2*  CFC AEWestrn  1934   1.82      1   3
     4*  CFC Glaisher  1877   2.06      1   7
     6*  CFC Glaisher  1877   1.91      2   23
     8*  CFC Glaisher  1877   1.78      2   89
    10   CFC DHLehmer  1957   2.03      3   139
    12   CFC DHLehmer  1957   2.27      3   199
    14*  CFC Glaisher  1877   2.96      3   113
    16   CFC DHLehmer  1957   2.13      4   1831
    18*  CFC Glaisher  1877   2.88      3   523
    20*  CFC Glaisher  1877   2.95      3   887
    22*  CFC AEWestrn  1934   3.13      4   1129
    24   CFC DHLehmer  1957   3.23      4   1669
    26   CFC DHLehmer  1957   3.33      4   2477
    28   CFC DHLehmer  1957   3.50      4   2971
    30   CFC DHLehmer  1957   3.59      4   4297
    32   CFC DHLehmer  1957   3.71      4   5591
    34*  CFC Glaisher  1877   4.73      4   1327
    36*  CFC Glaisher  1877   3.93      4   9551
    38   CFC DHLehmer  1957   3.68      5   30593
    40   CFC DHLehmer  1957   4.05      5   19333
    42   CFC DHLehmer  1957   4.33      5   16141
    44*  CFC Glaisher  1877   4.55      5   15683
    46   CFC DHLehmer  1957   4.07      5   81463
    48   CFC DHLehmer  1957   4.68      5   28229
    50   CFC DHLehmer  1957   4.82      5   31907
    52*  CFC Glaisher  1877   5.26      5   19609
    54   CFC Glaisher  1877   5.15      5   35617
    56   CFC Glaisher  1877   4.95      5   82073
    58   CFC Glaisher  1877   5.42      5   44293
    60   CFC Glaisher  1877   5.62      5   43331
    62   CFC Glaisher  1877   5.94      5   34061
    64   CFC Glaisher  1877   5.61      5   89689
    66   CFC DHLehmer  1957   5.50      6   162143
    68   CFC DHLehmer  1957   5.76      6   134513
    70   CFC DHLehmer  1957   5.80      6   173359
    72*  CFC Glaisher  1877   6.95      5   31397
    74   CFC DHLehmer  1957   5.73      6   404597
    76   CFC DHLehmer  1957   6.20      6   212701
    78   CFC DHLehmer  1957   6.42      6   188029
    80   CFC Glaisher  1877   6.06      6   542603
    82   CFC Glaisher  1877   6.57      6   265621
    84   CFC Glaisher  1877   6.44      6   461717
    86*  CFC Glaisher  1877   7.19      6   155921
    88   CFC Glaisher  1877   6.66      6   544279
    90   CFC Glaisher  1877   6.97      6   404851
    92   CFC Glaisher  1877   6.70      6   927869
    94   CFC DHLehmer  1957   6.76      7   1100977
    96*  CFC DHLehmer  1957   7.50      6   360653
    98   CFC Glaisher  1877   7.36      6   604073
   100   CFC Glaisher  1877   7.76      6   396733
   102   CFC Glaisher  1877   7.19      7   1444309
   104   CFC Glaisher  1877   7.35      7   1388483
   106   CFC DHLehmer  1957   7.62      7   1098847
   108   CFC Glaisher  1877   7.39      7   2238823
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110   CFC Glaisher 1877    7.75    7   1468277
112*  CFC Glaisher 1877    8.74    6   370261
114*  CFC Glaisher 1877    8.70    6   492113
116   CFC DHLehmer 1957    7.44    7   5845193
118*  CFC Glaisher 1877    8.36    7   1349533
120   CFC Glaisher 1877    8.30    7   1895359
122   CFC DHLehmer 1957    8.16    7   3117299
124   CFC Glaisher 1877    7.89    7   6752623
126   CFC Glaisher 1877    8.79    7   1671781
128   CFC DHLehmer 1957    8.44    7   3851459
130   CFC DHLehmer 1957    8.37    7   5518687
132*  CFC Glaisher 1877    9.35    7   1357201
134   CFC Glaisher 1877    8.50    7   6958667
136   CFC Glaisher 1877    8.68    7   6371401
138   CFC DHLehmer 1957    9.10    7   3826019
140   CFC Glaisher 1877    8.83    7   7621259
142   CFC DHLehmer 1957    8.79    8   10343761
144   CFC DHLehmer 1957    8.83    8   11981443
146   CFC Glaisher 1877    9.35    7   6034247
148*  CFC Glaisher 1877   10.20    7   2010733
150   CFC DHLehmer 1957    9.13    8   13626257
152   CFC Glaisher 1877    9.53    7   8421251
154*  CFC AEWestrn 1934   10.03    7   4652353
156   CFC DHLehmer 1957    9.34    8   17983717
158   CFC GABandAR 1961    8.92    8   49269581
160   CFC DHLehmer 1957    9.23    8   33803689
162   CFC GABandAR 1961    9.27    8   39175217
164   CFC DHLehmer 1957    9.75    8   20285099
166   CFC GABandAR 1961    9.10    8   83751121
168   CFC GABandAR 1961    9.64    8   37305713
170   CFC DHLehmer 1957    9.92    8   27915737
172   CFC GABandAR 1961    9.85    8   38394127
174   CFC GABandAR 1961    9.79    8   52721113
176   CFC GABandAR 1961   10.08    8   38089277
178   CFC GABandAR 1961   10.18    8   39389989
180*  CFC DHLehmer 1957   10.81    8   17051707
182   CFC DHLehmer 1957   10.46    8   36271601
184   CFC GABandAR 1961   10.12    8   79167733
186   CFC LndrPrkn 1967    9.89    9   147684137
188   CFC LndrPrkn 1967   10.05    9   134065829
190   CFC LndrPrkn 1967   10.12    9   142414669
192   CFC LndrPrkn 1967   10.31    9   123454691
194   CFC LndrPrkn 1967   10.25    9   166726367
196   CFC GABandAR 1961   10.85    8   70396393
198   CFC GABandAR 1961   11.22    8   46006769
200   CFC LndrPrkn 1967   10.13    9   378043979
202   CFC LndrPrkn 1967   10.92    9   107534587
204   CFC LndrPrkn 1967   11.01    9   112098817
206   CFC LndrPrkn 1967   10.69    9   232423823
208   CFC LndrPrkn 1967   10.90    9   192983851
210*  CFC DHLehmer 1957   12.46    8   20831323
212   CFC LndrPrkn 1967   11.05    9   215949407
214   CFC LndrPrkn 1967   11.06    9   253878403
216   CFC LndrPrkn 1967   11.29    9   202551667
218   CFC LndrPrkn 1967   11.12    9   327966101
220*  CFC GABandAR 1961   12.45    8   47326693
222*  CFC LndrPrkn 1967   11.92    9   122164747
