BUREAU INTERNATIONAL DES POIDS ET MESURES

BIPM Annual Report on Time Activities

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Contents

Practical information about the BIPM Time Department

The BIPM Time Department issues three periodic publications. These are: UTCr (weekly), *Circular T* (monthly) and the *BIPM Annual Report on Time Activities*.

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BIPM Time Department

Director: E.F. Arias

(1 January 2015 to 31 December 2015)

1. International Atomic Time (TAI), Coordinated Universal Time (UTC) and Rapid UTC (UTCr)

(E.F. Arias, A. Harmegnies, Z. Jiang, H. Konaté, G. Panfilo, G. Petit and L. Tisserand)

The reference time scales, International Atomic Time (TAI) and Coordinated Universal Time (UTC), are computed from data reported regularly to the BIPM by the various timing centres that maintain a local UTC; monthly results are published in *Circular T*. The UTC rapid solution (UTCr) is published every Wednesday at 18 h UTC at the latest. All information related to the publication of UTC and UTCr can be accessed at www.bipm.org/en/scientific/tai/ftp_server/introduction.html.

The *BIPM Annual Report on Time Activities for 2014*, volume 9, provides the definitive results for 2014 and is available on the BIPM website at www.bipm.org/en/bipm/tai/annual-report.html.

2. Algorithms for time scales (G. Panfilo, G. Petit, A. Harmegnies, L. Tisserand and F. Parisi[1])

The algorithm used to calculate the time scales by the Time Department is an iterative process that starts by producing a free atomic scale (*Échelle atomique libre,* EAL) from which TAI and UTC are derived. Research into time-scale algorithms is ongoing in the department, with the aim of improving the long-term stability of EAL and the accuracy of TAI.

After the implementation of the new weighting algorithm, based on the concept of clock frequency predictability, the behaviour of UTC is routinely and carefully monitored to trap and fix unexpected anomalies although none were observed throughout the year. An improvement in the short- and long-term stability of EAL is already visible after the application of the new weighting algorithm.

Within the framework of a six month placement with a student from the University of Torino (Italy), which began in 2014, the use of the Kalman Filter (a very powerful statistical tool) has been tested to build an independent time scale. The results are very promising and encouraging for its continued investigation and development for its application in UTC.

The revision of the algorithm for the calculation of the uncertainties reported in Section 1 of *Circular T* is in progress. The current algorithm underestimates the uncertainty values for the pivot laboratory (at present PTB) because correlations have not been fully considered. The result of the revision study was presented at the 20th meeting of the CCTF, and the implementation of the new algorithm, which will provide the correct uncertainty estimations, is expected within the next 2 years.

2.1 EAL stability

Some 87 % of the clocks used in the calculation of UTC are either commercial atomic clocks with high performance caesium tubes or active hydrogen masers. The number of hydrogen masers operated at the participating laboratories has increased by 24 % in the last two years, without any significant increase in the number of caesium standards. The weighting procedure involved in the time scale computation guarantees the long-term stability of EAL. To prevent domination of the scale by a small number of very stable clocks, a

[1] Department of Mathematics, University of Torino, Italy, on a six-month secondment from 1 November 2014

maximum relative weight is used each month which depends on the number of participating clocks. On average, about 11 % of the participating clocks were at the maximum weight during 2015; almost all of these were hydrogen masers. The new weighting algorithm, based on the predictability of the clock's frequency, enhanced the influence of the hydrogen masers on the resulting time scale; 40 % of the contributing hydrogen masers were, on average, at the maximum weight in 2015, whilst only 0.1 % of the caesium clocks reached the maximum weight.

UTC implicitly relies on the hydrogen masers in the short term and on caesium clocks in the long term, which was an aim of the new weighting procedure. The stability of EAL at the end of 2015, expressed in terms of an Allan deviation, is about three parts in 10^{16} for averaging times of one month.

2.2 TAI accuracy

To characterize the accuracy of TAI, estimates are made of the relative departure, and its uncertainty, of the duration of the TAI scale interval from the SI second, as produced on the rotating geoid, by primary and secondary frequency standards. Since January 2015, individual measurements of the TAI frequency have been provided by thirteen primary frequency standards, including eleven caesium fountains (SYRTE FO1, SYRTE FO2, NIST F1, NIST F2, IT CSF2, SU CSFO2, NPL CSF2, PTB CSF1, PTB CSF2, NPLI CSF1 and NIM 5), and by a rubidium secondary frequency standard (SYRTE FORb). Reports of the operation of the primary and secondary frequency standards are regularly published on the BIPM website and collated in the *BIPM Annual Report on Time Activities*.

Since January 2015, the global treatment of individual measurements has led to a relative departure of the duration of the TAI scale unit from the SI second on the geoid ranging from $+0.83 \times 10^{-15}$ to -0.44×10^{-15}, with a maximum standard uncertainty of 0.39×10^{-15}. No steering correction has been applied since October 2012, confirming that the new algorithm maintains a positive impact on the accuracy of TAI.

2.3 Independent atomic time scales: TT(BIPM)

TAI is computed in 'real-time' and is subject to operational constraints; as a result it does not provide an optimal realization of TT, the time coordinate of the geocentric reference system. The BIPM therefore computes an additional realization, TT(BIPM), in post-processing, which is based on a weighted average of the evaluation of the TAI frequency by the primary frequency standards. The Time Department provided an updated computation of TT(BIPM) in January 2015, known as TT(BIPM14), valid until December 2014, which had an estimated accuracy of about 2-3 parts in 10^{16} over recent years. Moreover, the Time Department provides a formula to extend TT(BIPM14) based on the most recent TAI computation. Such an extension is useful for pulsar analysis pending the yearly updates of TT(BIPM). Studies to improve the computation of TT(BIPM) are ongoing, in order to keep it in line with improvements in the primary and secondary frequency standards.

2.4 Local representations of UTC in national laboratories as broadcast by the GNSS

The Time Department continues to calculate and publish the differences between the predictions of UTC(USNO) and UTC(SU) (as broadcast by GPS and GLONASS) and UTC in BIPM *Circular T*. As a consequence of the alert made by the BIPM on the offset of GLONASS time and the broadcast prediction of UTC(SU) with respect to UTC, work has been developed with the VNIIFTRI, Russian Federation, and the GLONASS authorities on the absolute calibration of a BIPM receiver.

3. Primary frequency standards and secondary representations of the second (E.F. Arias, G Panfilo, G. Petit and L. Robertsson)

Members of the BIPM Time Department actively participate in the work of the CCL-CCTF Frequency Standards Working Group (WGFS), and the Consultative Committee for Time and Frequency (CCTF) Working Group on Primary and Secondary Frequency Standards (WGPSFS). These Working Groups seek to encourage comparisons, knowledge-sharing between laboratories, the creation of better documentation, the use of high-accuracy primary frequency standards (Cs fountains) and secondary frequency standards for TAI.

The WGFS maintains a list of recommended values of standard frequencies for applications including secondary representations of the second. Updates of frequency values and their respective uncertainties for secondary representations of the second in the list have been recommended by the CCTF in September 2015, and have been adopted by the CIPM in Recommendation 2 (CI-2015).

Secondary representations of the second reported in BIPM Circular T

Since January 2012 the LNE-SYRTE has reported frequency measurements of the Rb microwave transition obtained with a double Cs-Rb fountain (FORb). Twelve measurement reports of FORb were submitted in 2015 and have been officially used for the accuracy of TAI.

4. Time links used for UTC (E.F. Arias, A. Harmegnies, Z. Jiang, H. Konaté, G. Panfilo, G. Petit, L. Tisserand, and W. Wenjun[2])

At the end of 2015, 74 time laboratories supplied data for the calculation of UTC at the BIPM. The laboratories are equipped with GNSS receivers and some of them also operate two-way satellite time and frequency transfer (TWSTFT) stations.

Data from three independent techniques are included in the process of comparison of laboratories' clocks based on tracking GPS and GLONASS satellites, and TWSTFT.

The GPS all-in-view method is widely used and takes advantage of the increasing quality of the International GNSS Service (IGS) products (clocks and IGS time). Clock comparisons for UTC are implemented using C/A code measurements from GPS single-frequency receivers, or dual-frequency, multi-channel GPS geodetic-type receivers (P3). The GPS phase and code data provided by time laboratories which operate geodetic-type receivers is processed each month using the Precise Point Positioning (PPP) technique. The Time Department also regularly computes combined GPS/GLONASS links resulting in improved link uncertainty. About five GPS/GLONASS links are regularly computed for *Circular T*.

Nine laboratories operate TWSTFT stations and officially submit data for use in the computation of UTC, representing 8 % of the time links. No TWSTFT contributions from the laboratories in the Asia-Pacific region were possible in 2015 due to an interruption of the satellite service. The combination of TWSTFT and PPP (so called TWPPP) has been used whenever possible. This combination takes advantage of the small noise of the GPSPPP and of the accuracy of the TWSTFT links.

GPS PPP alone or in combination with TWSTFT are in use for UTC clock comparisons in almost 60 % of the links, where the statistical uncertainty of time transfer is well below the nanosecond, the best value is 0.3 ns for 51 % of the time links.

4.1 Global Positioning System (GPS) and Global Navigation Satellite System (GLONASS)

All GNSS time and frequency transfer data are corrected for satellite positions using IGS and the Information and Analysis Centre of Navigation (IAC) of the Mission Control Centre in Russia. The measurement data

[2] Chinese Academy of Sciences, NTSC (Xi'an, China), on a one-year secondment starting 3 June 2014

obtained by using single-frequency receivers are corrected for ionospheric delays using maps of the total electron content of the ionosphere provided by the Centre for Orbit Determination in Europe (CODE).

Techniques that use dual-frequency, GNSS carrier-phase measurements in addition to the codes, are widely used by the geodetic community and have been adapted to the needs of time and frequency transfer. This topic is studied within the framework of the IGS Working Group on Clock Products, which has a physicist from the Time Department as a member.

Data from world-wide geodetic-type receivers are collected for UTC computation, using procedures and software developed in collaboration with the Observatoire Royal de Belgique (ORB). These P3 time links are routinely computed and compared to other available techniques, notably two-way time transfer. The software producing iono-free has been implemented in some receivers, and these now automatically produce both formatted GPS and GLONASS P3 code results. These newly available data will be used in multi-GNSS system time links, but further studies on GLONASS inter-frequency biases have to be carried out first.

The NRCan's PPP software is used for the time link calculation. The current version of the software is capable of processing both GPS and GLONASS data but only GPS results are used operationally. Comparisons with other PPP software have been carried out. Studies are continuing to improve long-term stability, using new processing techniques, in collaboration with software developers at NRCan, the ORB, the *Centre National d'Études Spatiales* (CNES) and also with other institutes. A novel PPP technique using integer phase ambiguities (IPPP) has been successfully developed within the framework of a post-doctoral project. It significantly improves the stability in the medium term (several hours) and mostly in the long term (days). In 2015 the IPPP technique moved to a pre-operational stage and it is used regularly to compare IPPP results to the few available optical fibre links.

Comparisons of the different possible links on a baseline linking two contributing laboratories are computed and published monthly on the Time Department's ftp server.

4.2. Two-way satellite time and frequency transfer

One meeting of the TWSTFT participating stations was held during 2015 at the IFCS/EFTF meeting in Denver, USA, on 12-16 April. The 23rd annual meeting of the CCTF WG on TWSTFT was held at the BIPM on 7-8 September 2015. The outcomes of these meetings that impact the Time Department's activities are: the approval and implementation of TWSTFT Calibration Guidelines; and the organization of calibration trips between TW stations, where the BIPM is charged with the validation of the reports and introduction of the calibration parameters in the calculation of UTC. The BIPM is also involved in the calibration of two-way time-transfer links by comparison with the corresponding GPS links. This is necessary to maintain stability of the TWSTFT links, in case of a loss of their direct calibration.

The TWSTFT technique is currently operational in eleven European, two North American and nine Asia-Pacific time laboratories. Eight TWSTFT links had been used in the computation of UTC in 2015; they are combined with GPS PPP solutions. Due to the interruption of the satellite service, no TW data contribution from institutes in the Asia-Pacific region had been possible during the year. Some of the TWSTFT links involved in the computation of UTC are used in the experiment 'Time Transfer by Laser Link' (T2L2). The BIPM aims to develop studies on this technique, which could be used to validate less accurate time links and their calibrations.

Campaigns with a travelling calibration station were organized and funded by the participating laboratories in 2015. The parameters obtained have been implemented for UTC computation following validation of the results by the Time Department.

Results of the time links and link comparison using GNSS single-frequency, dual-frequency and TW observations are published monthly on the Time Department's ftp server (ftp://ftp2.bipm.org/pub/tai/publication/timelinks/lkc/).

4.3 Calibration of delays of time-transfer equipment and time links

The characterization of the delays (so-called “calibration”) of time transfer equipment in the contributing laboratories is necessary to improve the uncertainty of [*UTC-UTC*(*k*)] and for the accuracy of UTC dissemination.

Following a recommendation by the CCTF, the Time Department has issued the *BIPM Guidelines for GNSS calibration*. This document is intended for Regional Metrology Organizations (RMOs) and establishes a permanent cooperation for sharing the organization of campaigns to determine the relative delays of time transfer equipment and links in UTC contributing laboratories. The *Guidelines* are under continuous improvement, and this has led to a revised edition of the *Guidelines* being produced in September 2015.

In 2015 the BIPM concluded the first calibration campaign to the “Group 1” laboratories in APMP, EURAMET, SIM and COOMET, and expects that regional calibration trips to “Group 2” laboratories will be implemented in 2016 by the RMOs in accordance with the *BIPM Guidelines*. By repeatedly applying this new procedure time transfer accuracy is expected to improve by a factor of 2.

The BIPM Time Department is not directly involved in specific TWSTFT calibration trips, but is responsible for the validation of the calibration reports and implementation of the results in the calculation of UTC. It also provides support whenever necessary to maintain a TW calibration by alignment with a calibrated GPS link (see section 4.2).

Results of the differential calibration exercises are made available on a dedicated web page (www.bipm.org/jsp/en/TimeCalibrations.jsp), where past calibration results are also provided.

The Guidelines for TWSTFT link calibration, elaborated by the CCTF WG on TWSTFT, were approved at the 20th meeting of the CCTF in September 2015.

4.4 Advanced time and frequency transfer

Data from two fibre links between UTC contributing laboratories in Europe are regularly submitted and compared with the corresponding links by GNSS time transfer techniques. The aim of the Time Department is to include the fibre links in the computation of UTC in the future, and in this direction the CCTF WG on Coordination of the Development of Advanced Time and Frequency Transfer Techniques (WGATFT) has established a study group to develop the strategy for the use of these very accurate links in UTC. The terms of reference of this study group include the establishment of standards for data transmission and the validation of the compatibility of the different techniques.

5. **Key comparisons** (E.F. Arias, H. Konaté, G. Panfilo, A. Harmegnies and L. Robertsson)

Key comparison in Time CCTF-K001.UTC

Results of the key comparison in time, CCTF-K001.UTC, involving the time laboratories participating in the CIPM MRA, have been published monthly in the BIPM key comparison database (KCDB) since March 2015.

Key comparison of stabilized lasers CCL-K11

Following a decision at the 98th meeting of the CIPM in 2009 the BIPM continues to support the CCL-K11 key comparison by participating in measurement campaigns and by providing general advice whenever solicited. This comparison is the internationally recognized traceability chain to the SI metre and is supervised by the CCL. In 2015, BIPM staff supported the key comparison on issues relating to the development of the measurement campaigns and reporting.

6. **Rapid UTC** (A. Harmegnies, G. Panfilo, G. Petit and L. Tisserand)

Since January 2013 the Time Department has published a UTC rapid solution 'UTCr', that is, daily values of [*UTCr* – *UTC*(*k*)] evaluated on a weekly solution on one-month batches of data. About 48 laboratories that are traceable to UTC contribute to UTCr, together representing 60 % to 70 % of the clocks participating in UTC.

UTCr attained the expected quality, providing a weekly solution which is consistent within 1.1 ns RMS and ±3 ns peak to peak with the values published monthly in BIPM *Circular T*. The results (ftp://tai.bipm.org/UTCr) have been published every Wednesday, without interruption since the end of February 2012.

UTCr does not change the procedures for the monthly calculation of UTC, which remains the only key comparison on time. However, UTCr favourably impacts on the quality of the local representations UTC(k) in national laboratories, and on the steering of GNSS times to UTC via some UTC(k).

7. **New proposed definition of UTC** (F. Arias)

The BIPM has actively participated in discussions about a possible redefinition of UTC without leap seconds since 2000. This proposal favours systems that require precise time synchronization and does not allow a discontinuity in the time scale that they use as a reference.

The BIPM contributed to this process at the International Telecommunication Union (ITU), and participated in the World Radiocommunication Conference held in Geneva, Switzerland, from 2-27 November 2015 (WRC15). A resolution of the WRC15 stresses the responsibility of the BIPM on the definition and maintenance of the reference time scale, and of the ITU on its dissemination by time signals and frequency services. The resolution also recommends strengthening the cooperation that the ITU has with the BIPM and other international organizations and delaying the decision on the adoption of a continuous reference time scale until WRC23. In the meantime, further studies are to be developed on the impact of possible reference time scales.

8. **Pulsars** (G. Petit)

Collaboration continues with radioastronomy groups that observe pulsars and which analyse pulsar data to study the possibility of using millisecond pulsars as a means of sensing the very long-term stability of atomic time. The Time Department provides these groups with its post-processed realization of Terrestrial Time, TT(BIPM). Additionally it participates in a Working Group on pulsars and time scales established by the International Astronomical Union (IAU).