224   CFC LndrPrkn 1967   11.30    9   409866323
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226   CFC LndrPrkn 1967   11.26    9   519653371
228   CFC LndrPrkn 1967   11.06    9   895858039
230   CFC LndrPrkn 1967   11.37    9   607010093
232   CFC LndrPrkn 1967   11.55    9   525436489
234*  CFC LndrPrkn 1967   12.28    9   189695659
236   CFC LndrPrkn 1967   12.30    9   216668603
238   CFC LndrPrkn 1967   11.71    9   673919143
240   CFC LndrPrkn 1967   12.13    9   391995431
242   CFC LndrPrkn 1967   12.27    9   367876529
244   CFC LndrPrkn 1967   11.99    9   693103639
246   CFC LndrPrkn 1967   12.22    9   555142061
248*  CFC LndrPrkn 1967   13.00    9   191912783
250*  CFC LndrPrkn 1967   12.64    9   387096133
252   CFC LndrPrkn 1967   12.44    9   630045137
254   CFC LndrPrkn 1967   12.15   10   1202442089
256   CFC LndrPrkn 1967   11.99   10   1872851947
258   CFC LndrPrkn 1967   12.29   10   1316355323
260   CFC LndrPrkn 1967   12.58    9   944192807
262   CFC LndrPrkn 1967   12.34   10   1649328997
264   CFC LndrPrkn 1967   12.23   10   2357881993
266   CFC LndrPrkn 1967   12.61   10   1438779821
268   CFC LndrPrkn 1967   12.65   10   1579306789
270   CFC LndrPrkn 1967   12.82   10   1391048047
272   CFC LndrPrkn 1967   12.75   10   1851255191
274   CFC LndrPrkn 1967   13.07   10   1282463269
276   CFC LndrPrkn 1967   13.60    9   649580171
278   CFC LndrPrkn 1967   12.54   10   4260928601
280   CFC LndrPrkn 1967   13.12   10   1855047163
282*  CFC LndrPrkn 1967   14.18    9   436273009
284   CFC LndrPrkn 1967   13.37   10   1667186459
286   CFC LndrPrkn 1967   13.14   10   2842739311
288*  CFC LndrPrkn 1967   13.73   10   1294268491
290   CFC LndrPrkn 1967   13.56   10   1948819133
292*  CFC LndrPrkn 1967   13.84   10   1453168141
294   CFC LndrPrkn 1967   13.09   10   5692630189
296   CFC LndrPrkn 1967   13.22   10   5260030511
298   CFC LndrPrkn 1967   13.02   10   8650524583
300   CFC LndrPrkn 1967   13.46   10   4758958741
302   CFC LndrPrkn 1967   13.35   10   6675573497
304   CFC LndrPrkn 1967   14.07   10   2433630109
306   CFC LndrPrkn 1967   13.85   10   3917587237
308   CFC LndrPrkn 1967   13.73   10   5490459101
310   CFC LndrPrkn 1967   14.02   10   4024713661
312   CFC LndrPrkn 1967   13.80   10   6570018347
314   CFC LndrPrkn 1967   13.70   10   8948418749
316   CFC RP.Brent 1973   13.61   11   12109172293
318   CFC LndrPrkn 1967   14.33   10   4372999721
320*  CFC LndrPrkn 1967   14.84   10   2300942549
322   CFC LndrPrkn 1967   14.12   10   7961074441
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326   CFC LndrPrkn 1967   14.50   10   5837935373
328   CFC RP.Brent 1973   14.08   11   13086861181
330   CFC LndrPrkn 1967   14.63   10   6291356009
332   CFC LndrPrkn 1967   14.76   10   5893180121
334   CFC RP.Brent 1973   13.83   11   30827138509
336*  CFC LndrPrkn 1967   15.22   10   3842610773
338   CFC RP.Brent 1973   14.19   11   22076314313
340   CFC LndrPrkn 1967   14.86   10   8605261447
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342   CFC RP.Brent 1973   14.74   11   12010745569
344   CFC RP.Brent 1973   14.51   11   19724087267
346   CFC RP.Brent 1973   14.95   11   11291401837
348   CFC RP.Brent 1973   14.77   11   17002876643
350   CFC RP.Brent 1973   14.87   11   16808773277
352   CFC RP.Brent 1973   14.58   11   30750892801
354*  CFC LndrPrkn 1967   15.96   10   4302407359
356   CFC RP.Brent 1973   14.89   11   24355072517
358   CFC RP.Brent 1973   15.21   11   16792321339
360   CFC RP.Brent 1973   15.18   11   20068818197
362   CFC RP.Brent 1973   14.90   11   35877724601
364   CFC RP.Brent 1973   15.19   11   25425617317
366   CFC RP.Brent 1973   15.43   11   20108776097
368   CFC RP.Brent 1973   14.92   11   51430518413
370   CFC RP.Brent 1973   14.91   11   59942358571
372   CFC RP.Brent 1973   15.67   11   20404137779
374   CFC RP.Brent 1973   15.67   11   23064761663
376   CFC RP.Brent 1973   16.00   11   16161669787
378   CFC RP.Brent 1973   15.51   11   38116957819
380   CFC RP.Brent 1973   15.92   11   23323808741
382*  CFC LndrPrkn 1967   16.54   11   10726904659
384*  CFC RP.Brent 1973   16.17   11   20678048297
386   CFC RP.Brent 1973   15.89   11   35238645587
388   CFC RP.Brent 1973   15.05   12   156798792223
390   CFC RP.Brent 1973   15.79   11   53241805651
392   CFC RP.Brent 1973   15.38   12   117215204531
394*  CFC RP.Brent 1973   16.53   11   22367084959
396   CFC RP.Brent 1973   16.06   11   50806025873
398   CFC RP.Brent 1973   16.30   11   40267027589
400   CFC RP.Brent 1973   16.27   11   47203303159
402   CFC RP.Brent 1973   16.40   11   44293346177
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406   CFC RP.Brent 1973   16.49   11   49306638307
408   CFC RP.Brent 1973   15.92   12   134664608389
410   CFC RP.Brent 1973   16.20   11   98276144093
412   CFC RP.Brent 1973   16.13   12   124221464119
414   CFC RP.Brent 1973   16.81   11   49914935177
416   CFC RP.Brent 1973   16.30   12   121972158437
418   CFC RP.Brent 1973   16.34   12   129300694603
420   CFC RP.Brent 1973   16.71   11   82490815123
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424   CFC RP.Brent 1973   16.12   12   264495345259
426   CFC RP.Brent 1973   16.44   12   180265084403
428   CFC RP.Brent 1973   16.39   12   219950168411
430   CFC RP.Brent 1973   16.38   12   250964194171
432   CFC RP.Brent 1973   17.15   11   87241770619
434   CFC RP.Brent 1973   16.97   12   127084569923
436   CFC RP.Brent 1973   16.37   12   367459059871