9. **Space-time references** (E.F. Arias and G. Petit)

Activities related to the realization of reference frames for astronomy and geodesy are ongoing in cooperation with the International Earth Rotation and Reference Systems Service (IERS). In these domains, improvements in accuracy will increase the need for a full relativistic treatment and it is essential to continue to participate in international working groups in this field.

Cooperation continues on the maintenance of the international celestial reference system within the framework of the activities of a working group created by the IAU in August 2012. This working group met within the period, and submitted a report on the features of the next realization of the International Celestial Reference Frame (ICRF3) to the IAU General Assembly held in Honolulu, USA, in August 2015, with a view to the submission of the catalogue with the set of coordinates in ICRF3 in 2018.

As part of its participation in the Conventions Centre of the IERS, the BIPM maintains the web and ftp sites for the *IERS Conventions* (http://tai.bipm.org/iers/). The Conventions describe the latest realizations of the celestial and terrestrial reference frames, and the model for the transformation between them. They also describe conventional models for the gravitational field, the displacement of markers on the Earth's crust and for the propagation of electromagnetic signals. In addition, the *Conventions* now provide a complete set of associated conventional software. Since the completion of the latest reference edition, *IERS Conventions* (2010) in December 2010, work is continuing with the help of an Editorial Board to provide updates to the *Conventions* (2010) which are posted on the website (http://tai.bipm.org/iers/convupdt).

10. **Comb activities** (L. Robertsson)

The BIPM comb activities are limited to the maintenance of the BIPM frequency comb for internal use related to laser applications only and in other departments when needed.

11. Publications

External publications

1. Fey A, Arias E.F., *et al*., The second realization of the International Celestial Reference Frame by Very Long Baseline Interferometry, *Astron. J.*, 2015, **150**, 58.
2. Petit G., Arias F., Panfilo G., International atomic time: Status and future challenges, *Comptes Rendus Physique*, 2015, **16**(5), 480-488.
3. Jiang Z., Czubla A., Nawrocki J., Lewandowski W., Arias E.F., Comparing a GPS time link calibration with optical fibre self-calibration with 200 ns accuracy, *Metrologia*, 2015, **52**(2), 384-391.
4. Defraigne P., Petit G., CGGTTS-V2E: an upgraded standard for GNSS Time Transfer, *Metrologia*, 2015, **52**(6), G1.
5. Petit G., Conventional reference systems, models and parameters for space geodesy, in *Encyclopedia of Geodesy*, E. Grafarend Editor, Springer, to be published.
6. Petit G., Arias E.F., Panfilo G., International atomic time: Status and future challenges, *Comptes Rendus de Physique*, 2015, **16**(5), 480-488.
7. Petit G., Kanj A., *et al*., 1×10^{-16} frequency transfer by GPS PPP with integer ambiguity resolution, *Metrologia*, 2015, **52**(2), 301-309.
8. Luzum B., Petit G., *et al*., IAU Working Group for Numerical Standards of Fundamental Astronomy (NSFA): Past Efforts and Future Endeavors, *IAU General Assembly*, 2015.
9. Jiang Z, Czubla A, Nawrocki J, Lewandowski W and Arias F (2015), Comparing a GPS time link calibration to an optical fibre self-calibration with 200 ps accuracy, *Metrologia*, 2015, **52**(2), 384-391.
10. Jiang Z. (2015) Link calibration or receiver calibration for accurate time transfer? *Proc. EFTF/IFCS2015*, April, Denver, US
11. Yao J., Skakun I., Jiang Z. and Levine J. A Detailed Comparison of Two Continuous GPS Carrier-Phase Time Transfer Techniques, *Metrologia,* 2015, **52**(5), 666-676.
12. Matsakis D., Jiang Z. Wu W (2015) Carrier Phase and Pseudo-range Disagreement as Revealed by Precise Point Positioning Solutions, *Proc. EFTF/IFCS2015*, April, Denver, US.

13. Esteban H., Galindo J., Bauch A., Polewka T., Cerretto G., Costa R., Whibberley P., Uhrich P., Chupin B., Jiang Z. (2015) GPS Time Link Calibrations in the Frame of EURAMET Project 1156, *Proc. EFTF/IFCS2015*, April, Denver, US.

BIPM publications

14. *BIPM Annual Report on Time Activities for 2014*, 9, 131 pp., available only at http:// http://www.bipm.org/en/bipm/tai/annual-report.html.

15. *Circular T* (monthly), 8 pp.

16. *Rapid UTC* (*UTCr*) (weekly), 1 pp.

12. Activities related to the work of Consultative Committees

E.F. Arias is Executive Secretary of the Consultative Committee for Time and Frequency (CCTF). She is the Secretary of the CCTF Working Group on TAI (WGTAI) and the CCTF Working Group on Strategic Planning (WGSP).

Z. Jiang is Secretary of the CCTF Working Group on TWSTFT (WGTWSTFT).

G. Panfilo is Secretary of the CCTF Working Group on the CIPM MRA (WGMRA) and the CCTF Working Group on Time Scale Algorithms (WG-ALGO). She has been appointed in November 2015 Secretary of the Consultative Committee for Acoustics, Ultrasound and Vibration (CCAUV).

G. Petit is Secretary of the CCTF Working Group on Primary and Secondary Frequency Standards (WGPSFS) and the Working Group on Global Navigation Satellite Systems (WGGNSS).

L. Robertsson is Executive Secretary of the Consultative Committee for Length (CCL), a member of the CCL Working Group on Strategic Planning (WG-S) and of the Discussion Group DG-11 (Lasers). He is the BIPM representative on the CCM Working Group on Gravimetry (WGG). He is also Secretary for the CCTF WG on Coordination of the Development of Advanced Time and Frequency Transfer Techniques (WGATFT) and shares the secretariat of the CCL-CCTF Frequency Standards WG (WGFS) with E.F. Arias.

13. Activities related to external organizations

E.F. Arias is a member of the IAU and participates in its working group on the International Celestial Reference Frame (ICRF); she had been vice-president of Commission 31 (Time) until mid-2015, when the IAU put in place a new set of commissions. She has been elected a member of the Steering Committee of IAU Division A on Fundamental Astronomy and a member of the Division A Working Group on the Third Realisation of the International Celestial Reference Frame. She is an associate member of the IERS, a member of its International Celestial Reference System Centre, and of the Conventions Centre. E.F. Arias is a member of the International VLBI Service (IVS). She is the BIPM representative to the Governing Board of the International GNSS Service (IGS). She is the BIPM representative to the UN sponsored International Committee on GNSS (ICG) and the chairperson of its Task Force on Time References. E.F. Arias is a member of the IAG Global Geodetic Observing System (GGOS) Steering Committee representing the BIPM. She is a member of the Argentine Council of Research (CONICET) and an associate astronomer at the LNE-SYRTE, Paris Observatory. She is a corresponding member of the *Bureau des longitudes* and the BIPM representative to the Working Party 7A of Study Group 7 of the International Telecommunication Union – Radiocommunication Sector (ITU-R).

G. Petit is co-director of the Conventions Centre of the IERS. He is an associate member of the IGS and member of the IGS Working Groups on Clock Products and on Bias Calibration. He is a member of the IAU Working Groups on Numerical Standards in Fundamental Astronomy and on Pulsar Time Scale.

G. Panfilo collaborates with the Joint Committee for Guides in Metrology (JCGM) Working Group 1 (WG1) on the Expression of Uncertainty in Measurement (GUM) to provide a section on uncertainty of time measurements for the new version of the GUM.

14. Travel in 2015 (conferences, lectures and presentations, visits)

E.F. Arias to:

- Paris (France), 29 January, for the Journée GNSS et Science at the CNES, with an invited lecture;
- Vienna (Austria), 17-18 March, for the meeting of the EURAMET Technical Committee on Time and Frequency for coordinating on GNSS calibrations and presenting the Time Department activities;
- Geneva (Switzerland), 23 March to 1 April, for the 2nd Conference Preparatory Meeting for the ITU World Radiocommunication Conference 2015;
- Gran Canaria (Spain), 18-20 May, for the URSI Atlantic Radio Science Conference, to chair a session and make a presentation, and to participate to the business meeting of URSI Commission A;
- Geneva (Switzerland), 20-26 May, for the meeting of the Working Party 7A at the ITU;
- Bordeaux (France), 16 June, for a PhD dissertation, acting as rapporteur and member of the jury;
- Saint Mandé (France), 17 June, to the Journée Scientifique de l'IGN;
- Honolulu (Hawaii, USA), 4-14 August, for the IAU General Assembly 2015, for the relevant commission and working group meetings, including presentations and reports;
- London (UK), 28 October, for the Workshop on UTC Traceability to the Financial Sector, with an invited lecture;
- CCTF and associated meetings.

Z. Jiang to:

- Xian (China), 13-15 May, for the China Satellite Navigation Conference 2015;
- Beijing (China), May, for a visit to NIM gravity and time laboratories;
- Xian (China), May, for a visit to NTSC time laboratory;
- Denver (Colorado, USA) 13-17 April, to attend the FCS/EFTF 2015 and the TWSTFT Participation Stations meeting;
- CCTF and associated meetings.

G. Panfilo to:

- Turin (Italy), 16-21 April, for the master's degree panel for Federica Parisi, and for planning future work in collaboration between the BIPM Time Department and the Department of Mathematics at the University of Turin;
- CCTF and associated meetings.

G. Petit to:

- Paris (France), 29 January, to attend the "Journée GNSS et science";
- Denver (Colorado, USA) 13-17 April, to attend the FCS/EFTF 2015 meeting, to give three oral presentations, and to attend two CCTF WG meetings;
- Besançon (France), 30 June-1 July, to give two lectures at the European Frequency and Time Seminar;

- Prague (Czech Republic), 24-27 June, to attend the UGGI General Assembly, with one invited presentation;
- Potsdam (Germany), 12-14 October, for the 8th Symposium on frequency standards and metrology, with one presentation;
- Boulder (Colorado, USA), 2-6 November, for the tenth meeting the International Committee on GNSS (ICG), with chair of task force and presentations;
- Toulouse (France), 18-19 November, for the GRGS Workshop G2 with a presentation, and for discussions with the CNES/CLS groups on the IPPP technique;
- Bern (Switzerland), 30 November-1 December, for the ISSI workshop HISPAC, with an invited presentation;
- CCTF and associated meetings.

15. Visitors, secondees

- W. Wu (NICT, Chinese Academy of Sciences) on a one-year secondment starting on 3 June 2014, for activities on time transfer and calibration;
- F. Parisi from the University of Torino (Italy) to study an independent time scale based on the Kalman Filter, 1 November 2014 – 6 March 2015, 1-30 June 2015 and 1-18 September 2015;
- S. Zagier from Zagier and Urruty Publications for discussions on the historical evolution of clocks, 23 April 2015;
- J. Park and S.H. Hong (KRISS, Republic of Korea) for a visit to the Time Department and laboratory, 20 July 2015;
- Long-Sheng Ma from the East China Normal University (China) for discussions on optical metrology, 9-13 September 2015;
- P. Gabor from the Vatican Observatory for discussions on time scales for astronomy, 5 October 2015;
- K. Madanipour, A.M. Levi and O. Masoudi (Iran) for a visit to the Time Department and laboratory, 23 October 2015;
- D. Rovera (LNE-SYRTE) for the QMS external audit of the Time Department, 10 December 2015.

Access to electronic files on the FTP server of the BIPM Time Department.

The files related to BIPM Time Activities are available from the website.
(http://www.bipm.org/en/bipm-services/timescales/time-ftp.html)

The files are found in the four subdirectories **data**, **publications**, **scales and links**.
Data, **publications** and **scales** are available by ftp (62.161.69.5 or ftp2.bipm.org, user anonymous, e-mail address as password, cd pub/tai).

Links is available by ftp (62.161.69.131 or tai.bipm.org, user anonymous, e-mail address as password, cd TimeLink/LkC).

Data - Reports of evaluation of primary and secondary frequency standards and all clock and time transfer data files used for the computation of TAI, arranged in yearly directories.
See readme.txt for details.

Rapid UTC - From February 2012 until June 2013 results of the Pilot Experiment on Rapid UTC (UTCr). Starting in July 2013 official results of Rapid UTC (UTCr).

Publications - the latest issues on time activities.

In the following directories XY represents the last two digits of the year number (19XY or 20XY); WW represents the week number in the year, ZT represents the month number in the year (01-12) except until 1997 when Z represents the two-month interval of TAI computation (Z =1 for Jan.-Feb., 2 for Mar.- Apr., etc…); XX, XXX are ordinal numbers.

publications	**filename**
Acronyms of laboratories	acronyms.pdf
Leap seconds	leaptab.pdf
UTCr	UTCr_XYWW
Circular T	cirt.XXX
Circular T HTML	cirt.XXX
Fractional frequency of EAL from primary and secondary frequency standards	etXY.ZT
Weights of clocks participating in the computation of TAI	wXY.ZT
Rates relative to TAI of clocks participating in the computation of TAI	rXY.ZT
Frequency drifts of clocks participating in the computation of TAI	dXY.ZT
Daily values of the differences between UTCr and its local representation by the given laboratory	UTCr - lab
Values of the differences between TAI and the local atomic scale of the given laboratory, including relevant notes	TAI - lab
Values of the differences between UTC and its local representation by the given laboratory including graphics and relevant notes	UTC - lab
Relations of UTC and TAI with predictions of UTC(k) disseminated by GNSS and with the GNSS times	UTC - gnss

Scale- time scales data

Content	filename
Time Dissemination Services	TIMESERVICES.PDF
Time Signals	TIMESIGNALS.PDF
Rates of clocks contributing to TAI	RTAIXY.ar
Weights of clocks contributing to TAI	WTAIXY.ar
Drifts of clocks contributing to TAI	DTAIXY.ar
TT(BIPMXY) computation ending in 19XY or 20XY	TTBIPM.XY
Difference between the normalized frequencies of EAL and TAI	EALTAIXY.ar (starting 1993)
Measurements of the duration of the TAI scale interval	UTAIXY.ar (starting 1995)
Mean fractional deviation of the TAI scale interval from that of TT duration of TAI scale interval	SITAIXY.ar (starting 2000)
Relations of UTC and TAI with GPS and GLONASS system times, and also with the predictions of UTC(*k*) disseminated by GNSS	UTCGPSGLOXY.ar (starting January 2011)

Links - Results of link comparison, arranged in yearly directories, starting January 2005. See readme.txt for details.

Results of Rapid UTC Pilot Project since February 2012 until June 2013 **Rapid UTC**

Older files can be accessed directly from the ftp site (62.161.69.5 or ftp2.bipm.org).

Any comments or queries should be sent to: tai@bipm.org

Leap seconds

Since 1 January 1988, the maintenance of International Atomic Time, TAI, and of Coordinated Universal Time, UTC (with the exception of decisions and announcements concerning leap seconds of UTC) has been the responsibility of the International Bureau of Weights and Measures (BIPM) under the authority of the International Committee for Weights and Measures (CIPM). The dates of leap seconds of UTC are decided and announced by the International Earth Rotation and Reference Systems Service (IERS), which is responsible for the determination of Earth rotation parameters and the maintenance of the related celestial and terrestrial reference systems. The adjustments of UTC and the relationship between TAI and UTC are given in Tables 1 and 2 of this volume.

Further information about leap seconds can be obtained from the IERS:

IERS Earth Orientation Centre
Dr Christian Bizouard
Observatoire de Paris
61, avenue de l'Observatoire
75014 Paris, France

Telephone: + 33 1 40 51 23 35
Telefax: + 33 1 40 51 22 91
iers@obspm.fr
http://hpiers.obspm.fr
Anonymous ftp://hpiers.obspm.fr or ftp://145.238.203.2/

Establishment of International Atomic Time and of Coordinated Universal Time

1. Data and computation

International Atomic Time (TAI) and Coordinated Universal Time (UTC) are obtained from a combination of data from more than 500 atomic clocks operated by more than 70 timing centres which maintain a local UTC, UTC(*k*) (see Table 3). The data are in the form of time differences [*UTC*(*k*) - *Clock*] taken at 5 day intervals for Modified Julian Dates (MJD) ending in 4 and 9, at 0 h UTC; these dates are referred to here as “standard dates”. The equipment maintained by the timing centres is detailed in Table 4.

An iterative algorithm produces a free atomic time scale, EAL (Échelle Atomique Libre), defined as a weighted average of clock readings. The processing is carried out and, subsequently, treats one month batches of data. The weighting procedure and clock frequency prediction [1, 2] are chosen such that EAL is optimized for long-term stability. No attempt is made to ensure the conformity of the EAL scale interval with the second of the International System of Units (SI).

2. Accuracy

The duration of the scale interval of EAL is evaluated by comparison with the data of primary frequency caesium standards and secondary frequency standards recommended for secondary representations of the second, correcting their proper frequency as needed to account for known effects (e.g. general relativity, blackbody radiation). TAI is then derived from EAL by adding a linear function of time with an appropriate slope to ensure the accuracy of the TAI scale interval. The frequency offset between TAI and EAL is changed when necessary to maintain accuracy, the magnitude of the changes being of the same order as the frequency fluctuations resulting from the instability of EAL. This operation is referred to as the “steering of TAI”. Table 5 gives the normalized frequency offsets between EAL and TAI. Measurements of the duration of the TAI scale interval and estimates of its mean duration are reported in Table 6 and Table 7.

3. Availability

TAI and UTC are made available in the form of time differences with respect to the local time scales UTC(*k*), which approximate UTC, and TA(*k*), the independent local atomic time scales. These differences, [*TAI - TA(k)*] and [*UTC - UTC(k)*], are computed for the standard dates including uncertainties of
[UTC – UTC(*k*)] [3].