438   CFC RP.Brent 1973   17.28   12   101328529441
440   CFC RP.Brent 1973   17.14   12   141846299801
442   CFC RP.Brent 1973   16.52   12   417470554687
444   CFC RP.Brent 1973   18.26   11   36172730063
446   CFC RP.Brent 1973   17.17   12   190418076203
448   CFC RP.Brent 1973   16.77   12   402872474743
450   CFC RP.Brent 1973   18.09   11   63816175447
452   CFC RP.Brent 1973   16.82   12   466855187471
454   CFC RP.Brent 1973   17.44   12   202530831163
456*  CFC RP.Brent 1973   19.04   11   25056082087
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458   CFC RP.Brent 1973   17.32   12   304040251469
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462   CFC RP.Brent 1973   17.29   12   400729567081
464*  CFC RP.Brent 1973   18.96   11   42652618343
466   CFC RP.Brent 1973   17.22   12   565855695631
468*  CFC RP.Brent 1973   18.30   12   127976334671
470   CFC RP.Brent 1973   17.25   12   681753256133
472   CFC RP.Brent 1973   17.17   12   865244709607
474*  CFC RP.Brent 1973   18.28   12   182226896239
476   CFC RP.Brent 1973   17.43   12   725978934347
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480   CFC RP.Brent 1973   17.84   12   482423533897
482   CFC RP.Brent 1973   17.41   13   1051602787181
484   CFC RP.Brent 1973   17.69   12   767644374817
486*  CFC RP.Brent 1973   18.54   12   241160624143
488   CFC RP.Brent 1973   17.51   13   1275363152099
490*  CFC RP.Brent 1973   18.55   12   297501075799
492   CFC RP.Brent 1973   17.87   12   910361180689
494   CFC RP.Brent 1973   18.02   12   804541404419
496   CFC RP.Brent 1973   18.03   12   880318998907
498   CFC RP.Brent 1973   18.59   12   428315806823
500*  CFC RP.Brent 1973   18.91   12   303371455241
502   CFC RP.Brent 1973   18.02   13   1258535916601
504   CFC RP.Brent 1973   18.43   12   747431049203
506   CFC RP.Brent 1973   18.12   13   1339347750707
508   CFC RP.Brent 1973   17.99   13   1841086484491
510   CFC RP.Brent 1973   17.94   13   2209016910131
512   CFC RP.Brent 1973   18.08   13   1999066711391
514*  CFC RP.Brent 1973   19.44   12   304599508537
516*  CFC RP.Brent 1973   19.29   12   416608695821
518   CFC RP.Brent 1973   18.20   13   2296497058133
520   CFC RP.Brent 1973   18.26   13   2336167262449
522   CFC RP.Brent 1973   18.76   13   1214820695701
524   CFC RP.Brent 1973   18.42   13   2256065636039
526   CFC RP.Brent 1973   18.71   13   1620505682371
528   CFC RP.Brent 1973   18.82   13   1529741785139
530   CFC RP.Brent 1973   18.65   13   2205492372371
532*  CFC RP.Brent 1973   19.81   12   461690510011
534*  CFC RP.Brent 1973   19.67   12   614487453523
536   CFC Yng&Ptlr 1989   18.29   13   5371284217763
538   CFC RP.Brent 1973   18.95   13   2122536905311
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542   CFC RP.Brent 1980   18.93   13   2707053887651
544   CFC RP.Brent 1973   19.02   13   2652427555639
546   CFC RP.Brent 1973   19.22   13   2164206784721
548   CFC RP.Brent 1980   19.00   13   3380058341279
550   CFC RP.Brent 1973   19.27   13   2496646209271
552   CFC RP.Brent 1973   19.42   13   2210401546601
554   CFC RP.Brent 1980   19.16   13   3621153039299
556   CFC RP.Brent 1980   19.11   13   4338624362173
558   CFC Yng&Ptlr 1989   19.05   13   5263973982823
560   CFC RP.Brent 1980   19.26   13   4260199366373
562   CFC RP.Brent 1973   19.81   13   2081209441279
564   CFC RP.Brent 1973   20.13   13   1480064231153
566   CFC Yng&Ptlr 1989   19.37   13   4897642179197
568   CFC Yng&Ptlr 1989   19.30   13   6010330572331
570   CFC RP.Brent 1980   19.57   13   4442109925217
572   CFC Yng&Ptlr 1989   19.51   13   5441175346967
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574    CFC RP.Brent 1980    19.95    13    3108794067079
576    CFC Yng&Ptlr 1989    19.32    13    8817792098461
578    CFC Yng&Ptlr 1989    19.49    13    7552870120721
580    CFC Yng&Ptlr 1989    19.42    13    9383081340541
582*   CFC RP.Brent 1973    20.84    13    1346294310749
584    CFC Yng&Ptlr 1989    19.75    13    6993007248239
586    CFC Yng&Ptlr 1989    19.88    13    6364466316577
588*   CFC RP.Brent 1973    21.02    13    1408695493609
590    CFC Yng&Ptlr 1989    19.24    14    20761252261751
592    CFC RP.Brent 1980    20.51    13    3410069454097
594    CFC Yng&Ptlr 1989    20.25    13    5499789519863
596    CFC Yng&Ptlr 1989    19.88    14    10487995154603
598    CFC Yng&Ptlr 1989    20.37    13    5614481773561
600    CFC Yng&Ptlr 1989    20.54    13    4872634110067
602*   CFC RP.Brent 1973    21.27    13    1968188556461
604    CFC Yng&Ptlr 1989    20.60    13    5439564948583
606    CFC Yng&Ptlr 1989    20.12    14    12112937821403
608    CFC Yng&Ptlr 1989    19.83    14    20767330530329
610    CFC Yng&Ptlr 1989    20.44    13    9105981382177
612    CFC Yng&Ptlr 1989    20.25    14    13397310636587
614    CFC Yng&Ptlr 1989    20.14    14    17418754709747
616    CFC Yng&Ptlr 1989    20.73    13    8095224517651
618    CFC RP.Brent 1980    21.27    13    4165633395149
620    CFC Yng&Ptlr 1989    20.76    13    9344093035661
622    CFC Yng&Ptlr 1989    20.60    14    13059969946711
624    CFC Yng&Ptlr 1989    20.23    14    24923033918059
626    CFC Yng&Ptlr 1989    20.10    14    33605480400197
628    CFC Yng&Ptlr 1989    20.15    14    34140047613391
630    CFC Yng&Ptlr 1989    20.88    14    12644461143649
632    CFC Yng&Ptlr 1989    20.09    14    45678685880759
634    CFC Yng&Ptlr 1989    20.79    14    17659394869309
636    CFC Yng&Ptlr 1989    21.28    13    9483480841753
638    CFC Yng&Ptlr 1989    20.92    14    17499522060011
640    CFC Yng&Ptlr 1989    20.83    14    22099408494481
642    CFC Yng&Ptlr 1989    21.20    14    14141685364577
644    CFC Yng&Ptlr 1989    20.54    14    41433781612373
646    CFC Yng&Ptlr 1989    20.47    14    51027160468351
648    CFC Yng&Ptlr 1989    21.66    13    9787731507761
650    CFC Yng&Ptlr 1989    22.21    13    5120731250207
652*   CFC RP.Brent 1973    22.80    13    2614941710599
654    CFC Yng&Ptlr 1989    20.67    14    54916086007427
656    CFC Yng&Ptlr 1989    20.62    14    65862966031241
658    CFC Yng&Ptlr 1989    21.01    14    39883132551139
660    CFC Yng&Ptlr 1989    22.00    14    10653514291843
662    CFC Yng&Ptlr 1989    22.04    14    11082394066097
664    CFC Yng&Ptlr 1989    21.22    14    38745678640849
666    CFC Yng&Ptlr 1989    21.79    14    18691113008663
668    CFC Yng&Ptlr 1989    21.57    14    28340177964929
670    CFC Yng&Ptlr 1989    21.28    14    47137733785861
672    CFC Yng&Ptlr 1989    21.74    14    26456514142099
674*   CFC Yng&Ptlr 1989    22.77    13    7177162611713
676    CFC TRNicely 1996    21.13    14    78610833115261
678    CFC Yng&Ptlr 1989    21.68    14    37970994487033
680    CFC TRNicely 1996    21.22    14    82385435331119
682    CFC Yng&Ptlr 1989    21.75    14    41459443375351
684    CFC Yng&Ptlr 1989    22.04    14    30236507704253
686    CFC TRNicely 1996    21.48    14    74014757794301
688    CFC TRNicely 1996    21.28    15    110526670235599
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690    CFC Yng&Ptlr 1989    22.71    14    15712145060693
692    CFC Yng&Ptlr 1989    22.03    14    436035837013331
694    CFC Yng&Ptlr 1989    21.85    14    62088893223739
696    CFC Yng&Ptlr 1989    22.61    14    23333096984797
698    CFC Yng&Ptlr 1989    22.41    14    33785727371453
700    CFC Yng&Ptlr 1989    23.07    14    14998144209049
702    CFC Yng&Ptlr 1989    22.93    14    19786638118631
704    CFC TRNicely  1996   21.85    14    97731545943599
706    CFC Yng&Ptlr 1989    22.63    14    35625755878981
708    CFC TRNicely  1995   21.72    15    143679495784681
710    CFC TRNicely  1995   21.80    15    138965383978937
712    CFC TRNicely  1996   22.04    15    106749746034601
714    CFC Yng&Ptlr 1989    22.64    14    49639993268989
716*   CFC Yng&Ptlr 1989    23.66    14    13829048559701
718    CFC TRNicely  1996   22.41    14    82342388119111
720    CFC TRNicely  1996   22.26    15    111113196467011
722    CFC TRNicely  1996   21.87    15    218356872845927
724    CFC Yng&Ptlr 1989    22.82    14    59692452738913
726    CFC TRNicely  1995   22.21    15    156100489308167
728    CFC Yng&Ptlr 1989    22.97    14    57723522921803
730    CFC Yng&Ptlr 1989    23.69    14    24179270588173
732    CFC TRNicely  1995   22.47    15    140085225001801
734    CFC TRNicely  1995   22.47    15    154312610974979
736    CFC TRNicely  1995   22.50    15    161443383249583
738    CFC TRNicely  1995   22.64    15    143282994823909
740    CFC Yng&Ptlr 1989    23.36    14    57360609786539
742    CFC TRNicely  1996   22.57    15    189442329715069
744    CFC Yng&Ptlr 1989    23.71    14    42610475373269
746    CFC TRNicely  1995   22.71    15    184219698008123
748    CFC TRNicely  1995   22.82    15    172373989611793
750    CFC TRNicely  1995   23.00    15    145508250945419
752    CFC TRNicely  1996   22.67    15    255294593822687
754    CFC TRNicely  1996   22.83    15    219831875554399
756    CFC Yng&Ptlr 1989    23.71    14    70099348325843
758    CFC Yng&Ptlr 1989    24.07    14    47581758352253
760    CFC TRNicely  1996   23.59    14    98103148488133
762    CFC TRNicely  1995   23.37    15    144895907074481
764    CFC TRNicely  1996   22.87    15    323811481625339
766*   CFC Yng&Ptlr 1989    25.03    14    19581334192423
768    CFC TRNicely  1996   22.80    15    423683030575549
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772    CFC TRNicely  1996   23.50    15    186129514280467
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776    CFC TRNicely  1996   23.61    15    187865909338091
778*   CFC Yng&Ptlr 1989    24.79    14    42842283925351
780    CFC TRNicely  1996   23.09    15    471911699384963
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788    CFC TRNicely  1996   24.47    14    96949415903999
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804*   CFC YPPauloR 1991    25.02    14    90874329411493
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816   CFC  TRNicely  1997   23.94    15   632213931500513
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874   CFC  TRNicely  1998   25.03    16   1466977528790023
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1354    CFC  PardiTOS  2011   31.88    19   2805562883448462853
1356*   CFC  DonKnuth  2006   33.45    18   401429925999153707
1358    CFC  HrzogTOS  2007   33.29    18   523255220614645319
1360    CFC  HrzogTOS  2008   32.70    19   1153277647303540597
1362    CFC  TOeSilva  2011   31.81    19   3937457950646269397
1364    CFC  HrzogTOS  2007   32.87    19   1051140888051230423
1366    CFC  RobSmith  2017   31.63    19   5662268059649697577
1368    CFC  LLnhardy  2011   31.92    19   4105079953458040849
1370*   CFC  DonKnuth  2006   33.77    18   418032645936712127
1372    CFC  LLnhardy  2014   31.99    19   4219088970046367161
1374    CFC  PardiTOS  2011   32.34    19   2812814235281609869
1376    CFC  Jacobsen  2017   31.89    19   5468779003189090187