The computation of TAI/UTC is carried out every month and the results are published monthly in *Circular T*.

The BIPM pilots the key comparison in time CCTF-K001.UTC. Institutes participating in the key comparison are National Metrology Institutes and Designated Institutes; they constitute a sub-set of the participants in *Circular T* listed in table 3.

A rapid solution, *UTCr* has been published without interruption since July 2013. Regular publication of the values [*UTCr* - *UTC*(*k*)] allows weekly access to a prediction of UTC [4] for about forty laboratories which also contribute to the regular monthly publication. However, the final results published in BIPM *Circular T* remain the only official source of traceability to the SI second for participating laboratories.

4. Time links

The BIPM organizes the international network of time links to compare local realizations of UTC in contributing laboratories and uses them in the calculation of TAI. The network of time links used by the BIPM is non-redundant and relies on observation of GNSS satellites and on two-way satellite time and frequency transfer (TWSTFT).

Most time links are based on GPS satellite observations. Data from multi-channel dual-frequency GPS receivers are regularly used in the calculation of time links, in addition to that acquired by a few multi-channel single-frequency GPS time receivers. For those links realized using more than one technique, one of them is considered official for UTC and the others are calculated as back-ups. Single-frequency GPS data are corrected using the ionospheric maps produced by the Centre for Orbit Determination in Europe (CODE); all GPS data are corrected using precise satellite ephemerides and clocks produced by the International GNSS Service (IGS).

GPS links are computed using the method known as “GPS all in view” [5], with a network of time links that uses the PTB as a unique pivot laboratory for all the GPS links. Links between laboratories equipped with dual-frequency receivers providing Rinex format files are computed with the “Precise Point Positioning” method GPS PPP [6].

Clock comparisons using GLONASS C/A (L1C frequency) satellite observations with multi-channel receivers have been in use since October 2009 [7]. These links are computed using the “common-view” [8] method; data are corrected using the IAC ephemerides SP3 files and the CODE ionospheric maps.

A combination of individual TWSTFT and GPS PPP links and of individual GPS and GLONASS links are currently used in the calculation of TAI [9, 10].

A figure showing the time link techniques in the contributing laboratories can be downloaded from the BIPM website. For more detailed information on the equipment refer to [Table 4], and to BIPM *Circular T* for the techniques and methods of time transfer officially used and for the values of the uncertainty of [$UTC(k_1)$ - $UTC(k_2)$], obtained at the BIPM with these procedures.

The BIPM publishes in *Circular T* daily values of
[*UTC – UTC(USNO)_GPS*] and [*UTC – UTC(SU)_GLONASS*] where *UTC(USNO)_GPS* and *UTC(SU)_GLONASS* are respectively, UTC(USNO) and UTC(SU) as predicted by USNO and SU and broadcast by GPS and GLONASS. Evaluations of [*UTC - GPS time*] and [*UTC - GLONASS time*] had been published in *Circular T* until the end of 2015; starting in January 2016 the evaluations are provided only through the ftp server of the Time Department. These tables are based on GPS data provided by the Paris Observatory (LNE-SYRTE), France, and on GLONASS data provided by the Astrogeodynamical Observatory (AOS), Poland.

5. Time scales established in retrospect

For the most demanding applications, such as millisecond pulsar timing, the BIPM retrospectively issues atomic time scales. These are designated TT(BIPMxx) where 19xx or 20xx is the year of computation [11, 12, 13]. The successive versions of TT(BIPMxx) are both updates and revisions; they may differ for common dates.

Starting with TT(BIPM09), until TT(BIPM12) extrapolation for the current year of the latest realization TT(BIPMxx) had been provided in the file TTBIPMxx.ext. It had been updated each month after the TAI computation. Starting with TT(BIPM13), a formula for extrapolation is provided in the file TTBIPM.xx.

Notes

Tables 8, 9 and 10 of this report give the rates relative to TAI and the weights and the drift relative to monthly realization of TT(BIPM) of the clocks contributing to TAI in 2015.

Since January 2016 BIPM *Circular T* has been published in a new format with a different distribution of contents in the sections. See
ftp://62.161.69.5/pub/tai/publication/notes/explanatory_supplement_v0.1.pdf.

A full list of time signals and time dissemination services is compiled by the BIPM from the information provided by the time laboratories. The report on the scientific work of the BIPM on time activities for the period January - December 2015 is extracted from the *Director’s Report on the Activity and Management of the BIPM (1 January – 31 December 2015)*. All the publications mentioned in this report are available on request from the BIPM.

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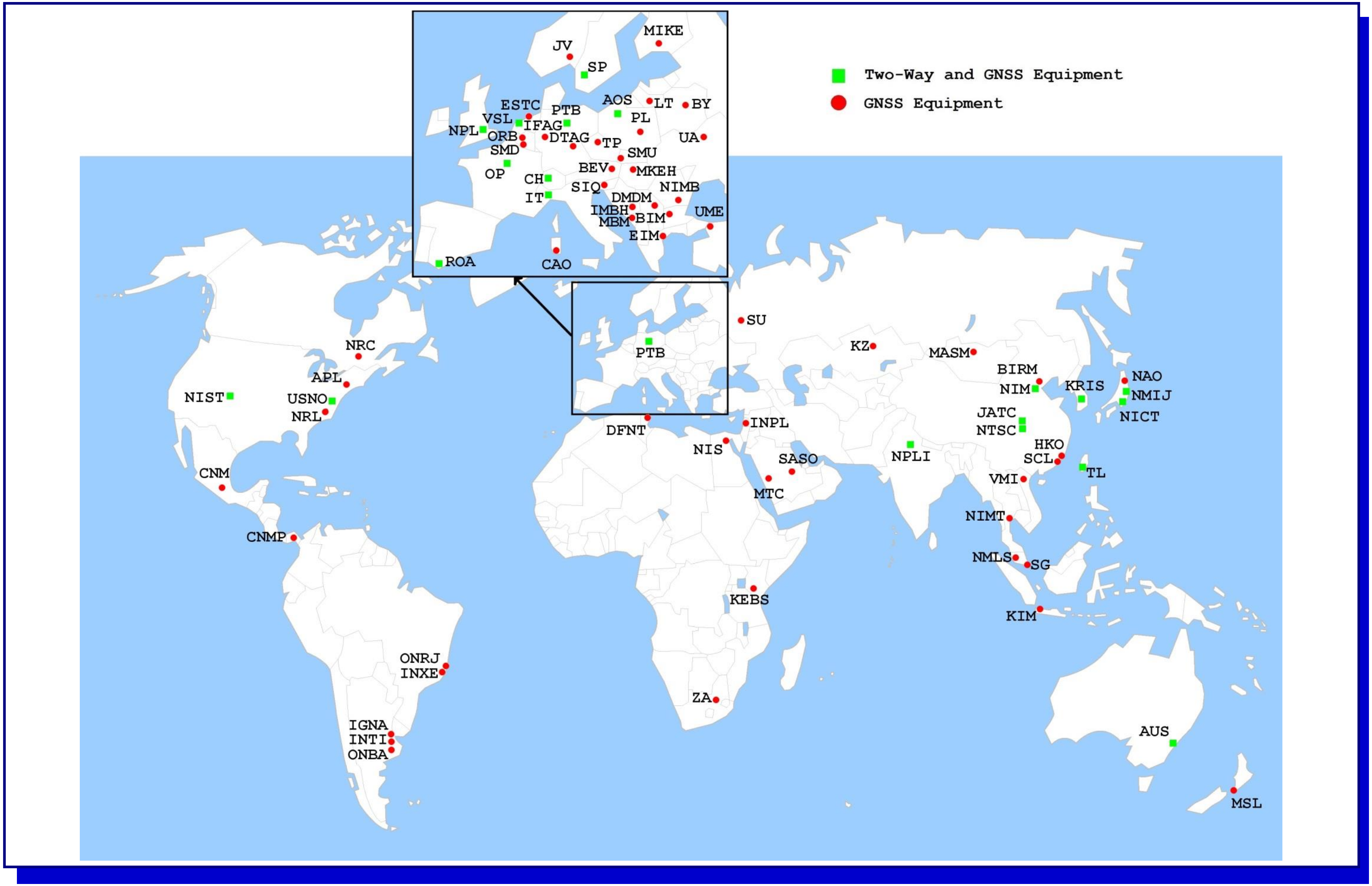

Geographical distribution of the laboratories that contribute to TAI and time transfer equipment (April 2016)

Table 1. Relative frequency offsets and step adjustments of UTC, up to 31 December 2016

Date (at 0 h UTC)	Offsets	Steps/s
1961 Jan. 1	-150×10^{-10}	
1961 Aug. 1	"	+0.050
1962 Jan. 1	-130×10^{-10}	
1963 Nov. 1	"	−0.100
1964 Jan. 1	-150×10^{-10}	
1964 Apr. 1	"	−0.100
1964 Sep. 1	"	−0.100
1965 Jan. 1	"	−0.100
1965 Mar. 1	"	−0.100
1965 Jul. 1	"	−0.100
1965 Sep. 1	"	−0.100
1966 Jan. 1	-300×10^{-10}	
1968 Feb. 1	"	+0.100
1972 Jan. 1	0	−0.107 7580
1972 Jul. 1	"	−1
1973 Jan. 1	"	−1
1974 Jan. 1	"	−1
1975 Jan. 1	"	−1
1976 Jan. 1	"	−1
1977 Jan. 1	"	−1
1978 Jan. 1	"	−1
1979 Jan. 1	"	−1
1980 Jan. 1	"	−1
1981 Jul. 1	"	−1
1982 Jul. 1	"	−1
1983 Jul. 1	"	−1
1985 Jul. 1	"	−1
1988 Jan. 1	"	−1
1990 Jan. 1	"	−1
1991 Jan. 1	"	−1
1992 Jul. 1	"	−1
1993 Jul. 1	"	−1
1994 Jul. 1	"	−1
1996 Jan. 1	"	−1
1997 Jul. 1	"	−1
1999 Jan. 1	"	−1
2006 Jan. 1	"	−1
2009 Jan. 1	"	−1
2012 Jul. 1	"	−1
2015 Jul. 1	"	−1

Table 2. Relationship between TAI and UTC, up to 31 December 2016

Limits of validity (at 0 h UTC)	[*TAI* - *UTC*] / s
1961 Jan. 1 - 1961 Aug. 1	1.422 8180 + (MJD - 37300) × 0.001 296
1961 Aug. 1 - 1962 Jan. 1	1.372 8180 + " "
1962 Jan. 1 - 1963 Nov. 1	1.845 8580 + (MJD - 37665) × 0.001 1232
1963 Nov. 1 - 1964 Jan. 1	1.945 8580 + " "
1964 Jan. 1 - 1964 Apr. 1	3.240 1300 + (MJD - 38761) × 0.001 296
1964 Apr. 1 - 1964 Sep. 1	3.340 1300 + " "
1964 Sep. 1 - 1965 Jan. 1	3.440 1300 + " "
1965 Jan. 1 - 1965 Mar. 1	3.540 1300 + " "
1965 Mar. 1 - 1965 Jul. 1	3.640 1300 + " "
1965 Jul. 1 - 1965 Sep. 1	3.740 1300 + " "
1965 Sep. 1 - 1966 Jan. 1	3.840 1300 + " "
1966 Jan. 1 - 1968 Feb. 1	4.313 1700 + (MJD - 39126) × 0.002 592
1968 Feb. 1 - 1972 Jan. 1	4.213 1700 + " "
1972 Jan. 1 - 1972 Jul. 1	10 (integral number of seconds)
1972 Jul. 1 - 1973 Jan. 1	11
1973 Jan. 1 - 1974 Jan. 1	12
1974 Jan. 1 - 1975 Jan. 1	13
1975 Jan. 1 - 1976 Jan. 1	14
1976 Jan. 1 - 1977 Jan. 1	15
1977 Jan. 1 - 1978 Jan. 1	16
1978 Jan. 1 - 1979 Jan. 1	17
1979 Jan. 1 - 1980 Jan. 1	18
1980 Jan. 1 - 1981 Jul. 1	19
1981 Jul. 1 - 1982 Jul. 1	20
1982 Jul. 1 - 1983 Jul. 1	21
1983 Jul. 1 - 1985 Jul. 1	22
1985 Jul. 1 - 1988 Jan. 1	23
1988 Jan. 1 - 1990 Jan. 1	24
1990 Jan. 1 - 1991 Jan. 1	25
1991 Jan. 1 - 1992 Jul. 1	26
1992 Jul. 1 - 1993 Jul. 1	27
1993 Jul. 1 - 1994 Jul. 1	28
1994 Jul. 1 - 1996 Jan. 1	29
1996 Jan. 1 - 1997 Jul. 1	30
1997 Jul. 1 - 1999 Jan. 1	31
1999 Jan. 1 – 2006 Jan. 1	32
2006 Jan. 1 – 2009 Jan. 1	33
2009 Jan. 1 – 2012 Jul. 1	34
2012 Jul. 1 – 2015 Jul. 1	35
2015 Jul. 1 –	36

Table 3. Acronyms and locations of the timing centres which maintain a local approximation of UTC, UTC(*k*), and/or an independent local time scale, TA(*k*)

#AOS	Astrogeodynamical Observatory, Space Research Centre P.A.S., Borowiec, Poland
#APL	Applied Physics Laboratory, Laurel, Maryland, USA
AUS	Consortium of laboratories in Australia
BEV	Bundesamt für Eich- und Vermessungswesen, Vienna, Austria
BIM	Bulgarian Institute of Metrology, Sofia, Bulgaria
#BIRM	Beijing Institute of Radio Metrology and Measurement, Beijing, P. R. China
BY	Belarussian State Institute of Metrology, Minsk, Belarus
#CAO	Stazione Astronomica di Cagliari (Cagliari Astronomical Observatory), Cagliari, Italy
CH	Federal Institute of Metrology (METAS), Bern-Wabern, Switzerland
CNM	Centro Nacional de Metrología, Querétaro (CENAM), Mexico
CNMP	Centro Nacional de Metrología de Panamá (CENAMEP), Panama
DFNT(1)	Laboratoire de Métrologie de la Direction Générale des Transmissions et de l'Informatique (DEF-NAT), Tunis, Tunisia
DMDM	Directorate of Measures and Precious Metals, Belgrade, Serbia
#DTAG	Deutsche Telekom AG, Frankfurt/Main, Germany
EIM	Hellenic Institute of Metrology, Thessaloniki, Greece
ESTC	European Space Research and Technology Centre (ESA-ESTEC), Noordwijk, the Netherlands
#HKO	Hong Kong Observatory, Hong Kong, China
#IFAG	Bundesamt für Kartographie und Geodäsie (Federal Agency for Cartography and Geodesy), Fundamental station, Wettzell, Kötzting, Germany
#IGNA	Instituto Geográfico Nacional, Buenos Aires, Argentina
IMBH(2)	Institute of Metrology of Bosnia and Herzegovina, Sarajevo, Bosnia and Herzegovina
INPL	National Physical Laboratory, Jerusalem, Israel
INTI	Instituto Nacional de Tecnología Industrial, Buenos Aires, Argentina
INXE	National Institute for Metrology and Technology (INMETRO) - Time and Frequency Laboratory, Rio de Janeiro, Brazil
IT	Istituto Nazionale di Ricerca Metrologica (INRIM), Torino, Italy
#JATC	Joint Atomic Time Commission, Lintong, P.R. China
JV	Justervesenet, Norwegian Metrology and Accreditation Service, Kjeller, Norway
KEBS	Kenya Bureau of Standards, Nairobi, Kenya
KIM	Research Centre for Calibration, Instrumentation and Metrology, The Indonesian Institute of Sciences, Serpong-Tangerang, Indonesia
KRIS	Korea Research Institute of Standards and Science (KRISS), Daejeon, Rep. of Korea
KZ	Kazakhstan Institute of Metrology (KazInMetr), Astana, Kazakhstan
LT	Center for Physical Sciences and Technology (VMT/FTMC), Vilnius, Lithuania
MASM	Mongolian Agency for Standardization and Metrology, Bayanzurkh District, Mongolia
MBM(3)	Bureau of Metrology - Laboratory for time and frequency, Podgorica, Montenegro
MIKE	MIKES Metrology, VTT Technical Centre of Finland Ltd, Espoo, Finland
MKEH	Hungarian Trade Licensing Office, Budapest, Hungary
MSL	Measurement Standards Laboratory, Lower Hutt, New Zealand
#MTC	MAKKAH Time Centre - King Abdulah Centre for Crescent Observations and Astronomy, Makkah, Saudi Arabia
#NAO	National Astronomical Observatory, Misuzawa, Japan
NICT	National Institute of Information and Communications Technology, Tokyo, Japan

(1) First participation since February 2015
(2) First participation since May 2015
(3) First participation since August 2015

Table 3. Acronyms and locations of the timing centres which maintain a local approximation of UTC, UTC(*k*), and/or an independent local time scale, TA(*k*) (Cont.)

NIM	National Institute of Metrology, Beijing, P.R. China
NIMB	National Institute of Metrology, Bucharest, Romania
NIMT	National Institute of Metrology, Bangkok, Thailand
NIS	National Institute for Standards, Cairo, Egypt
NIST	National Institute of Standards and Technology, Boulder, Colo., USA
NMIJ	National Metrology Institute of Japan, Tsukuba, Japan
NMLS	National Metrology Laboratory of SIRIM Berhad, Shah Alam, Malaysia
NPL	National Physical Laboratory, Teddington, United Kingdom
NPLI	National Physical Laboratory, New Delhi, India
NRC	National Research Council of Canada, Ottawa, Canada
#NRL	U.S. Naval Research Laboratory, Washington D.C., USA
#NTSC	National Time Service Center of China, Lintong, P.R. China
#ONBA	Observatorio Naval, Buenos Aires, Argentina
ONRJ	Observatório Nacional, Rio de Janeiro, Brazil
OP	Laboratoire national de métrologie et d'essais – Systèmes de références Temps-Espace, Observatoire de Paris (LNE-SYRTE), Paris, France
#ORB	Observatoire Royal de Belgique, Brussels, Belgium
PL	Consortium of laboratories in Poland
PTB	Physikalisch-Technische Bundesanstalt, Braunschweig, Germany
ROA	Real Instituto y Observatorio de la Armada, San Fernando, Spain
SASO	Saudi Standards, Metrology and Quality Organization, Riyadh, Saudi Arabia
SCL	Standards and Calibration Laboratory, Hong Kong, China
SG	National Metrology Centre - Agency for Science, Technology and Research (A*STAR), Singapore
SIQ	Slovenian Institute of Quality and Metrology, Ljubljana, Slovenia
SMD	Metrology Division of the Quality and Safety Department - Scientific Metrology, Brussels, Belgium
SMU	Slovenský Metrologičký Ústav (Slovak Institute of Metrology), Bratislava, Slovakia
SP	Sveriges Provnings- och Forskningsinstitut (Swedish National Testing and Research Institute), Borås, Sweden
SU	Institute of Metrology for Time and Space (IMVP), NPO "VNIIFTRI" Mendeleevo, Moscow Region, Russian Federation
TL	Telecommunication Laboratories, Chung-Li, Chinese Taipei
TP	Institute of Photonics and Electronics, Czech Academy of Sciences (IPE/ASCR), Prague, Czech Republic
UA	National Science Center "Institute of Metrology" (NSC), Kharkhov, Ukraine
UME	Ulusai Metroloji Enstitüsü, Marmara Research Centre, (National Metrology Institute), Gebze Kocaeli, Turkey
#USNO	U.S. Naval Observatory, Washington D.C., USA
VMI	Vietnam Metrology Institute, Ha Noi, Viet Nam
VSL	VSL, Dutch Metrology Institute, Delft, the Netherlands
ZA	National Metrology Institute of South Africa (NMISA), Pretoria, South Africa

Laboratories not participating in the key comparison CCTF-K001.UTC. See details at "Participants list"

Note: Most of the timing centres in the table can be accessed through the BIPM website, at "Useful links".

Table 4. Equipment and source of UTC(*k*) of the laboratories contributing to TAI in 2015

Ind. Cs: industrial caesium standard
Ind. Rb: industrial rubidium standard
Lab. Cs: laboratory caesium standard
Lab. Rb: laboratory rubidium standard
H-maser: hydrogen maser
SF: single frequency receiver
DF: dual frequency receiver
* means 'yes'

Lab *k*	Equipment	Source of UTC(*k*) (1)	TA(*k*)	UTCr	Time Links: GPS SF	Time Links: GPS DF	Time Links: GLONASS	Time Links: Two-Way
AOS	3 Ind. Cs 2 H-masers	1 H-maser (2) + microphase-stepper	* (18)	*	*	*	*	*
APL	3 Ind. Cs 3 H-masers	1 H-maser + frequency synthesizer steered to UTC(APL)			*	*		
AUS	5 Ind. Cs 2 H-masers	1 Cs		*	*	*	*	*
BEV	2 Ind. Cs 1 H-maser	1 Cs		*	*	*	*	
BIM	3 Ind. Cs	1 Cs			*	*		
BIRM (a)	2 Ind. Cs 3 H-masers	1 Cs + microphase-stepper			*			
BY	6 H-masers	3-4 H-masers + microphase-stepper			*		*	
CAO (a)	2 Ind. Cs	1 Cs			*	*	*	
CH	3 Ind. Cs (3) 2 H-maser	all the Cs 1 H-maser	*	*		*		*
CNM	4 Ind. Cs 2 H-maser	1 H-maser + microphase-stepper	*	*		*	*	
CNMP (a)	3 Ind. Cs	1 Cs + frequency offset generator		*	*			

Table 4. Equipment and source of UTC(*k*) of the laboratories contributing to TAI in 2015 (Cont.)

Ind. Cs: industrial caesium standard
Ind. Rb: industrial rubidium standard
Lab. Cs: laboratory caesium standard
Lab. Rb: laboratory rubidium standard
H-maser: hydrogen maser
SF: single frequency receiver
DF: dual frequency receiver
* means 'yes'

Lab *k*	Equipment	Source of UTC(*k*) (1)	TA(*k*)	UTCr	Time Links			
					GPS		GLONASS	Two-Way
					SF	DF		
DFNT	2 Ind. Cs	1 Cs				*	*	
DMDM	2 Ind. Cs	1 Cs + microphase-stepper		*	*	*		
DTAG	3 Ind. Cs	1 Cs		*		*		
EIM	4 Ind. Cs	1 Cs			*			
ESTC	4 Ind. Cs 3 H-masers	1 H-maser + microphase-stepper		*		*		
HKO	2 Ind. Cs	1 Cs				*	*	
IFAG (a)	5 Ind. Cs 2 H-masers	1 Cs + microphase-stepper		*		*		
IGNA (a)	2 Ind. Cs	1 Cs		*	*			
IMBH	2 Ind. Cs	1 Cs		*		*	*	
INPL	2 Ind. Cs	1 Cs				*	*	

Table 4. Equipment and source of UTC(*k*) of the laboratories contributing to TAI in 2015 (Cont.)

Ind. Cs: industrial caesium standard
Ind. Rb: industrial rubidium standard
Lab. Cs: laboratory caesium standard
Lab. Rb: laboratory rubidium standard
H-maser: hydrogen maser
SF: single frequency receiver
DF: dual frequency receiver
* means 'yes'

Lab *k*	Equipment	Source of UTC(*k*) (1)	TA(*k*)	UTCr	Time Links			
					GPS		GLONASS	Two-Way
					SF	DF		
INTI	1 Ind. Cs	1 Cs		*	*			
INXE	3 Ind. Cs (4) 1 Ind. Rb 1 Lab. Cs	1 Cs (5) + microphase-stepper		*	*	*	*	
IPQ (a)	3 Ind. Cs	1 Cs + microphase-stepper		*		*	*	*
IT	6 Ind. Cs 4 H-masers 2 Lab. Cs	1 H-maser + microphase-stepper		*		*		*
JATC	(6)	1 Cs + microphase-stepper	*					
JV	3 Ind. Cs 1 H-maser	1 H-maser + microphase-stepper		*	*	*		
KEBS	3 Ind. Cs	1 Cs + reference generator				*	*	
KIM (a)	2 Ind. Cs	1 Cs				*	*	
KRIS	5 Ind. Cs 4 H-masers	1 H-maser + microphase-stepper	*	*	*	*	*	*
KZ	5 Ind. Cs (7)	1 Cs + microphase-stepper				*	*	
LT	2 Ind. Cs	1 Cs		*	*			

Table 4. Equipment and source of UTC(*k*) of the laboratories contributing to TAI in 2015 (Cont.)

Ind. Cs: industrial caesium standard
Ind. Rb: industrial rubidium standard
Lab. Cs: laboratory caesium standard
Lab. Rb: laboratory rubidium standard
H-maser: hydrogen maser
SF: single frequency receiver
DF: dual frequency receiver
* means 'yes'

Lab *k*	Equipment	Source of UTC(*k*) (1)	TA(*k*)	UTCr	Time Links			
					GPS		GLONASS	Two-Way
					SF	DF		
MASM (a)	1 Ind. Cs	1 Cs + time/frequency steering				*	*	
MBM (b)	1 Ind. Cs	1 Cs			*			
MIKE	1 Ind. Cs 4 H-masers	1 H-maser + microphase-stepper		*	*	*		
MKEH	1 Ind. Cs	1 Cs			*			
MSL	2 Ind. Cs	1 Cs + microphase-stepper		*		*		
MTC (a)	5 Ind. Cs	1 Cs (8)		*	*	*		
NAO	4 Ind. Cs 1 H-maser	1 Cs + microphase-stepper		*	*			
NICT	33 Ind. Cs 7 H-masers (9) 1 Lab. Cs	1 H-maser (10) + microphase-stepper	* (11)	*	*	*		*
NIM (a)	7 Ind. Cs 6 H-masers	1 H-maser + microphase-stepper		*	*	*		*
NIMB	2 Ind. Cs	1 Cs			*	*		
NIMT	2 Ind. Cs	1 Cs + microphase-stepper		*	*	*		

Table 4. Equipment and source of UTC(*k*) of the laboratories contributing to TAI in 2015 (Cont.)

Ind. Cs: industrial caesium standard
Ind. Rb: industrial rubidium standard
Lab. Cs: laboratory caesium standard
Lab. Rb: laboratory rubidium standard
H-maser: hydrogen maser
SF: single frequency receiver
DF: dual frequency receiver
* means 'yes'

Lab *k*	Equipment	Source of UTC(*k*) (1)	TA(*k*)	UTCr	Time Links			
					GPS		GLONASS	Two-Way
					SF	DF		
NIS	3 Ind. Cs	1 Cs			*	*	*	
NIST	2 Lab. Cs 11 Ind. Cs 14 H-masers	5 Cs 6 H-masers + microphase-stepper	*	*		*		*
NMIJ	3 Ind. Cs 1 Lab. Cs 4 H-masers	1 H-maser + microphase-stepper		*	*	*		*
NMLS	2 Ind. Cs	1 Cs		*		*		
NPL	3 Ind. Cs 4 H-masers	1 H-maser			*	*		*
NPLI	5 Ind. Cs 1 H-maser	1 H-maser + microphase-stepper		*	*	*		*
NRC	6 Ind. Cs (12) 2 H-masers	1 Cs + microphase-stepper	*	*		*		
NRL	29 Ind. Cs 6 H-masers	1 H-maser + frequency synthesizer steered to UTC(NRL)		*		*		
NTSC	33 Ind. Cs 4 H-masers	1 H-maser + microphase-stepper	*	*	*	*		*
ONBA	2 Ind. Cs	1 Cs			*			
ONRJ	7 Ind. Cs 2 H-masers	7 Cs 2 H-masers + frequency offset generator	* (13)	*		*	*	

Table 4. Equipment and source of UTC(*k*) of the laboratories contributing to TAI in 2015 (Cont.)

Ind. Cs: industrial caesium standard
Ind. Rb: industrial rubidium standard
Lab. Cs: laboratory caesium standard
Lab. Rb: laboratory rubidium standard
H-maser: hydrogen maser
SF: single frequency receiver
DF: dual frequency receiver
* means 'yes'

Lab *k*	Equipment	Source of UTC(*k*) (1)	TA(*k*)	UTCr	Time Links			
					GPS		GLONASS	Two-Way
					SF	DF		
OP	7 Ind. Cs 3 Lab. Cs 1 Lab. Rb 4 H-masers	1 H-maser (14) + microphase-stepper	* (15)	*	*	*	*	*
ORB	4 Ind. Cs 1 H-masers	1 H-maser or 1 Cs (16) + femtostepper		*		*	*	
PL	12 Ind. Cs 3 H-masers	1 Cs (17) + femtostepper	* (18)	*	*	*	*	
PTB	3 Ind. Cs 4 Lab. Cs (19) 4 H-masers	1 H-maser (20) + microphase-stepper	* (21)	*	*	*	*	*
ROA	6 Ind. Cs (22) 1 H-maser	1 H-maser (23) + frequency synthesizer steered to UTC(ROA)		*		*	*	*
SASO (a)	5 Ind. Cs	1 Cs		*		*	*	
SCL	2 Ind. Cs	1 Cs + microphase-stepper		*	*			
SG	5 Ind. Cs 1 H-maser	1 H-maser + microphase-stepper	*	*		*	*	
SIQ	1 Ind. Cs	1 Cs				*	*	
SMD	3 Ind. Cs 1 H-maser	1 Cs + microphase-stepper		*		*	*	
SMU (a)	1 Ind. Cs	1 Cs + output frequency steering			*	*	*	

Table 4. Equipment and source of UTC(*k*) of the laboratories contributing to TAI in 2015 (Cont.)

Ind. Cs: industrial caesium standard
Ind. Rb: industrial rubidium standard
Lab. Cs: laboratory caesium standard
Lab. Rb: laboratory rubidium standard
H-maser: hydrogen maser
SF: single frequency receiver
DF: dual frequency receiver
* means 'yes'

Lab *k*	Equipment	Source of UTC(*k*) (1)	TA(*k*)	UTCr	Time Links GPS SF	Time Links GPS DF	Time Links GLONASS	Time Links Two-Way
SP	19 Ind. Cs (24) 9 H-masers	1 H-maser + microphase-stepper		*		*	*	*
SU	2 Lab. Cs (25) 8-9 H-masers	5-9 H-masers (26)	* (27)	*		*	*	
TL	13 Ind. Cs 4 H-masers	1 H-maser + microphase-stepper	* (28)	*		*		*
TP	4 Ind. Cs	1 Cs + output frequency steering				*		
UA	1 Ind. Cs 3 H-masers	3 H-masers + microphase-stepper			*	*	*	
UME	5 Ind. Cs	1 Cs		*		*	*	
USNO	81 Ind. Cs 33 H-masers 6 Lab. Rb	1 H-maser + frequency synthesizer steered to UTC(USNO) (29)	* (29)	*	*	*		*
VMI	3 Ind. Cs	1 Cs + microphase-stepper				*		
VSL	4 Ind. Cs	1 Cs + microphase-stepper		*		*		*
ZA	4 Ind. Cs 1 H-maser	1 Cs / 1 H-maser (30)				*	*	

Notes

(a)		Information based on the Annual Report for 2014, not confirmed by the laboratory.
(b)		Information not confirmed by the laboratory.
(1)		When several clocks are indicated as source of UTC(*k*), laboratory k computes a software clock, steered to UTC. Often a physical realization of UTC(*k*) is obtained using a Cs clock and a micro-phase-stepper.
(2)	AOS	The UTC(AOS) is formed technically using 1 hydrogen maser and microstepper, it is steered using TA(PL) data as a reference. TA(PL) laboratories are linked via MC GPS-CV, except for two clocks of TPSA, two clocks of NIT and four clocks of AOS linked via a two-directional optical fibre connection to GUM. Optical Fibre Link *UTC*(*AOS*)-*UTC*(*PL*), 480 km long.
(3)	CH	All the standards are located in Bern at METAS (Swiss Federal Institute of Metrology). Since November 2007, UTC(CH) is defined in real time by a hydrogen maser steered to the paper time scale UTC(CH.P) which is defined as a weighted average of all the clocks, steered to UTC. TA(CH) is also a weighted average of all the clocks, but free running.
(4)	INXE	The standards are located as follows: *Instituto Nacional de Metrologia, Qualidade e Tecnologia (Inmetro, Xerém) — 2 Cs *Instituto de Física da Universidade de São Paulo (IFUSP, São Carlos) — 1 Cs
(5)	INXE	The source of UTC(INXE) is generated by a microphase-stepper, driven by one Cs clock, steered towards UTC since September 2012.
(6)	JATC	The standards are located at National Time Service Centre (NTSC). The link between UTC(JATC) and UTC(NTSC) is obtained by internal connection.
(7)	KZ	The standards are located as follows: *Kazakhstan Institute for Metrology (Astana) — 4 Cs *South-Kazakhstan branch of Kazakhstan Institute for Metrology (Almaty) — 1 Cs
(8)	MTC	UTC(MTC) is generated by Symmetricom/Microsemi TSC 2043B Direct Digital Synthesizer, DC to 6.48 MHz
(9)	NICT	The standards are located as follows: * Koganei Headquarters — 20 Cs, 6 H-masers * Ohtakadoya-yama LF station — 4 Cs * Hagane-yama LF station — 5 Cs * Advanced ICT Research Institute in Kobe — 5 Cs, 1 H-maser
(10)	NICT	The NICT atomic timescale TA(NICT) is computed from the weighted average of 18 commercial Cs clocks at the Koganei HQ.
(11)	NICT	UTC(NICT) is generated from the output of a hydrogen maser, steered to TA(NICT) regularly, and steered to UTC if necessary.
(12)	NRC	The standards are located as follows: * Measurement Science and Standards (Ottawa) — 4 Cs, 2 H-masers * CHU Time signal radio station (Ottawa) — 2 Cs

Notes (Cont.)

(13)	ONRJ	The Brazilian atomic time scale TA(ONRJ) is computed by the National Observatory Time Service Division in Rio de Janeiro with data from 7 industrial caesium clocks and 2 hydrogen masers.
(14)	OP	Since MJD 56218 UTC(OP) is based on the output signal of a H-maser frequency steered towards UTC using the LNE-SYRTE fountains calibrations.
(15)	OP	The French atomic time scale TA(F) is computed by the LNE-SYRTE with data from up to 23 industrial caesium clocks in 2015 located as follows :

* Centre Electronique de l'Armement (CELAR, Rennes)	1 Cs
* Centre National d'Etudes Spatiales (CNES, Toulouse)	3 Cs
* France Telecom Recherche et Developpement (Lannion)	2 Cs
* Observatoire de la Côte d'Azur (OCA, Grasse)	2 Cs
* Observatoire de Paris (LNE-SYRTE, Paris)	7 Cs
* Observatoire de Besançon (OB, Besançon)	3 Cs
* Direction des Constructions Navales (DCN, Brest)	4 Cs
* Spectracom, Orolia (Les Ulis)	1 Cs

All laboratories are linked via GPS receivers. The TA(F) frequency is steered using the LNE-SYRTE PFS data. The difference TA(F) – UTC(OP) is published in the OP Time Service Bulletin.