1378    CFC  Jacobsen  2017   31.95    19   5412399181863804469
1380    CFC  HrzogTOS  2007   33.27    19   1031501833130243273
1382    CFC  RobSmith  2017   31.50    20   11320694552053653731
1384    CFC  Toni_Key  2017   31.85    19   7421944961369698183
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1386    CFC  PardiTOS  2012   32.47     19    3449340080274651527
1388    CFC  TOeSilva  2011   32.63     19    2975205524123301149
1390    CFC  PardiTOS  2012   32.55     19    3492657661005161107
1392    CFC  TOeSilva  2009   33.27     19    1480032037939634731
1394    CFC  Ritschel  2017   32.13     19    6910128698372846693
1396    CFC  ColeStev  2017   32.04     19    8382021357433147093
1398    CFC  TOeSilva  2011   33.02     19    2424708729726767749
1400    CFC  PardiTOS  2012   32.80     19    3431657795858378003
1402    CFC  Ritschel  2017   32.04     20    10103695526434940251
1404    CFC  RobSmith  2017   32.30     19    7529566736915883083
1406    CFC  Pinho_MF  2017   32.22     19    8987860411525737317
1408    CFC  LLnhardy  2017   32.73     19    4834864424015986771
1410    CFC  HrzogTOS  2011   33.24     19    2635281932481539903
1412    CFC  Ritschel  2018   32.05     20    13533471241504919417
1414    CFC  RobSmith  2018   32.02     20    15170997176864748337
1416    CFC  TOeSilva  2012   33.11     19    3750992529339978877
1418    CFC  TOeSilva  2012   33.16     19    3725235533504101511
1420    CFC  Ritschel  2017   32.46     19    9984196949838014041
1422    CFC  Jacobsen  2017   32.87     19    6124339150787745169
1424    CFC  Jacobsen  2018   32.33     20    13512363187520983367
1426    CFC  Ritschel  2017   32.92     19    6508776242818491391
1428    CFC  Ritschel  2017   32.89     19    7161997391085310681
1430    CFC  LLnhardy  2017   33.28     19    4606937813294064947
1432    C?C  Spielaur  2011   27.13     23    84218359021503505748941
1434    CFC  LLnhardy  2017   33.30     19    5013757591652095753
1436    CFC  Be.Nyman  2015   32.41     20    17494076304651094403
1438    CFC  Be.Nyman  2014   32.45     20    17554325571496337149
1440    CFC  LLnhardy  2014   33.57     19    4253027105513399527
1442*   CFC  HrzogTOS  2005   34.98     18    8042128306866677669
1444    C?C  Spielaur  2011   27.31     23    91008005972217030656653
1446    CFC  Jacobsen  2017   33.08     19    9656919634106230133
1448    CFC  Ritschel  2017   33.59     19    5295442011781310951
1450    CFC  LMorelli  2017   33.16     19    9808299410025809701
1452    CFC  RobSmith  2017   33.63     19    5642831456340753611
1454    CFC  PardiTOS  2011   34.12     19    3219107182492871783
1456    CFC  Pinho_MF  2017   33.62     19    6446080171984989091
1458    C?C  Spielaur  2011   27.58     23    91008005946943131136471
1460    CFC  Be.Nyman  2015   32.97     20    16952841674089990313
1462    CFC  Ritschel  2017   33.61     19    7787601252820494607
1464    CFC  ColeStev  2017   33.37     20    11243131368574587263
1466    CFC  Ritschel  2017   33.73     19    7547190328070365163
1468    CFC  RobSmith  2017   34.00     19    5662789033400271433
1470    CFC  Ritschel  2018   33.39     20    13193289465222402713
1472    C?C  Spielaur  2011   27.87     23    86218359339887747268047
1474    C?C  Spielaur  2016   27.14     24    383125781171409136307917
1476*   CFC  TOeSilva  2009   35.31     19    1425172824437699411
1478    C?C  Spielaur  2016   27.06     24    531003024200344806027041
1480    C?C  Spielaur  2016   27.16     24    461003024868247915125547
1482    CFC  Ritschel  2017   33.69     20    12685915882452557351
1484    C?C  Spielaur  2011   28.18     23    73801917125338389287387
1486    CFC  ColeStev  2017   33.85     20    11596084211508428503
1488*   CFC  ANair_MF  2017   34.45     19    5733241593241196731
1490    CFC  Jacobsen  2017   34.28     19    7562321651334729221
1492    C?C  Spielaur  2016   27.57     24    316129781931380000239027
1494    CFC  ColeStev  2017   34.05     20    11312044110819306577
1496    C?C  Spielaur  2018   28.01     24    157169791076572756411427
1498    C?C  Spielaur  2016   27.44     24    512152024202519512101751
1500    C?C  RobSmith  2019   29.94     22    5770048436461955692099
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1502   CFC Ritschel 2017    34.37    19   9586724781371233277
1504   C?C Spielaur 2018    27.91    24   25316789949009657060949
1506   CFC Ritschel 2018    34.11    20   14950212737555571061
1508   C?C Spielaur 2018    28.53    23   90222023473132140911693
1510*  CFC Jacobsen 2017    34.82    19   6787988999657777797
1512   C?C Spielaur 2018    28.58    23   9430002392855118094019
1514   C?C Spielaur 2016    27.85    24   407157025236974485914323
1516   C?C Spielaur 2018    27.54    24   804129785116002444535417
1518   C?C Spielaur 2018    28.72    23   90878026146410320319899
1520   C?C Spielaur 2018    28.21    24   25316789816132426550317
1522   C?C Spielaur 2018    27.88    24   511125438130918347478759
1524   C?C Spielaur 2016    28.16    24   321118702204796464465487
1526*  CFC ColeStev 2018    34.53    20   15570628755536096243
1528   C?C Spielaur 2018    28.15    24   373125439110289088473021
1530*  CFC Be.Nyman 2014    34.52    20   17678654157568189057
1532   C?C Spielaur 2018    28.03    24   541125437432624695426031
1534   C?C Spielaur 2018    28.10    24   511125438233180134480537
1536   C?C Spielaur 2018    28.31    24   365125479831480440522173
1538   C?C Spielaur 2018    29.10    23   89710026486429798992891