(16)	ORB	The source of UTC(ORB) is generated by a Cs clock since July 2013.
(17)	PL	The Polish official timescale UTC(PL) is maintained by the GUM.
(18)	PL	The Polish atomic timescale TA(PL) is computed by the AOS and GUM with data from 14 caesium clocks and 3 hydrogen masers located as follows:

* Central Office of Measures (GUM, Warsaw)	3 Cs, 1 H-maser
* Astrogeodynamical Observatory, Space Research Center P.A.S. (AOS, Borowiec)	2 Cs, 2 H-masers
* National Institute of Telecommunications (IŁ, Warsaw)	2 Cs
* Polish Telecom (Orange Polska S.A., Warsaw)	3 Cs
* Military Primary Standards Laboratory (CWOM, Warsaw and Poznan)	2 Cs
and additionally	
* Time and Frequency Standard Laboratory of the Semiconductor Physics Institute, a guest laboratory from Lithuania (LT, Vilnius, Lithuania)	2 Cs

All laboratories are linked via MC GPS-CV, except for two clocks of TPSA and two clocks of NIT linked via a two-directional optical fibre connection.

(19)	PTB	The laboratory Cs, PTB CS1 and PTB CS2 are operated continuously as clocks. PTB CSF1 and CSF2 are fountain frequency standards using laser cooled caesium atoms. Both are intermittently operated as frequency standards. Contributions to TAI are made through comparisons with one of PTB's hydrogen masers.
(20)	PTB	UTC(PTB) is based on the output of an active hydrogen maser steered in frequency since MJD 55224 (February 2010).

Notes (Cont.)

(21) PTB Since MJD 56079 0:00 UTC TA(PTB) has been generated from an active hydrogen maser, steered in frequency so as to follow PTB caesium fountains as close as possible. The deviation d between the fountains and the TAI second is not taken into account.
TAI-TA(PTB) got an initial arbitrary offset from TAI without continuity to the data reported in previous months.

(22) ROA The standards are located as follows:

* Real Observatorio de la Armada en San Fernando	5 Cs, 1 H-maser
* Centro Español de Metrología	1 Cs

(23) ROA Since March 2009, UTC(ROA) is defined in real time by a hydrogen maser, steered to the paper time scale UTC(ROA) which is defined as a weighted average of all the clocks, steered to UTC.

(24) SP The standards are located as follows (at the end of 2015):

* SP Technical Research Institute of Sweden (SP, Borås)	4 Cs, 2 H-masers
* SP Technical Research Institute of Sweden (SP, Stockholm)	6 Cs, 2 H-masers
* STUPI AB (Stockholm)	8 Cs, 3 H-masers
* Onsala Space Observatory (Onsala)	1 Cs, 2 H-masers

(25) SU CsFO1 and CsFO2 are fountain frequency standards using laser cooled caesium atoms. CsFO2 operated as frequency standard almost regularly and contributed to TAI.

(26) SU Laboratory computes UTC(SU) as a software clock, steered to UTC.

(27) SU TA(SU) is generated from an ensemble of active hydrogen masers, software steered in frequency so as to follow SU caesium fountains as close as possible. The deviation d between the fountains and the TAI second is not taken into account. TAI-TA(SU) has an initial arbitrary offset from TAI.

(28) TL TA(TL) is generated from a 13-caesium-clock ensemble.

(29) USNO The time scales A.1(MEAN) and UTC(USNO) are computed by USNO. They are determined by a weighted average of Cs clocks, hydrogen masers, and rubidium fountains located at the USNO. A.1(MEAN) is a free atomic time scale, while UTC(USNO) is steered to UTC. Included in the total number of USNO atomic standards are the clocks located at the USNO Alternate Master Clock in Colorado Springs, CO.

(30) ZA The H-Maser was added in October 2015 and became the source of UTC(ZA) from 4 March 2016.

Table 5. Differences between the normalized frequencies of EAL and TAI, up to March 2016

(File containing values since the beginning of the steering is available at ftp://62.161.69.5/pub/tai/scale/ealtai15.ar)

Date	MJD	$[f(EAL) - f(TAI)] \times 10^{-13}$
2010 Jan 28 - 2010 Feb 27	55224 - 55254	6.666
2010 Feb 27 - 2010 Mar 29	55254 - 55284	6.661
2010 Mar 29 - 2010 Apr 28	55284 - 55314	6.656
2010 APR 28 - 2010 MAY 28	55314 - 55344	6.651
2010 MAY 28 - 2010 JUN 27	55344 - 55374	6.645
2010 JUN 27 - 2010 JUL 27	55374 - 55404	6.639
2010 JUL 27 - 2010 AUG 26	55404 - 55434	6.633
2010 AUG 26 - 2010 SEP 30	55434 - 55469	6.626
2010 SEP 30 - 2010 OCT 30	55469 - 55499	6.619
2010 OCT 30 - 2010 NOV 29	55499 - 55529	6.612
2010 NOV 29 - 2010 DEC 29	55529 - 55559	6.605
2010 DEC 29 - 2011 JAN 28	55559 - 55589	6.598
2011 JAN 28 - 2011 FEB 27	55589 - 55619	6.591
2011 FEB 27 - 2011 MAR 29	55619 - 55649	6.584
2011 MAR 29 - 2011 APR 28	55649 - 55679	6.577
2011 APR 28 - 2011 MAY 28	55679 - 55709	6.570
2011 MAY 28 - 2011 JUN 27	55709 - 55739	6.563
2011 JUN 27 - 2011 JUL 27	55739 - 55769	6.556
2011 JUL 27 - 2011 AUG 31	55769 - 55804	6.551
2011 AUG 31 - 2011 SEP 30	55804 - 55834	6.546
2011 SEP 30 - 2011 OCT 30	55834 - 55864	6.541
2011 OCT 30 - 2011 NOV 29	55864 - 55894	6.536
2011 NOV 29 - 2011 DEC 29	55894 - 55924	6.531
2011 DEC 29 - 2012 JAN 28	55924 - 55954	6.526
2012 JAN 28 - 2012 FEB 27	55954 - 55984	6.521
2012 FEB 27 - 2012 MAR 28	55984 - 56014	6.516
2012 MAR 28 - 2012 APR 27	56014 - 56044	6.511
2012 APR 27 - 2012 MAY 27	56044 - 56074	6.506
2012 MAY 27 - 2012 JUN 26	56074 - 56104	6.501
2012 JUN 26 - 2012 JUL 31	56104 - 56139	6.496
2012 JUL 31 - 2012 AUG 30	56139 - 56169	6.491
2012 AUG 30 - 2012 SEP 29	56169 - 56199	6.486
2012 SEP 29 - 2015 MAR 27	56199 - 57474	6.483

As the time scales UTC and TAI differ by an integral number of seconds(see Tables 1 and 2), UTC is necessarily subjected to the same intentional frequency adjustment as TAI.

Table 6. Measurements of the duration of the TAI scale interval

(File available on ftp://62.161.69.5/pub/tai/scale/UTAI/utai15.ar)

TAI is a realization of coordinate time TT. The following tables give the fractional deviation *d* of the scale interval of TAI from that of TT (in practice the SI second on the geoid), i.e. the fractional frequency deviation of TAI with the opposite sign: $d = -y_{TAI}$.

In Table 6A, *d* is obtained on the given periods of estimation by comparison of the TAI frequency with that of the individual primary frequency standards (PFS) IT-CsF2, NIM5, NIST-F1, NIST-F2, NPL-CSF2, NPLI-CsF1, PTB-CS1, PTB-CS2, PTB-CSF1, PTB-CSF2, SU-CsFO2, SYRTE-FO1 and SYRTE-FO2 reported on the year 2015.
In Table 6B, *d* is obtained on the given periods of estimation by comparison of the TAI frequency with that of the individual secondary frequency standard (SFS) SYRTE-FORb reported on the year 2015.
Previous calibrations are available in the successive annual reports of the BIPM Time Section volumes 1 to 18 and in the BIPM Annual Report on Time Activities volumes 1 to 9 (web only since volume 4 for 2009).

Each comparison is provided with the following information:
u_A is the uncertainty originating in the instability of the PFS,
u_B is the combined uncertainty from systematic effects,
$u_{link/lab}$ is the uncertainty in the link between the PFS and the clock participating to TAI, including the uncertainty due to dead-time,
$u_{link/TAI}$ is the uncertainty in the link to TAI, computed using the standard uncertainty of [UTC-UTC(*k*)],
u is the quadratic sum of all four uncertainty values.

In addition, Table 6B includes the following information:
u_{SRep} is the recommended uncertainty of the secondary representation of the second, as specified in the CIPM Recommendation identified under Ref(u_S).

In these tables, a frequency over a time interval is defined as the ratio of the end-point phase difference to the duration of the interval.

The typical characteristics of the calibrations of the TAI frequency provided by the different primary and secondary standards reported in 2015 are indicated below. Reports of individual evaluations may be found at ftp://62.161.69.5/pub/tai/data/PFS_reports. Ref(u_B) is a reference giving information on the value of u_B as stated in the 2015 reports, u_B(Ref) is the u_B value stated in this reference. Note that the current u_B values are generally not the same as the peer reviewed values given in Ref(u_B).

Primary Standard	Type /selection	Type B std. uncertainty/ 10^{-15}	u_B(Ref)/10^{-15}	Ref(u_B)	Comparison with	Number/typical duration of comp.
IT-CsF2	Fountain	(0.17 to 0.30)	0.18	[1]	H maser	7 / 15 d to 30 d
NIM5	Fountain	1.4	1.4	[2]	H maser	3 / 15 d to 20 d
NIST-F1	Fountain	0.31	0.35	[3]	H maser	2 / 15 d to 25 d
NIST-F2	Fountain	0.15	0.11	[4]	H maser	1 / 20 d
NPL-CSF2	Fountain	(0.22 to 0.37)	0.23	[5]	H maser	2 / 25 d
NPLI-CsF1	Fountain	2.82	2.5	[6]	H maser	1 / 10 d
PTB-CS1	Beam /Mag.	8	8.	[7]	TAI	10 / 30 d
PTB-CS2	Beam /Mag.	12	12.	[8]	TAI	12 / 30 d
PTB-CSF1	Fountain	(0.69 to 0.71)	1.4	[9]	H maser	8 / 20 d to 35 d
PTB-CSF2	Fountain	(0.30 to 0.33)	0.41	[10]	H maser	4 / 10 d to 30 d
SU-CsFO2	Fountain	0.25	0.50	[11]	H maser	11 / 25 d to 35 d
SYRTE-FO1	Fountain	(0.38 to 0.44)	0.37	[12]	H maser	2 / 30 d
SYRTE-FO2	Fountain	(0.25 to 0.30)	0.23	[12]	H maser	11 / 15 d to 35 d

Secondary Standard	Type	Type B std. uncertainty/ 10^{-15}	u_B(Ref)/10^{-15}	Ref(u_B)	Comparison with	Number/typical duration of comp.
SYRTE-FORb	Fountain	(0.28 to 0.32)	0.32	[13]	H maser	12 / 10 d to 30 d

More detailed information on the characteristics and operation of individual PFS and SFS may be found in the annexes supplied by the individual laboratories.

Table 6A. Measurements of the duration of the TAI scale interval by Primary Frequency Standards

Standard	Period of estimation		$d/10^{-15}$	$u_A/10^{-15}$	$u_B/10^{-15}$	$u_{link/lab}/10^{-15}$	$u_{link/TAI}/10^{-15}$	$u/10^{-15}$	Note
IT-CsF2	57029	57054	-1.11	0.37	0.17	0.17	0.23	0.50	
IT-CsF2	57054	57074	-0.76	0.62	0.17	0.14	0.28	0.72	
IT-CsF2	57124	57139	-1.49	0.47	0.17	0.32	0.61	0.85	
IT-CsF2	57139	57169	0.08	0.34	0.17	0.11	0.27	0.48	
IT-CsF2	57169	57199	1.82	0.19	0.30	0.10	0.20	0.42	
IT-CsF2	57199	57229	0.09	0.29	0.30	0.12	0.20	0.48	
IT-CsF2	57269	57289	-0.02	0.30	0.30	0.10	0.28	0.52	
NIM5	57094	57109	-0.46	0.60	1.40	0.20	0.37	1.58	
NIM5	57119	57139	-1.32	0.60	1.40	0.20	0.28	1.56	
NIM5	57179	57199	-1.91	0.60	1.40	0.20	0.28	1.56	
NIST-F1	57264	57289	-0.01	0.37	0.31	0.16	0.23	0.56	
NIST-F1	57359	57374	0.23	0.46	0.31	0.11	0.37	0.67	
NIST-F2	57069	57089	-2.07	0.43	0.15	0.19	0.57	0.75	
NPL-CsF2	57259	57284	-0.28	0.34	0.22	0.14	0.23	0.49	
NPL-CsF2	57289	57314	-0.47	0.29	0.37	0.13	0.23	0.54	
NPLI-CsF1	57319	57329	-3.88	0.90	2.82	0.19	0.53	3.01	
PTB-CS1	57019	57049	-4.53	6.00	8.00	0.00	0.13	10.00	(1)
PTB-CS1	57049	57079	-4.72	6.00	8.00	0.00	0.10	10.00	
PTB-CS1	57079	57109	-8.31	6.00	8.00	0.00	0.07	10.00	
PTB-CS1	57109	57139	-9.78	6.00	8.00	0.00	0.07	10.00	
PTB-CS1	57139	57169	-5.69	6.00	8.00	0.00	0.07	10.00	
PTB-CS1	57169	57199	-12.01	6.00	8.00	0.00	0.07	10.00	
PTB-CS1	57199	57234	-9.80	6.00	8.00	0.00	0.06	10.00	
PTB-CS1	57234	57264	-5.96	6.00	8.00	0.00	0.07	10.00	
PTB-CS1	57264	57294	-6.23	6.00	8.00	0.00	0.07	10.00	
PTB-CS1	57294	57324	-7.89	6.00	8.00	0.00	0.07	10.00	
PTB-CS2	57019	57049	-6.46	3.00	12.00	0.00	0.13	12.37	(1)
PTB-CS2	57049	57079	0.49	3.00	12.00	0.00	0.10	12.37	
PTB-CS2	57079	57109	-0.75	3.00	12.00	0.00	0.07	12.37	
PTB-CS2	57109	57139	-4.57	3.00	12.00	0.00	0.07	12.37	
PTB-CS2	57139	57169	-3.87	3.00	12.00	0.00	0.07	12.37	
PTB-CS2	57169	57199	-2.37	3.00	12.00	0.00	0.07	12.37	
PTB-CS2	57199	57234	-1.60	3.00	12.00	0.00	0.06	12.37	
PTB-CS2	57234	57264	2.18	3.00	12.00	0.00	0.07	12.37	
PTB-CS2	57264	57294	-3.91	3.00	12.00	0.00	0.07	12.37	
PTB-CS2	57294	57324	-3.18	3.00	12.00	0.00	0.07	12.37	
PTB-CS2	57324	57354	0.91	3.00	12.00	0.00	0.07	12.37	
PTB-CS2	57354	57384	-3.99	3.00	12.00	0.00	0.07	12.37	
PTB-CSF1	57029	57049	0.40	0.12	0.70	0.04	0.19	0.74	
PTB-CSF1	57084	57104	0.37	0.12	0.69	0.02	0.09	0.71	
PTB-CSF1	57109	57139	0.36	0.10	0.70	0.01	0.07	0.71	
PTB-CSF1	57179	57199	1.08	0.10	0.71	0.02	0.09	0.72	
PTB-CSF1	57229	57264	0.50	0.08	0.70	0.01	0.06	0.71	
PTB-CSF1	57264	57294	0.48	0.08	0.69	0.02	0.07	0.70	
PTB-CSF1	57294	57324	0.37	0.09	0.69	0.03	0.07	0.70	
PTB-CSF1	57324	57344	-0.21	0.09	0.70	0.01	0.09	0.71	
PTB-CSF2	57094	57104	-0.23	0.23	0.31	0.03	0.18	0.43	
PTB-CSF2	57114	57129	-0.21	0.19	0.33	0.02	0.12	0.40	
PTB-CSF2	57149	57169	0.51	0.17	0.31	0.03	0.09	0.37	
PTB-CSF2	57169	57199	0.57	0.13	0.30	0.04	0.07	0.34	

Table 6A. (Cont.)

Standard	Period of estimation		$d/10^{-15}$	$u_A/10^{-15}$	$u_B/10^{-15}$	$u_{link/lab}/10^{-15}$	$u_{link/TAI}/10^{-15}$	$u/10^{-15}$
SU-CsFO2	57049	57079	−0.40	0.24	0.25	0.13	0.59	0.69
SU-CsFO2	57079	57104	−0.44	0.21	0.25	0.13	0.69	0.78
SU-CsFO2	57104	57139	−0.15	0.20	0.25	0.14	0.51	0.62
SU-CsFO2	57139	57169	0.68	0.17	0.25	0.13	0.59	0.67
SU-CsFO2	57169	57199	0.04	0.17	0.25	0.13	0.59	0.67
SU-CsFO2	57199	57234	0.78	0.19	0.25	0.13	0.51	0.61
SU-CsFO2	57234	57264	−0.27	0.28	0.25	0.12	0.59	0.71
SU-CsFO2	57264	57294	−0.30	0.21	0.25	0.10	0.59	0.68
SU-CsFO2	57299	57319	0.71	0.25	0.25	0.11	0.85	0.92
SU-CsFO2	57324	57354	0.17	0.24	0.25	0.11	0.59	0.69
SU-CsFO2	57354	57384	−0.40	0.25	0.25	0.11	0.59	0.69
SYRTE-FO1	57049	57079	−0.95	0.22	0.44	0.10	0.20	0.54
SYRTE-FO1	57169	57199	0.86	0.30	0.38	0.11	0.20	0.53
SYRTE-FO2	57019	57039	0.61	0.25	0.27	0.10	0.28	0.47
SYRTE-FO2	57054	57079	−0.04	0.29	0.27	0.11	0.23	0.47
SYRTE-FO2	57079	57109	−0.02	0.20	0.27	0.10	0.20	0.40
SYRTE-FO2	57109	57134	−0.03	0.40	0.27	0.11	0.23	0.55
SYRTE-FO2	57139	57169	0.41	0.30	0.28	0.11	0.20	0.47
SYRTE-FO2	57169	57199	0.99	0.30	0.27	0.10	0.20	0.46
SYRTE-FO2	57199	57234	0.86	0.35	0.27	0.11	0.17	0.49
SYRTE-FO2	57234	57259	0.56	0.20	0.27	0.11	0.23	0.42
SYRTE-FO2	57264	57289	0.39	0.20	0.28	0.10	0.23	0.43
SYRTE-FO2	57294	57324	0.55	0.20	0.25	0.10	0.20	0.39
SYRTE-FO2	57324	57339	−0.11	0.30	0.30	0.11	0.37	0.57

Note:
(1) Continuously operating as a clock participating in TAI.

Table 6B. Measurements of the duration of the TAI scale interval by Secondary Frequency Standards

Standard	Period of estimation		$d/10^{-15}$	$u_A/10^{-15}$	$u_B/10^{-15}$	$u_{link/lab}/10^{-15}$	$u_{link/TAI}/10^{-15}$	$u/10^{-15}$	u_{SRep}	Ref(u_s)
SYRTE-FORb	57019	57029	1.59	0.30	0.32	0.10	0.53	0.69	1.3	[14]
SYRTE-FORb	57049	57079	0.06	0.20	0.31	0.10	0.20	0.43	1.3	[14]
SYRTE-FORb	57079	57109	0.29	0.20	0.30	0.10	0.20	0.42	1.3	[14]
SYRTE-FORb	57109	57139	0.13	0.20	0.30	0.11	0.20	0.42	1.3	[14]
SYRTE-FORb	57139	57169	0.38	0.30	0.30	0.11	0.20	0.48	1.3	[14]
SYRTE-FORb	57169	57199	1.12	0.26	0.29	0.11	0.20	0.45	1.3	[14]
SYRTE-FORb	57204	57224	0.87	0.20	0.31	0.11	0.28	0.48	1.3	[14]
SYRTE-FORb	57234	57259	0.81	0.20	0.30	0.10	0.23	0.44	1.3	[14]
SYRTE-FORb	57264	57289	0.16	0.20	0.28	0.10	0.23	0.43	1.3	[14]
SYRTE-FORb	57294	57324	0.71	0.20	0.30	0.10	0.20	0.42	1.3	[14]
SYRTE-FORb	57324	57354	0.29	0.20	0.30	0.11	0.20	0.42	1.3	[14]
SYRTE-FORb	57354	57384	-0.01	0.30	0.32	0.11	0.20	0.49	1.3	[14]

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Operation of IT-CsF2 in 2015

F. Levi and G.A. Costanzo

IT-CsF2 is the primary atomic frequency standard operated at INRIM. The frequency standard is based on a laser cooled Cs fountain apparatus operating at cryogenic temperature (88.5K), in order to reduce the blackbody radiation shift. The formal evaluation of the frequency standard is published in [1], while TAI calibration data are reported to BIPM since the end of 2013 and are published in the *Circular T*. The accuracy evaluation of the PFS involves periodic checks and validations of the whole set of parameters affecting the standard frequency: i.e. Zeeman shift, spectral purity of the microwave synthesis chain, interaction region temperature, atomic density shift, gravitational potential, and laser and microwave leak.

During 2015 we reported to BIPM seven formal evaluations of the standard hereafter summarized. The seven measurements have a duration ranging from 15 to 30 days with unwanted dead times ranging from 3 to 15 % over the whole evaluation period. The total operating time of ITCSF2 as PFS during 2015 was 170 days.

During fall 2015 ITCSsF2 was used to perform tests of the light shift theory, Hence during that period the fountain was not operated as a PFS and did not report useful data to calibrate TAI.

Circ T	Period	days	ITCsF2-d	uA	uB	Ul/Lab	Ul/Tai	u
326	57029 57054	25	-0.67	0.37	0.17	0.17	0.23	0.50
326	57054 57074	20	-0.32	0.62	0.17	0.14	0.28	0.72
328	57124 57139	15	-1.26	0.47	0.17	0.32	0.61	0.85
329	57139 57169	30	-0.21	0.34	0.17	0.11	0.27	0.48
330	57169 57199	30	0.99	0.19	0.30	0.10	0.20	0.42
331	57199 57229	30	-0.46	0.35	0.27	0.11	0.17	0.49
333	57269 57289	20	-0.19	0.30	0.30	0.10	0.28	0.52

The accuracy of ITCsF2 is nearly the same that was reported in [1] and it is summarized in the following table. It is worth mention that the statistical uncertainty associated with the atomic density, is obtained with long measurement time and therefore can vary from case to case according to the available set of data. Typically the low density uncertainty is <2E-16.

Typical accuracy evaluation

Physical effect	**Bias (10^{-16})**	**Uncert. (10^{-16})**
Zeeman effect	1074.9	0.8
Blackbody radiation	-1.45	0.12
Gravitational redshift	260.4	0.1
Microwave leakage	-1.2	1.4
DCP	-	0.2
2^{nd} order cavity pulling	-	0.3
Background gas	-	0.5
Total Type B**	**1332.6**	**1.7**
Atomic density (typical LD)*	-6.3	1.9
Total	**1326.3**	**2.5**

[1] Accuracy evaluation of ITCsF2: a nitrogen cooled caesium fountain, F. Levi, D. Calonico, C.E. Calosso, A. Godone, S. Micalizio and G.A. Costanzo; *Metrologia* **51** (2014) 270–284

Evaluations of NIM5 for BIPM Annual Report 2015

1. Primary clocks

1.1 Fountain clock NIM5

The NIM5 Cs fountain primary frequency standard was operated and reported to the BIPM three times in 2015 during MJD 57094-57109, 57119-57139 and 57179-57199. There is no big modification of NIM5. A typical fractional frequency instability of 3×10^{-13} $(\tau/s)^{-1/2}$ was obtained when running at high atom density. A typical Type B fractional frequency uncertainty is 1.4×10^{-15} [1]. During these three evaluation campaigns, the duty cycles are all above 90 %. The uncertainties due to the link between the H271 and NIM5 $u_{l/lab}$ contributed from dead times is about 2×10^{-16}.

Through May to June in 2015, the absolute frequency of the ^{87}Sr optical lattice clock is measured with respect to NIM5, the frequency of a flywheel H-maser of NIM5 is transferred to the Sr laboratory through a 50-km-long fibre. A fibre optical frequency comb, phase-locked to the reference frequency of this H-maser, is used for the optical frequency measurement. A total of 49113 s effective measurement data was acquired with 5 measurements. The total uncertainty of NIM5 during the measurements is 3.1×10^{-15}, mainly due to the Type A uncertainty of the fountain.

One of the cooling lasers of NIM5 was broken and replaced by a new laser. The system started to operate again since Jan. 2016.

1.2 Research work on the new fountain

A new fountain is under developing since 2014. Atoms will be loaded into optical molasses from a 3D MOT in the new fountain [2]. A new Ramsey cavity with 4 feeds and the vacuum system have been built. A 3-layer magnetic shield has been build and the magnetic field homogeneous range is more than 400 mm.

A new microwave chain with an RF interferometric switch is built, the phase fluctuations induced by the switch is reduced compared to the NIM5 measured by a microwave inspection system developed in NIM. The laser system and computer control system are also developing. Hopefully, the new fountain will be assembled in 2016 and start to collect data.

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Operation of NIST-F1 and NIST-F2 in 2015

NIST-F1, the first Cs fountain primary frequency standard at the National Institute of Standards and Technology (NIST), has been in operation since November 1998, and the first formal report to the BIPM was made in November 1999 [1]. Two papers updating the operation of NIST-F1 were later published in 2005 [2, 3]. In October 2013 the first formal report from NIST-F2 was submitted to the BIPM. NIST-F2 is a cryogenic Cs fountain that is operated at about 80K [4]. During a formal evaluation the average frequency of one of the hydrogen masers at NIST is measured by NIST-F1 and/or NIST-F2 and the results, along with all relevant biases and uncertainties, are reported to the BIPM for publication in *Circular T*. Neither NIST-F1 nor NIST-F2 is operated as a clock and both are run only intermittently. The two standards are constantly evolving, and both hardware and software improvements are continually being made. In all formal evaluations a range of atom densities are used along with a weighted linear least squares fit to determine the frequency at zero density. The frequency shifts from the lowest measured density to zero density are typically in the range of 4×10^{-16} to 8×10^{-16} for both standards. Each formal evaluation also includes mapping the magnetic field, and measurements of possible biases due to such things as microwave amplitude and light leaks.

Two formal NIST-F1 evaluations were carried out in 2015 after much needed repairs and a move to a new building were completed. Though the stability of the standard has improved, the Type B uncertainty is essentially unchanged. The Type B uncertainties in NIST-F1 for the two runs in 2015 are substantially the same as those given in Table 1 of [2], and are dominated by the blackbody and microwave amplitude shifts. Reference 2 is the source for u_B(Ref) given in *Circular T*. The density shift uncertainty is included in the Type A uncertainty. The total Type B uncertainty for both of the runs in 2015 was 3.1×10^{-16}, dominated by the blackbody shift with an uncertainty of 2.8×10^{-16}. The Type A uncertainties ranged from 3.7×10^{-16} to 4.6×10^{-16} for the two runs. The uncertainties due to the spin exchange shift ranged from 3.1×10^{-16} to 4.2×10^{-16}. Total uncertainties, including frequency transfer and dead time uncertainties, ranged from 5.6×10^{-16} to 6.8×10^{-16}.

Only one 20 day formal evaluation of NIST-F2 was carried out in 2015 due to some lengthy down time for laser repairs. The Type B uncertainty for the NIST-F2 run was 1.5×10^{-16}. Reference 4 is the source for u_B(Ref) given in *Circular T*. The density shift uncertainty is included in the Type A uncertainty. The Type A uncertainty was 4.3×10^{-16} for the one run. The uncertainty contribution due to the spin exchange shift was 3.7×10^{-16}. Total uncertainty, including frequency transfer and dead time uncertainties, was 7.5×10^{-16}.

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Operation of the NPL primary frequency standards in 2015

The National Physical Laboratory in the UK operates two caesium fountains. The first one, NPL-CsF2, has been fully evaluated and is operated as a primary frequency standard. For the second one, NPL-CsF3, work on a complete accuracy evaluation is ongoing.

NPL-CsF2 was made operational and characterised for the first time in 2009. Its accuracy was reassessed in 2011 and 2013. In 2015, the treatment of the blackbody radiation frequency shift was reviewed and the uncertainty was marginally reduced by using coefficients published in [1]. The most recent uncertainty budget is given below.

Type B uncertainty evaluation	Uncertainty / 10^{-16}
Second order Zeeman	0.8
Blackbody radiation	1.0
AC Stark (lasers)	0.1
Microwave spectrum	0.1
Gravity	0.5
Cold collisions (typically)	0.4
Collisions with background gas	0.3
Rabi, Ramsey pulling	0.1
Cavity phase (distributed)	1.1
Cavity phase (dynamic)	0.1
Cavity pulling	0.2
Microwave leakage	0.6
Microwave lensing	0.3
Second-order Doppler	0.1
Total u_B (1σ)	2.0

The frequency values measured in NPL-CsF2 are corrected for the following systematic effects:

- Second order Zeeman effect
- Blackbody radiation
- Cold collisions (automatically during measurements)
- Distributed cavity phase frequency shift
- Microwave lensing

During the calendar year 2015, two evaluations of the step interval by NPL-CsF2 were used in the formulation of TAI. The measurement procedure at NPL was the same as in the previous years, with the fountain operating in the vicinity of the zero-collisional frequency shift point. The residual collisional shift was continuously evaluated and the standard frequency extrapolated to the zero-density value.

The new fountain NPL-CsF3 operates with higher signal to noise than NPL-CsF2, and an improvement of the short-term stability to better than 4×10^{-14} (1s) was demonstrated using a novel microwave source based on an optical frequency comb transferring the stability of an ultra-stable laser to the microwave range [2].

References:

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TIME AND FREQUENCY ACTIVITIES OF NATIONAL PHYSICAL LABORATORY, INDIA (NPLI)

1. Precise Timing Systems

[Section removed by the BIPM for this publication]

2. Cesium Fountain, NPLI-CsF1

NPLI-CsF1 is being operated and evaluated almost continuously. In each evaluation (lasting 10-20 days), major systematic shifts due to blackbody radiation (BBR), 2nd order Zeeman, gravitational potential and collision shift are calculated and corrected. During an evaluation, the fountain frequency is compared with the Hydrogen MASER (H-MASER) which is contributing to the universal coordinated time (UTC) and hence fountain is evaluated with respect to the UTC. The Allan deviation of the frequency difference between the fountain and the H-Maser shows that fountain frequency is stable to few parts in 10^{15} at less than one day of averaging.

NPLI-CsF1 has contributed only once to TAI in 2015. The result was reported in *Circular T* no. 335 (November 2015) as shown in Fig. 1. There are some issues with the regular operation of the fountain. Work is in progress to keep the fountain up and running on a regular basis.

All values are expressed in 10**-15 and are valid only for the stated period of estimation.

Standard	Period of Estimation		d	uA	uB	ul/Lab	ul/Tai	u	uSrep	Ref(uS)	Ref(uB)	uB(Ref)
PTB-CS2	57324	57354	0.91	3.00	12.00	0.00	0.07	12.37	PFS/NA		T148	12.
NPLI-CsF1	57319	57329	-3.88	0.90	2.82	0.19	0.53	3.01	PFS/NA		[1]	2.50
SYRTE-FO2	57324	57339	-0.11	0.30	0.30	0.11	0.37	0.57	PFS/NA		T301	0.23
SYRTE-FORb	57324	57354	0.29	0.20	0.30	0.11	0.20	0.42	1.3	[2]	T301	0.32
PTB-CSF1	57324	57344	-0.21	0.09	0.70	0.01	0.09	0.71	PFS/NA		T162	1.40
SU-CsFO2	57324	57354	0.17	0.24	0.25	0.11	0.59	0.69	PFS/NA		T315	0.50

Fig. 1: NPLI-CsF1 contributed live to the TAI as shown in BIPM *circular T* no. 335 (November 2015).
ftp://ftp2.bipm.org/pub/tai//publication/cirt/cirt.335 (December 2015)

Operation of the PTB primary clocks in 2015

PTB's primary clocks with a thermal beam

During 2015 PTB's primary clocks CS1 and CS2 [1] were operated almost continuously, except that the CS1 oven was depleted and needed to be refilled in November 2015. Time differences UTC(PTB) - clock in the standard ALGOS format were reported to BIPM, so that $u_{l/lab}$ is zero. CS1 data were unavailable for MJDs 57339–57354. The mean relative frequency offset y(CS1 – CS2) amounted to -5.5×10^{-15}, which is compliant with the stated u_B values.

The clocks' operational parameters were checked periodically and validated to estimate the clock uncertainty. These parameters are the Zeeman frequency, the temperature of the beam tube (vacuum enclosure), the line width of the clock transition as a measure of the mean atomic velocity, the microwave power level, the spectral purity of the microwave excitation signal, and some characteristic signals of the electronics. Using a high-resolution phase comparator, the 5 MHz output signals of both clocks have been continuously compared to the signal of an active hydrogen maser (BIPM code 1400508), whose frequency was steered to serve as backup for the UTC(PTB) generation. As the steering was derived practically always through input from the fountain clocks CSF1 or CSF2 such comparisons reveal the unbiased performance of CS1 and CS2, respectively. Data analysis has been made based on several 15 to 20-day batches distributed during 2015.

CS1

The CS1 relative frequency instability $\sigma_y(\tau = 5000\ \text{s})$ was found to vary between 80×10^{-15} and 92×10^{-15} during 2015, in reasonable agreement with the prediction based on the prevailing parameters beam flux, clock transition signal and line width. With reference to TAI, the standard deviation of *d*(CS1) (*Circular T* Section 4, period of 10 months including October 2015) was 2.5×10^{-15}, well within the value $u_A(\tau = 30\ \text{d, CS1}) = 6 \times 10^{-15}$ stated in *Circular T*. During the year, only one reversal of the beam direction was performed on CS1. A second one could not happen because of the loss of beam signal towards the end of the year. No findings call for a modification of the previously stated relative frequency uncertainty u_B, which is 8×10^{-15} for CS1 [2].

CS2

The relative CS2 frequency instability of $\sigma_y(\tau = 5000\ \text{s})$ was measured between 52×10^{-15} and 60×10^{-15} during 2015. This range of values justifies the estimate of the uncertainty contributions u_A as $u_A(\tau = 30\ \text{d, CS2}) = 3 \times 10^{-15}$. The standard deviation of the 12 *d*-values reported in *Circular T* for 2015 amounted to 2.6×10^{-15}, in good agreement herewith. During the year, three reversals of the beam direction were performed on CS2.The uncertainty estimate as detailed in [1, 2] is considered as still valid, and the CS2 u_B is thus estimated as 12×10^{-15}. This value complies well with the mean offset between the CS2 seconds and the scale unit of TAI during 2015 of 2.3×10^{-15}.