1540   C?C RobSmith 2019    30.96    22   4002619183924011786913
1542   C?C Spielaur 2016    28.39    24   386129781045655719636997
1544   C?C Spielaur 2011    29.21    23   90008005599853798224983
1546   C?C Spielaur 2018    28.09    24   804129785157132937665433
1548   C?C Spielaur 2016    28.61    24   316129781674683983721599
1550*  CFC Be.Nyman 2014    34.94    20   18361375334787046697
1552   C?C Spielaur 2017    28.15    24   876129783640337274493519
1554   C?C Spielaur 2018    29.10    24   156125481875506479892793
1556   C?C Spielaur 2016    28.61    24   413139024725895827274791
1558   C?C Spielaur 2016    27.61    25   3201211026096992172885613
1560   C?C Spielaur 2018    29.21    24   156125482244715684723361
1562   C?C Spielaur 2016    27.67    25   3301311026130755902574909
1564   C?C Spielaur 2018    29.59    23   89710026176773836945217
1566   C?C Spielaur 2017    27.87    25   2513007025963463586387241
1568   C?C Spielaur 2018    28.73    24   50616978578597518312989
1570   C?C Spielaur 2017    28.63    24   654774025979872326628579
1572   C?C Spielaur 2018    28.80    24   511125438041415299421601
1574   C?C Spielaur 2018    29.79    23   88409026124861029148819
1576   C?C Spielaur 2016    26.63    26   50011026000985432236994141
1578   C?C Spielaur 2014    28.98    24   444888024000161880076721
1580   C?C Spielaur 2018    29.89    23   9011023769130809399029
1582   C?C Spielaur 2016    27.84    25   4771561025190978473357407
1584   C?C Spielaur 2011    29.96    23   92008005233975799174049
1586   C?C Spielaur 2018    28.81    24   808129786082486355062717
1588   C?C Spielaur 2018    29.75    24   153125481414651411510001
1590   C?C Spielaur 2016    29.13    24   507139024133574480779581
1592   C?C Spielaur 2016    27.32    26   20383026002229098626547639
1594   C?C TRNicely 2010    27.96    25   5701963804766267176483453
1596   C?C Spielaur 2018    29.23    24   519125479346441609466023
1598   C?C Spielaur 2017    29.15    24   645600025854624019250411
1600   C?C Spielaur 2017    28.99    24   929125470064749912335467
1602   C?C Spielaur 2016    29.55    24   348125468109010265299271
1604   C?C Spielaur 2018    29.83    24   227125476252860770095113
1606   C?C Spielaur 2017    28.23    25   5111827025410880328372583
1608   C?C Spielaur 2017    28.34    25   4417837025271189172082513
1610   C?C Spielaur 2017    28.86    25   1689619025236598760976829
1612   C?C Spielaur 2011    30.49    23   91008005685955879916401
1614   C?C Spielaur 2016    27.28    26   50011026000605167554818833
1616   C?C Spielaur 2016    27.30    26   50503126001280209002157267
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1618   C?C Spielaur 2017   27.08    26    88148378027905948598974153
1620   C?C Spielaur 2016   29.59    24    60155902523666827190837
1622   C?C Spielaur 2017   27.17    26    84523126003293348705947939
1624   C?C Spielaur 2018   30.71    23    93310024192891977362587
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1628   C?C Spielaur 2018   30.81    23    88409025774659694609269
1630   C?C Spielaur 2016   28.29    26    105031260030777899309118
1632   C?C TRNicely 2010   29.75    24    67144287516399011682949
1634   C?C Spielaur 2017   29.67    24    82212546285719512274177
1636   C?C Spielaur 2017   29.14    25    24178370257029970288434
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1648   C?C Spielaur 2016   28.62    26    102340260028783092250867
1650   C?C Spielaur 2016   30.28    24    4610030250231481626670
1652   C?C Spielaur 2016   27.64    26    9052312600113684058614223
1654   C?C Spielaur 2017   29.98    24    90860002515901942341793
1656   C?C Spielaur 2010   29.44    25    26681230005824921194646
1658   C?C Spielaur 2014   28.15    26    38283026000105876456447549
1660   C?C Spielaur 2016   28.16    26    39753026000841430736202739
1662   C?C Spielaur 2016   28.19    26    4050312600171655876899379
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1670   C?C Spielaur 2014   27.35    27    33324529802856263940086135
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1674   C?C Spielaur 2017   28.11    26    7328302600397306710450133
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1678   C?C Spielaur 2016   28.36    26    50148375026035070947338349
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1682   C?C Spielaur 2017   28.18    26    83753026001934316187838497
1684   C?C M.Jansen  2017   28.08    27    11044965469755543811256131
1686   C?C RobSmith  2018   29.00    26    178533220059517115161684
1688   C?C Spielaur 2016   27.88    27    1970215510279756287060267
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1696   C?C Spielaur 2016   28.11    27    16102333702831036563163975
1698   C?C Spielaur 2012   28.64    26    55723122400866082032586
1700   C?C Spielaur 2017   27.86    27    31324569803323088915053052
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1716   C?C Spielaur 2017   28.41    27    16920631303591049758622463
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1732   C?C Spielaur 2018   29.01    26    841996500261608771105184
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1844   C?C Spielaur 2017    30.47    27    19150672903836182548948931
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1848   C?C RobSmith 2018    29.29    28    251897008081142422804829785
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1914   C?C Spielaur 2017   30.13    28   38837811702955336060678422?
1916   C?C Spielaur 2016   30.28    28   30392480000301814348972383?1
1918   C?C Spielaur 2017   30.13    28   43928044502860801600908183?
1920   C?C Spielaur 2016   30.37    28   28442300000308924533603637?3
1922   C?C Spielaur 2017   30.17    28   46112383710297163240773836?1
1924   C?C Spielaur 2017   30.07    28   61012383110316886727053090?9
1926   C?C Spielaur 2015   29.53    29   211244710291013987289888567?7
1928   C?C Spielaur 2017   28.90    29   93777234437033872048058808383
1930   C?C Spielaur 2017   28.93    29   93777234437032666433522975959
1932   C?C Spielaur 2015   29.48    29   29045119029001077581773468231
1934   C?C Spielaur 2017   30.57    28   30015496190293610612383433?9
1936   C?C Spielaur 2016   32.08    27   16102333702799432315208601?
1938   C?C Spielaur 2016   30.16    28   80122390000181151334393114?3
1940   C?C Spielaur 2017   28.13    30   89234083854903185383334951450?
1942   C?C Spielaur 2016   29.90    29   16107428778765313805063526049
1944   C?C Spielaur 2016   30.72    28   30442300000301284055837450?3
1946   C?C Spielaur 2016   30.42    28   61012393110304790077542281?3
1948   C?C Spielaur 2016   29.99    29   16107428778765206909298916249
1950   C?C Spielaur 2017   30.04    29   15600350800200591840837572687
1952   C?C Spielaur 2013   26.78    32   45154861419265032079255464330641
1954   C?C Spielaur 2017   30.69    28   45217773710285735012930310?9
1956   C?C Spielaur 2018   27.98    31   230460731954203249774986621306?
1958   C?C Spielaur 2011   28.53    30   631337750259693153112235938121
1960   C?C Spielaur 2016   30.59    28   66706050400158675594983405?3
1962   C?C Spielaur 2016   29.46    29   83723413734029484073263062011
1964   C?C Spielaur 2014   30.20    29   17361011751029174933335986203
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1966  C?C Spielaur 2016   28.55    30   80145114961103062425436487 3641
1968  C?C Spielaur 2016   30.28    29   16817006514738017659250207459
1970  C?C Spielaur 2013   27.81    31   58872502339040312844723986 60693
1972  C?C Jacobsen 2017   29.64    29   78965098027967495955787825381
1974  C?C Spielaur 2016   30.85    28   61392480000286438820726 89133
1976  C?C Spielaur 2016   30.93    28   55706750400162296185389 21497
1978  C?C Spielaur 2012   30.48    29   15251000000439240915164 391943
1980  C?C Spielaur 2016   30.81    28   80512300000199221378524 68729
1982  C?C Spielaur 2016   30.88    28   75002300000115230344962 81371
1984  C?C RFischer 2016   27.52    32   20282409603651671079340215344953
1986  C?C Spielaur 2017   28.20    31   38092057094180323583375 19745171
1988  C?C Spielaur 2017   28.82    30   91712368791303256116380 5565423
1990  C?C Spielaur 2013   32.20    27   68524529802705541834599 6361
1992  C?C Spielaur 2016   28.93    30   80145114961103024563612 0895591
1994  C?C Spielaur 2016   31.17    28   60213120010282596836265 68699
1996  C?C Spielaur 2010   27.14    32   85982514713000000005643994785767
1998  C?C Spielaur 2017   28.73    31   16112813855203137898023 2272063
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[Additional lists](#) of first known occurrence prime gaps are maintained on this site.

The following additional kilogaps (not first occurrences) were discovered, below 5e16, by Dr. Bertil Nyman (with one overlooked exception, discovered by [Tomás Oliveira e Silva](#)). The gaps in this list, together with the gaps of 1000 or greater in the above list, are believed to include all gaps of 1000 or greater lying below 5e16. The second character "N" in the classification column indicates that these are definitely <u>not</u> first occurrences. All are certified conventional gaps.