PTB's primary caesium fountain clocks

In 2015 both caesium fountain clocks, CSF1 and CSF2, were operated regularly with a high duty cycle. For the generation of UTC(PTB) data of both fountains were routinely used for the steering of a hydrogen maser output frequency [3]. The steering data was selected based on the availability of the respective fountain data and the chosen priority.

The frequency synthesis for both fountains now routinely makes use of an optically stabilized microwave oscillator [4, 5] instead of employing quartz based microwave synthesis. In our setup the short term stability of the microwave oscillator is provided by a 1.5 μm cavity-stabilized fiber laser via a commercial femto-second frequency comb. In the long-term the microwave oscillator is locked to the hydrogen maser to enable fountain frequency measurements with respect to the maser. In this setup the instability contribution of the microwave oscillator via the Dick-effect becomes negligible and the overall instability is mostly caused by the quantum projection noise.

In June 2015, CSF1 and CSF2 participated in a European clock comparison campaign, during which various optical and caesium fountain clocks were running simultaneously for a direct remote comparison over three weeks via Two-Way Satellite Time and Frequency Transfer and Global Positioning System frequency transfer. While the evaluation of the international comparisons is still ongoing, the evaluations of the internal PTB absolute optical clock frequency measurements ($^{171}Yb^{+}$ octupole transition, ^{87}Sr $^{1}S_0$–$^{3}P_0$ transition) performed with CSF1 and CSF2 show good agreement with previously obtained results at PTB and elsewhere. During the measurement campaign both fountain frequencies agreed at the low 10^{-16} level, well within the combined fountain clock uncertainties.

CSF1

A detailed description of the PTB fountain CSF1 is given in Refs. [6] and [7]. Nine measurements of the TAI scale unit of 15 (1×), 20 (4×), 30 (3×) and 35 (1×) days duration were performed in 2015 and reported to the BIPM. Due to the performance and reliability of the laser systems, dead times are normally kept below 3 % of the nominal measurement duration. The resulting clock link uncertainty $u_{l/lab}$ was typically 0.02 × 10^{-15}. The statistical uncertainty of CSF1 measurements was calculated with the assumption of white frequency noise during the measurement intervals. For the nine TAI contributions in 2015 statistical uncertainties u_A < 0.2 × 10^{-15} were achieved.

In 2015 a new evaluation of the effect of cavity phase gradients was performed. As a result in the future there will be no systematic uncertainty contribution due to microwave power dependence anymore. The findings will be published together with the results of a new evaluation of other significant physical effects. For future measurements a significantly reduced overall systematic uncertainty is anticipated.

Below we compile typical frequency biases and type B uncertainties of CSF1 in 2015.

Physical effect	Bias / 10^{-15}	Type B uncertainty / 10^{-15}
Quadratic Zeeman shift	107.81	0.10
Black body radiation shift	- 16.56	0.10
Cold collisions	0.87	0.19
Gravitational red shift	8.58	0.10
Cavity phase		0.10
Majorana transitions		0.10
Rabi and Ramsey pulling		0.10
Microwave leakage		0.10
Electronics		0.10
Light shift		0.10
Background gas collisions		0.10
Microwave power dependence		0.60
Total type B uncertainty		0.70

Table 1: Typical frequency biases and type B uncertainties of PTB-CSF1 in 2015.

CSF2

A detailed description of the PTB fountain CSF2 is given in Refs. [8] and [9]. Four measurements of the TAI scale unit of 10, 15, 20 and 30 days duration, respectively, were performed and reported to the BIPM. The dead times of these measurements were in most cases below 4 % (in one case 7 %), so that the resulting clock link uncertainty $u_{l/lab}$ was 0.04×10^{-15} or below.

For all these TAI scale unit measurements the atoms were loaded from the background gas into the molasses. The statistical uncertainty of CSF2 measurements was calculated with the assumption of white frequency noise for the total measurement intervals. For the four TAI contributions in 2015 we arrived at statistical uncertainties $u_A < 0.3 \times 10^{-15}$.

During the second half-year 2015, a cold atom beam source has been put into operation for loading the optical molasses. As a result the number of loaded and detected atoms in a given amount of time is significantly increased, and - benefitting from the low phase noise of the optically stabilized microwave oscillator - frequency instabilities as low as 2.5×10^{-14} $(\tau/1\mathrm{s})^{-1/2}$ have been achieved. These changes needed to be accompanied by a new evaluation of the effects of cavity phase gradients and microwave lensing. A publication about the results, which point to a further reduction of the overall systematic uncertainty for future measurements, is in preparation.

Below we compile typical frequency biases and type B uncertainties of CSF2 in 2015.

Physical effect	Bias / 10^{-15}	Type B uncertainty / 10^{-15}
Quadratic Zeeman shift	100.232	0.010
Black body radiation shift	- 16.538	0.057
Cold collisions	- 0.59	0.21
Gravitational red shift	8.567	0.006
Cavity phase	0.044	0.133
Microwave lensing	0.072	0.036
Majorana transitions		0.0001
Rabi and Ramsey pulling		0.0013
Microwave leakage		0.10
Electronics		0.10
Light shift		0.001
Background gas collisions		0.05
Total type B uncertainty		0.30

Table 2: Typical frequency biases and type B uncertainties of PTB-CSF2 in 2015.

References

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[5] S. Weyers, B. Lipphardt, and H. Schnatz, *Phys. Rev. A* **79**, 031803(R) (2009)

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[8] V. Gerginov, N. Nemitz, S. Weyers, R. Schröder, D. Griebsch and R. Wynands, *Metrologia* **47,** 65–79 (2010)

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Operation of CsFO2 in 2015

For the year 2015 the SU-CsFO2 results were reported to TAI every month. The data scattering and area of scattering are the same as for BIPM reported pfs data. For one year the mean frequency difference between SU-CsFO2 and pfs is about -1×10^{-16}, that is the SU-CsFO2 frequency is lower than pfs frequency.

To process the measurement data an algorithm was developed. The algorithm is based on the fountain noise model presented in [1]. According to the model every phenomenon produces first of all the noise. The following noises are considered: They are – photodetector noise, quantum projection noise, atomic temperature noise, microwave power (synthesizer) noise and spin-exchange noise. Because of nonlinear dependence between the number of atoms and frequency we always have some frequency shifts due to these noises.

For practical realization the measurements were grouped by five parts containing one hundred cycles each. Every part corresponds to its own number of atoms in a cycle. The number of atoms is changed by changing selecting cavity power.

Five equations are compiled for five fluxes of atoms. The solution of the equations enables us to determin the frequency corrections. As a result we have a meaning of fountain frequency, which is referenced to zero number of atoms. All shifts are taken into account via uncertainty $\mathbf{u_a}$ **and are not included in** uncertainty $\mathbf{u_b}$.

There are the following evaluations of different shifts, which were made after one year of investigations.

The shift due to a photodetector is ~ (5×10^{-17})

The shift due to an OPN is ~ ($+1.5 \times 10^{-16}$). It was called as **D**-shift

The shift due to a atomic temperature noise ~ (5×10^{-17})

The shift due to a microwave power is ~ (1×10^{-17})

Spin-exchange shift is ~ (-2.5×10^{-16}).

All shifts are referred to mean statistical frequency with mean statistical flux of atoms. In any case the frequency of SU-CsFO2 should be lower than the pfs frequency because only we take into account the **D**-shift.

Reference

[1] Yu.S.Domnin, ”Atomic Fountain Equation”, Measurement Techniques, 58(10), 1135-1138. **DOI** 10.1007/s11018-015-0854-4.

Operation of the SYRTE fountain clocks in 2015

FO1, FO2Cs and FOM primary frequency standards

During 2015 we have transmitted to BIPM 2 and 11 calibrations of the reference hydrogen maser performed by the SYRTE caesium fountains FO1 and FO2-Cs, respectively.

The nominal operation of FO1 and FO2-Cs was the same as in 2014. The microwave synthesizers of both fountains are referenced to the signal provided by a cryogenic sapphire oscillator (CSO) phase locked to a hydrogen maser taking benefit of the CSO ultra-low phase noise. The relative frequency instabilities are routinely $\sigma_y(\tau) \sim 5 \times 10^{-14}\ \tau^{-1/2}$ for FO1 and FO2-Cs. These instabilities result from the combination of low and high atomic density operations required for the real time extrapolation of the cold collisions frequency shift and correspond to the quantum projection noise. The linear Zeeman shift and the temperature around the interrogation zone are measured every ~1 hour in order to estimate the corresponding frequency shifts of the clock transition. The distributed cavity phase shift is verified from time to time with differential measurements alternating the cavity feeds.

Table 1 gives the typical uncertainty budgets for the two SYRTE caesium fountain clocks operating in 2015. The values and the uncertainties of the frequency shifts, which depend on the operating parameters, are updated for each TAI monthly contribution.

Fountain	FO1		FO2-Cs	
Physical origin	Correction	Uncertainty	Correction	Uncertainty
2nd order Zeeman	-1224.3	0.2	-1919.5	0.3
Blackbody Radiation	171.4	0.6	169.6	0.6
Cold Collisions + cavity pulling	43.4	1.7	115.0	1.6
Distributed cavity phase shift	-1.0	2.7	-0.9	1.2
Microwave Leaks, spectral purity	0	<1	0	0.5
Ramsey & Rabi pulling	0	<1	0	<0.1
Microwave lensing	-0.7	<0.7	-0.7	0.7
Second order Doppler	0	<0.1	0	<0.1
Background gas collisions	0	<0.3	0	<1
Red shift	-69.3	1	-65.4	1
Total (1σ) uncertainty u_B		**3.8**		**2.7**

Table 1: Typical accuracy budgets for the SYRTE caesium fountains FO1 and FO2-Cs similar to the one given in [1]. (Values given in units of 10^{-16})

FO2-Rb secondary frequency standard

During 2015, FO2-Rb calibration reports were regularly sent to BIPM and included in *Circular T* as SYRTE-FORb, providing 12 calibration values of the reference H-maser. The FO2-Rb data published in *Circular T* starting January 2012 had initially no weight in the steering of TAI. Since July 2013, the participation to the steering of TAI is effective.

The operation of FO2-Rb, which is the Rb part of the dual fountain FO2, is similar to that of the Cs fountains. FO2-Rb operates simultaneously to FO2-Cs, the Cs part of FO2, but with a slightly different launch velocity allowing for separated time of flights and selective detection of both atom clouds. The microwave synthesis of FO2-Rb is also based on the low noise signal provided by the CSO signal phase locked to the reference H-maser. The fountain stability is typically $5 \times 10^{-14}\ \tau^{-1/2}$ when combining low and high atomic density measurements. For each calibration, in addition to the type A uncertainty (typically $1 - 2 \times 10^{-16}$), the type B uncertainty (typically 3×10^{-16}), and the uncertainty due to the link between the reference maser and the standard (typically $1 - 2 \times 10^{-16}$), the recommended uncertainty of the secondary representation of the second (1.3×10^{-15} with the current recommended value [3, 4]) is included. Table 2 gives the typical type B uncertainty budget of FO2-Rb.

Fountain	FO2-Rb	
Physical origin	Correction	Uncertainty
2nd order Zeeman	-3470.2	0.7
Blackbody Radiation	125.3	1.4
Cold Collisions + cavity pulling	6.9	1.4
First order Doppler	-0.35	1.0
Microwave Leaks, spectral purity	0	<0.5
Ramsey & Rabi pulling	0	<0.1
Microwave lensing	-0.7	0.7
Second order Doppler	0	<0.1
Background gas collisions	0	<1.0
Red shift	-65.4	1
Total (1σ) uncertainty u_B		**2.9**

Table 2: Typical type B uncertainty budget for the SYRTE FO2-Rb fountain similar to the one given in [2]. (Values given in units of 10^{-16})

Throughout 2015, the frequency calibrations of the reference H-maser by the SYRTE fountains were also used to produce a daily steering of the H-maser output signal for the generation of the French timescale UTC(OP).

References

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[4] 2013 International Committee for Weights and Measures, Decision CIPM/102-24, Procès-Verbaux des Séances du Comité International des Poids et Mesures 102nd Meeting (Sèvres, 2013) p. 28

Table 7. Mean fractional deviation of the TAI scale interval from that of TT

(File available at ftp://62.161.69.5/pub/tai/scale/sitai15.ar)

The fractional deviation *d* of the scale interval of TAI from that of TT (in practice the SI second on the geoid), and its relative uncertainty, are computed by the BIPM for all the intervals of computation of TAI, according to the method described in 'Azoubib J., Granveaud M., Guinot B., *Metrologia* 1977, **13**, pp. 87-93', using all available measurements from the most accurate primary frequency standards (PFS) IT-CSF1, IT-CSF2, NICT-CSF1, NIM5, NIST-F1, NIST-F2, NMIJ-F1, NPL-CSF2, NPLI-CSF1, PTB-CS1, PTB-CS2, PTB-CSF1, PTB-CSF2, SU-CSFO2, SYRTE-FO1, SYRTE-FO2, SYRTE-FOM and secondary frequency standard (SFS) SYRTE-FORb consistently corrected for the black-body radiation shift.
In this computation, the uncertainty of the link to TAI has been computed using the standard uncertainty of [UTC-UTC(*k*)], following the recommendation of the CCTF working group on PFS. The model for the instability of EAL has been expressed as the quadratic sum of three components: a white frequency noise $1.7 \times 10^{-15}/\sqrt{(\tau)}$ in 2013 and 2014 and $1.4 \times 10^{-15}/\sqrt{(\tau)}$ in 2015, a flicker frequency noise 0.35×10^{-15} in 2013 and 2014 and 0.3×10^{-15} in 2015 and a random walk frequency noise $0.4 \times 10^{-16} x\sqrt{(\tau)}$ in 2013 and $0.2 \times 10^{-16} x\sqrt{(\tau)}$ in 2014 and in 2015, with τ in days. The relation between EAL and TAI is given in Table 5.

Month	Interval	$d/10^{-15}$	uncertainty/10^{-15}
Jan. 2013	56289-56319	-0.09	0.20
Feb. 2013	56319-56349	+0.11	0.22
Mar. 2013	56349-56379	+0.57	0.22
Apr. 2013	56379-56409	-0.16	0.21
May 2013	56409-56439	-0.27	0.19
Jun. 2013	56439-56469	+0.05	0.24
Jul. 2013	56469-56504	-0.39	0.21
Aug. 2013	56504-56534	-0.61	0.26
Sep. 2013	56534-56564	+0.30	0.25
Oct. 2013	56564-56594	+0.29	0.21
Nov. 2013	56594-56624	+0.32	0.21
Dec. 2013	56624-56654	-0.42	0.24
Jan. 2014	56654-56684	+0.32	0.25
Feb. 2014	56684-56714	-0.27	0.20
Mar. 2014	56714-56744	-0.64	0.21
Apr. 2014	56744-56774	-0.49	0.19
May 2014	56774-56804	-0.83	0.21
Jun. 2014	56804-56834	-0.86	0.23
Jul. 2014	56834-56869	-0.29	0.22
Aug. 2014	56869-56899	+0.42	0.19
Sep. 2014	56899-56929	+0.20	0.18
Oct. 2014	56929-56959	+0.37	0.20
Nov. 2014	56959-56989	+0.64	0.26
Dec. 2014	56989-57019	+0.48	0.25
Jan. 2015	57019-57049	+0.08	0.27
Feb. 2015	57049-57079	-0.48	0.24
Mar. 2015	57079-57109	-0.18	0.23
Apr. 2015	57109-57139	-0.14	0.23
May 2015	57139-57169	+0.34	0.21
Jun. 2015	57169-57199	+0.81	0.18
Jul. 2015	57199-57234	+0.52	0.25
Aug. 2015	57234-57264	+0.31	0.26
Sep. 2015	57264-57294	+0.07	0.21
Oct. 2015	57294-57324	+0.26	0.24
Nov. 2015	57324-57354	+0.05	0.31
Dec. 2015	57354-57384	+0.01	0.37

Independent local atomic time scales

Local atomic time scales are established by the time laboratories which contribute with the appropriate clock data to the BIPM. Starting on 1 January 1998, the differences between TAI and the atomic scale maintained by each laboratory are available on the Publications page of the Time Department's FTP Server including the relevant notes. For each time laboratory 'lab' a separate file TAI-lab is provided; it contains the respective values of the differences [*TAI - TA(lab)*] in nanoseconds, for the standard dates.

For dates from January 1982 to December 1992 and from January 1993 to December 1998, the differences between TAI and the atomic scale maintained by each laboratory are available on the Scales page of the Time Department's FTP server including the relevant notes. The values of [*TAI - TA(lab)*] are given in yearly files. Note that the formats of the [TAI – TA(lab)] files are different in the two intervals.

Local representations of UTC

The time laboratories which submit data to the BIPM keep local representations of UTC. Starting on 1 January 1998, the computed differences between UTC and each local representation are available on the Publications page of the Time Department's FTP Server including the relevant notes. For each time laboratory 'lab' a separate file UTC-lab is provided; it contains the values of the differences [*UTC - UTC(lab)*] in nanoseconds, for the standard dates.

For dates from January 1990 to December 1992 and from January 1993 to December 1998, the computed differences between UTC and each local representation maintained by each laboratory are available on the Scales page of the Time Department's FTP server including the relevant notes. The values of [*UTC - UTC(lab)*] are given in yearly files. Note that the formats of the files [*UTC – UTC*(*lab*)] are different in the two intervals.