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  Gap  Cls Discvrer Year   Merit Digts  Following the prime
============================================================
  1000  CNC Be.Nyman 2001   26.47    17   25595249272424341
  1000  CNC Be.Nyman 2001   26.39    17   28629011113073167
  1000  CNC Be.Nyman 2001   26.32    17   31823517013736431
  1000  CNC Be.Nyman 2002   26.24    17   35470670320988593
  1000  CNC Be.Nyman 2002   26.23    17   36135250678096117
  1000  CNC Be.Nyman 2002   26.21    17   36882315435317557
  1000  CNC Be.Nyman 2002   26.16    17   39958674936070063
  1000  CNC Be.Nyman 2002   26.13    17   41944157573468467
  1000  CNC Be.Nyman 2002   26.07    17   45323711805720487
  1000  CNC Be.Nyman 2002   26.04    17   47534032897345081
  1000  CNC Be.Nyman 2002   26.04    17   47804057785446727
  1002  CNC Be.Nyman 2001   26.56    17   24205807447675771
  1002  CNC Be.Nyman 2001   26.52    17   25540073145914881
  1002  CNC Be.Nyman 2001   26.52    17   25650415492326749
  1002  CNC Be.Nyman 2001   26.43    17   28994175076871317
  1002  CNC Be.Nyman 2002   26.33    17   33819298939289887
  1002  CNC Be.Nyman 2002   26.08    17   48285321959130517
  1002  CNC Be.Nyman 2002   26.06    17   49623447037451437
  1004  CNC Be.Nyman 2000   27.25    16   9960917025524369
  1004  CNC Be.Nyman 2001   26.52    17   27653636170984913
  1004  CNC Be.Nyman 2001   26.44    17   31014759148910297
  1004  CNC Be.Nyman 2002   26.37    17   34117668325273073
  1004  CNC Be.Nyman 2002   26.27    17   39561227332093133
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1004    CNC Be.Nyman 2002    26.15    17    47394134464385393
1004    CNC Be.Nyman 2002    26.13    17    48599214758753039
1006    CNC Be.Nyman 2001    26.34    17    38860190795020207
1006    CNC Be.Nyman 2002    26.32    17    39668119625430451
1006    CNC Be.Nyman 2002    26.26    17    43204462874641381
1006    CNC Be.Nyman 2002    26.26    17    43701230282969011
1008    CNC Be.Nyman 2000    27.13    17    13699073167684661
1008    CNC Be.Nyman 2000    27.05    17    15215879990782973
1008    CNC Be.Nyman 2001    26.68    17    25752061034549021
1008    CNC Be.Nyman 2001    26.66    17    26199868405684403
1008    CNC Be.Nyman 2001    26.55    17    30749317916353451
1008    CNC Be.Nyman 2002    26.43    17    36432701708932051
1008    CNC Be.Nyman 2002    26.36    17    40726545333502159
1008    CNC Be.Nyman 2002    26.34    17    41609910693405563
1008    CNC Be.Nyman 2002    26.31    17    43416655822933579
1008    CNC Be.Nyman 2002    26.25    17    47762273682225451
1010    CNC Be.Nyman 2001    26.64    17    28993025781109937
1010    CNC Be.Nyman 2001    26.62    17    30190277050766891
1010    CNC Be.Nyman 2002    26.50    17    35433701147012603
1010    CNC Be.Nyman 2002    26.41    17    40897155217629551
1010    CNC Be.Nyman 2002    26.34    17    45248261042639549
1012    CNC Be.Nyman 2001    26.68    17    29610479835016411
1012    CNC Be.Nyman 2002    26.50    17    38403638754920209
1012    CNC Be.Nyman 2002    26.37    17    46286557189022401
1014    CNC Be.Nyman 2000    27.24    17    14606010090226363
1014    CNC Be.Nyman 2002    26.53    17    39576352732310687
1014    CNC Be.Nyman 2002    26.49    17    42329881811496703
1014    CNC Be.Nyman 2002    26.46    17    44132204614638103
1014    CNC Be.Nyman 2002    26.42    17    46337133986629439
1016    CNC Be.Nyman 2001    26.60    17    38756248991068211
1016    CNC Be.Nyman 2002    26.46    17    47139760082920283
1018    CNC Be.Nyman 2002    26.62    17    40377635164335499
1018    CNC Be.Nyman 2002    26.53    17    45907165644486541
1020    CNC Be.Nyman 2001    26.95    17    27327900274794137
1020    CNC Be.Nyman 2001    26.87    17    30808037902520647
1020    CNC Be.Nyman 2001    26.83    17    32527997461232479
1020    CNC Be.Nyman 2002    26.80    17    33615066500120311
1020    CNC Be.Nyman 2002    26.67    17    40624127854015639
1020    CNC Be.Nyman 2002    26.67    17    40958706539854291
1020    CNC Be.Nyman 2002    26.62    17    43660628534512111
1020    CNC Be.Nyman 2002    26.62    17    43943832252612433
1020    CNC Be.Nyman 2002    26.57    17    47317406790880003
1022    CNC Be.Nyman 2002    26.63    17    46167071676726149
1024    CNC Be.Nyman 2001    27.05    17    27605430702324427
1024    CNC Be.Nyman 2002    26.74    17    42830075709068503
1024    CNC Be.Nyman 2002    26.68    17    46872829456465279
1026    CNC Be.Nyman 2001    27.23    17    23086519897791131
1026    CNC TOeSilva  2003    27.16    17    25382361249570613
1026    CNC Be.Nyman 2002    26.75    17    45126785735822477
1028    CNC Be.Nyman 2002    27.03    17    32889382083031571
1028    CNC Be.Nyman 2002    26.76    17    48449697954500351
1030    CNC Be.Nyman 2001    27.29    17    24772289265796027
1030    CNC Be.Nyman 2001    27.28    17    24923219403724231
1030    CNC Be.Nyman 2002    27.01    17    36249320156013301
1030    CNC Be.Nyman 2002    26.99    17    37255746206822929
1032    CNC Be.Nyman 2001    27.44    17    21446006399971841
1036    CNC Be.Nyman 2002    27.16    17    36908796640537957
1038    CNC Be.Nyman 2002    27.27    17    33832181549131129
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1038   CNC Be.Nyman 2002   27.18    17   38278044950622511
1040   CNC Be.Nyman 2002   27.06    17   49434138149438219
1042   CNC Be.Nyman 2002   27.22    17   42084539343243211
1044   CNC Be.Nyman 2001   27.70    17   23418901791860149
1044   CNC Be.Nyman 2001   27.55    17   28691351954678047
1044   CNC Be.Nyman 2002   27.36    17   37262207402572609
1044   CNC Be.Nyman 2002   27.19    17   47388635802622937
1044   CNC Be.Nyman 2002   27.17    17   48425839138502953
1044   CNC Be.Nyman 2002   27.15    17   49932966721269389
1046   CNC Be.Nyman 2002   27.35    17   40792193275354607
1050   CNC Be.Nyman 2001   27.75    17   27270049287533093
1050   CNC Be.Nyman 2001   27.72    17   28266777591970859
1050   CNC Be.Nyman 2002   27.44    17   41280978711324553
1050   CNC Be.Nyman 2002   27.37    17   45856086057270571
1054   CNC Be.Nyman 2002   27.42    17   49705923985791859
1058   CNC Be.Nyman 2002   27.63    17   42491913045456131
1062   CNC Be.Nyman 2001   28.01    17   29228210437894229
1062   CNC Be.Nyman 2002   27.74    17   42079111699533971
1062   CNC Be.Nyman 2002   27.74    17   42135469324106969
1098   CNC Be.Nyman 2002   28.91    17   31241326305775211
1098   CNC Be.Nyman 2001   28.88    17   32373474258793079
1100   CNC Be.Nyman 2001   29.02    17   28907866922785967
1106   CNC Be.Nyman 2001   29.13    17   30742387342787777
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