Starting on MJD 56467 daily values of the differences [*UTCr-UTC(lab)*] in nanoseconds are given in one file per laboratory. The results during the UTCr Pilot Experiment (February 2012-June 2013) are also available.

Relations of UTC and TAI with GPS time, GLONASS time, UTC(USNO)_GPS and UTC(SU)_GLONASS

(File available at ftp://62.161.69.5/pub/tai/scale/UTCGPSGLO/utcgpsglo15.ar)

[*TAI - GPS time*] and [*UTC - GPS time*]

The GPS satellites disseminate a common time scale designated 'GPS time'. The relation between GPS time and TAI is:

$$[TAI - GPS\ time] = 19\ \mathrm{s} + C_0,$$

where the time difference of 19 seconds is kept constant and C_0 is a quantity of the order of tens of nanoseconds, varying with time.

The relation between GPS time and UTC involves a variable number of seconds as a consequence of the leap seconds of the UTC system and is as follows:

From 1 July 2015, 0 h UTC, until further notice, $[UTC - GPS\ time] = -17\ \mathrm{s} + C_0$,

Here C_0 is given at 0 h UTC every day.

C_0 is computed as follows. The GPS data recorded at the Paris Observatory for highest-elevation satellites are first corrected for precise satellite ephemerides and for ionospheric delays derived from IGS maps, and then smoothed to obtain daily values of [*UTC*(*OP*) - *GPS time*] at 0 h UTC. Daily values of C_0 are then derived by linear interpolation of [*UTC* - *UTC*(*OP*)].

The standard deviation σ_0 characterizes the dispersion of individual measurements for a month. The actual uncertainty of user's access to GPS time may differ from these values. N_0 is the number of measurements.

[*TAI – UTC(USNO)_GPS*] and [*UTC – UTC(USNO)_GPS*]

The GPS satellites broadcast a prediction of UTC(USNO) calculated at the USNO, indicated by UTC(USNO)_GPS. The relation between UTC(USNO)_GPS and TAI involves a variable number of seconds as a consequence of the leap seconds of the UTC system, and is as follows:

From 1 July 2015, 0 h UTC, until further notice, $[TAI – UTC(USNO)\_GPS] = 36\ \mathrm{s} + C_0'$

Here C_0' is given at 0 h UTC every day.

C_0' is computed using the values of [*UTC* - *UTC*(*OP*)] similarly than the computation of C_0.

The relation between UTC(USNO)_GPS and UTC is $[UTC– UTC(USNO)\_GPS] = 0\ \mathrm{s} + C_0'$

The standard deviation σ_0' characterizes the dispersion of individual measurements for a month. The actual uncertainty of user's access to UTC(USNO)_GPS may differ from these values. N_0' is the number of measurements.

Relations of UTC and TAI with GPS time, GLONASS time, UTC(USNO)_GPS and UTC(SU)_GLONASS (Cont.)

(File available at ftp://62.161.69.5/pub/tai/scale/UTCGPSGLO/utcgpsglo15.ar

[*UTC - GLONASS time*] and [*TAI - GLONASS time*]

The GLONASS satellites disseminate a common time scale designated 'GLONASS time'. The relationship between GLONASS time and UTC is

$$[UTC - GLONASS\ time] = 0\text{ s} + C_1,$$

where the time difference 0 s is kept constant by the application of leap seconds so that GLONASS time follows the UTC system, and C_1 is a quantity of the order of several tens of nanoseconds (tens of microseconds until 1 July 1997), which varies with time.

The relation between GLONASS time and TAI involves a variable number of seconds and is as follows:

From 1 July 2015, 0 h UTC, until further notice, $[TAI - GLONASS\ time] = 36\text{ s} + C_1$.

Here C_1 is given at 0 h UTC every day.

C_1 is computed as follows. The GLONASS data recorded at the Astrogeodynamical Observatory, Borowiec, Poland for the highest-elevation satellites are smoothed to obtain daily values of [*UTC*(*AOS*) - *GLONASS time*] at 0 h UTC. Daily values of C_1 are then derived by linear interpolation of [*UTC* - *UTC*(*AOS*)].

To ensure the continuity of C_1 estimates, the following corrections are applied:

+1285 ns from 1 January 1997 (MJD 50449) to 22 March 1999 (MJD 51259)
+107 ns for 23 March 1999 and 24 March (MJD 51260 and MJD 51261)
0 ns since 25 March 1999, (MJD 51262).

The standard deviation σ_1 characterizes the dispersion of individual measurements for a month. The actual uncertainty of user's access to GLONASS time may differ from these values. N_1 is the number of measurements.

[*TAI – UTC(SU)_GLONASS*] and [*UTC – UTC(SU)_GLONASS*]

The satellites broadcast a prediction of UTC(SU) calculated at the SU, indicated by UTC(SU)_GLONASS. The relation between UTC(SU)_GLONASS and TAI involves a variable number of seconds as a consequence of the leap seconds of the UTC system, and is as follows:

From 1 July 2015, 0 h UTC, until further notice, $[TAI – UTC(SU)\_GLONASS] = 36\text{ s} + C_1'$

Here C_1' is given at 0 h UTC every day.

C_1' is computed using the values of [*UTC* - *UTC*(*AOS*)] similarly than the computation of C_1.

The relation between UTC(SU)_GLONASS and UTC is $[UTC– UTC(SU)\_GLONASS] = 0\text{ s} + C_1'$

The standard deviation σ_1' characterizes the dispersion of individual measurements for a month. The actual uncertainty of user's access to UTC(SU)_GPS may differ from these values. N_1' is the number of measurements.

Table 8. Rates relative to TAI of contributing clocks in 2015

(File available on http://www.bipm.org under the name RTAI15.AR)

Mean clock rates relative to TAI are computed for one-month intervals ending at the MJD dates given in the table.
When an intentional frequency adjustment has been applied to a clock, the uninterrupted data prior to this adjustment are corrected, so that Table 8 gives homogeneous rates for those clocks present along the whole year 2015. For studies including the clock rates of previous years, corrections must be brought to the data published in the Annual Report for the previous years.
These corrections are available from the Time department under request. Unit is ns/day,
"   -" denotes that the clock was not used, "*" denotes that the related rate was influenced by a frequency jump.

The clocks are designated by their type (2 digits) and serial number in the type. The codes for the types are:

12 HEWLETT-PACKARD 5061A
13 EBAUCHES, OSCILLATOM B5000
14 HEWLETT-PACKARD 5061A OPT. 4
16 OSCILLOQUARTZ 3200
17 OSCILLOQUARTZ 3000
15 DATUM/SYMMETRICOM Cs III
18 DATUM/SYMMETRICOM/MICROSEMI Cs 4000
19 RHODES AND SCHWARZ XSC
21 OSCILLOQUARTZ 3210
22 OSCILLOQUARTZ OSA 3230B
23 OSCILLOQUARTZ EUDICS 3020
24 OSCILLOQUARTZ OSA 3235B
25 HEWLETT_PACKARD 5062C
30 HEWLETT-PACKARD 5061B
31 HEWLETT-PACKARD 5061B OPT. 4
34 H-P 5061A/B with 5071A tube
35 H-P/AGILENT/SYMMETRICOM/MICROSEMI 5071A High perf.
36 H-P/AGILENT/SYMMETRICOM/MICROSEMI 5071A Low perf.
4x HYDROGEN MASERS
50 FREQ. AND TIME SYSTEMS INC. 4065A
51 DATUM/SYMMETRICOM 4065 B
52 DATUM/SYMMETRICOM 4065 C
53 DATUM/SYMMETRICOM/MICROSEMI 4310 B
9x PRIMARY CLOCKS AND PROTOTYPES

Lab.	Clock	57049	57079	57109	57139	57169	57199	57234	57264	57294	57324	57354	57384
APL	35 904	38.08	37.57	38.70	40.05	40.12	40.33	40.08	39.11	38.25	37.29	37.73	39.80
APL	35 1264	19.85	20.30	19.55	20.16	19.60	19.78	19.07	18.19	18.12	17.99	19.44	19.78
APL	35 1791	0.92	0.13	0.21	0.50	0.73	1.04	1.03	0.31	1.21	1.58	1.27	3.43
APL	40 3107	33.79	33.82	34.12	34.29	34.50	34.64	34.84	34.76	35.19	35.19	35.50	35.59
APL	40 3108	488.97	491.66	494.57	497.32	500.11	502.83	505.91	508.65	511.61	514.15	516.86	519.41
APL	40 3109	31.30	30.83	30.56	30.12	29.77	29.34	29.10	28.40	28.30	27.76	27.55	27.17
AUS	35 2269	-2.26	-2.76	-1.45	-1.96	-3.54	-2.76	-	-	12.94	12.57	-	-
AUS	36 299	13.67	12.70	13.78	13.01	11.73	12.48	-	14.91	11.34	13.67	13.98	12.87
AUS	36 340	3.37	0.14	1.95	1.58	0.80	0.68	-	2.77	1.17	1.84	2.45	2.74
AUS	36 654	2.33*	1.86*	1.44*	1.24*	1.92*	2.69	-	-	3.91	3.80	3.85	4.04

Table 8. (Cont.)

Lab.	Clock	57049	57079	57109	57139	57169	57199	57234	57264	57294	57324	57354	57384
AUS	36 1141	14.57	12.64	11.95	12.61	11.43	12.81	-	11.81	11.37	10.04	14.45	13.77
AUS	36 2269	-	-	-	-	-	-	-	-	-	-	-	12.04
BEV	35 1793	1.56*	0.56*	1.77*	1.05*	0.70*	-1.74*	-0.80*	0.45*	-0.77*	-0.47*	-0.34	-0.74
BEV	35 3009	-0.87	-1.20	-1.35	-0.57	-0.49	-	-0.47	-0.65	-0.47	-0.36	-0.28	-0.57
BEV	40 3452	-35.79*	-	-72.71*	-68.07*	-63.50*	-	-53.80*	-	-43.34*	-38.29*	-33.61*	-27.83
BIM	18 8058	3.40	1.74	3.03	4.12	2.52	4.18	1.44	5.18	5.15	3.27	3.50	5.20
BY	40 4222	0.70	-3.60	-2.91	-4.82	-8.48	-7.48	-6.59	-6.62	-5.45	-	-	-
BY	40 4227	3.85*	6.05*	7.86*	6.33*	7.01*	3.25	1.97	1.41	1.67	1.04	0.66	1.90
BY	40 4229	9.10*	-5.19*	-5.62*	-5.46*	-5.57*	-2.40*	6.14*	5.07	-8.77	-9.25	-9.64	-15.08
BY	40 4278	-	14.60	14.50	13.75	12.41	11.09	10.00	8.31	4.61	3.00	0.90	1.56
CH	24 105	8.07	12.68	13.40	16.41	18.89	21.16	23.84	28.93	36.00	35.41	36.14	39.67
CH	35 2117	3.17	1.80	1.68	1.72	1.24	2.05	1.68	1.59	1.79	3.70	1.83	1.98
CH	35 2743	-3.78	-4.90	-12.66	-12.87	-11.93	-12.25	-13.92	-14.15	-13.88	-13.50	-13.67	-15.32
CH	40 5701	-0.09	-0.62	-0.89	-1.08	-1.30	-1.61	-1.88	-1.99	-2.06	-2.14	-2.17	-2.34
CH	40 5702	-	-	-	-	-	-	-	18.17	20.15	22.08	24.27	26.57
CNM	35 2708	-	-7.82	-7.24	-8.06	-7.68	-8.47	-9.10	-8.86	-8.37	-8.40	-8.82	-8.83
CNM	35 2709	-	-0.40	-0.90	-0.51	0.74	-0.12	-1.62	-1.57	-0.93	-0.39	-1.63	-1.77
CNM	35 2885	-	-20.61	-21.21	-20.84	-21.06	-20.77	-20.58	-20.84	-21.73	-22.01	-21.44	-22.57
CNM	35 3055	-	-	-	2.96	3.29	3.87	4.45	4.26	4.91	4.91	4.17	4.51
CNM	40 7301	-	-1.83	-2.20	-2.40	-2.50	-2.66	-2.04	-2.22	-2.07	-2.75	-2.53	-2.77
CNM	40 7302	-	39.07	49.89	60.10	70.45	80.57	91.10	101.44	111.09	6.52	11.25	19.85
CNMP	36 1752	7.16	5.86	6.13	5.86	5.73	9.06	-	-25.26	-24.89	-25.30	-24.72	-23.49
CNMP	36 1806	-0.39	-0.53	0.21	0.87	-1.24	-0.59	-	36.61	36.61	36.69	37.03	35.00
CNMP	36 2873	1.52	1.57	2.13	2.48	1.56	2.36	-	-4.50	-5.13	-5.41	-5.17	-2.28
DFNT	36 2866	-	-	38.66	38.57	38.40	37.26	37.46	-	-	36.49	36.93	37.31
DMDM	35 2191	20.40	17.93	-	19.26	-	-	-	-	-	-	2.13	2.29
DMDM	36 2033	8.69	10.25	9.89	9.46	9.03	8.45	9.03	9.08	10.18	8.89	7.67	9.44
DTAG	35 2805	0.47	0.55	0.60	-0.04	0.67	0.89	-	-	-0.34	-0.31	0.29	0.46
DTAG	35 2941	-0.67*	-1.45*	-1.73*	-1.81*	-1.10*	-0.46*	-	-	-0.21	-0.12	-	-
DTAG	35 2966	1.42	1.65	1.62	1.66	2.00	1.98	-	-	2.71	2.49	3.58	2.72

Table 8. (Cont.)

Lab.	Clock	57049	57079	57109	57139	57169	57199	57234	57264	57294	57324	57354	57384
DTAG	35 3053	-	-	-	-	-	-	-	-	-	-	-	0.04
EIM	35 716	16.74	-	-	19.69	18.63	19.34	-	-	-	-	-	-
EIM	35 2060	0.09	0.10	-	-0.05	-0.22	-0.01	-	-	-	0.24	-0.31	-0.13
ESTC	22 132	-243.00*	-238.18*	-230.48*	-227.15*	-237.94*	-	-273.14*	-217.12*	-214.13*	-205.35	-	-
ESTC	35 1615	14.82	15.34	16.12	16.13	16.90	17.02	17.54	16.90	17.06	18.14	19.08	10.63
ESTC	35 2025	3.63	4.21	4.29	5.23	4.45	4.90	3.30	2.66	2.98	3.06	3.36	5.05
ESTC	35 2353	7.87	7.34	7.27	8.10	8.04	8.69	8.40	8.17	8.30	8.68	6.70	17.92
ESTC	40 2543	0.47	0.83	1.08	1.38	0.16	-0.45	-1.73	-2.14	-2.66	-1.67	-1.92	-0.84
ESTC	40 2544	1.17	0.54	1.86	0.63	-0.13	-	-	-3.92	-6.19	-5.98	-7.52	-7.94
F	35 124	6.37	6.57	6.73	6.47	6.62	6.45	6.59	5.28	4.74	5.84	6.11	-
F	35 157	12.61	13.12	12.93	13.50	12.71	11.68	12.04	12.48	12.67	12.75	12.40	12.37
F	35 158	14.55	-	-	-	-	-	-	-	-	-	-	-
F	35 355	2.57	2.79	3.40	3.09	2.40	0.78	1.06	0.96	1.14	-0.08	0.06	0.08
F	35 385	23.48	21.82	21.80	21.22	-	-	-	-	-	-	-	-
F	35 396	1.68	2.36	1.47	2.69	2.56	1.83	1.32	1.78	2.37	1.71	1.65	2.00
F	35 469	-3.14	-3.12	-3.00	-2.45	-3.75	-3.75	-2.74	-3.82	-3.40	-3.70	-4.31	-3.60
F	35 489	18.03	19.45	19.80	19.53	19.48	19.76	19.15	19.24	20.41	18.66	18.93	19.91
F	35 609	-32.82	-33.22	-32.66	-33.60	-34.49	-	-	-	-	-	-	-34.67
F	35 770	-10.13	-9.73	-9.52	-10.28	-9.97	-8.98	-11.30	-10.83	-10.42	-10.58	-10.80	-
F	35 774	26.12	25.77	25.99	25.57	25.34	26.35	26.31	25.53	28.21	28.87	29.34	30.06
F	35 781	8.13	8.13	7.82	9.34	8.48	8.70	8.55	8.73	8.73	8.85	7.81	7.74
F	35 859	5.70	6.40	3.03	2.89	2.73	3.72	3.67	4.35	2.86	4.01	3.63	2.61
F	35 1177	-0.52	-1.79	-3.09	-3.70	-4.24	-3.41	-4.83	-4.35	-4.60	-5.54	-3.77	-3.68
F	35 1222	1.73	1.99	1.73	2.69	1.73	2.82	2.63	3.85	2.94	1.17	0.95	0.18
F	35 1321	0.92	2.84	2.41	1.80	1.20	0.55	1.54	1.53	1.90	1.34	0.96	2.76
F	35 1556	-4.48	-2.58	-2.71	-2.99	-2.95	-	-	-	-	-	-	-6.40
F	35 1644	8.29	9.61	8.48	9.11	9.02	8.34	8.61	8.52	8.76	9.21	8.39	9.12
F	35 2388	3.57	4.41	3.86	3.36	2.91	3.15	3.61	4.05	3.79	4.09	4.23	4.36
F	35 2609	5.39	5.88	2.96	1.52	2.02	2.30	2.13	2.81	3.46	2.78	2.83	2.31
F	35 2647	24.94	25.34	25.88	27.11	26.70	25.79	27.01	26.68	28.22	26.22	25.72	24.70

Table 8. (Cont.)

Lab.	Clock	57049	57079	57109	57139	57169	57199	57234	57264	57294	57324	57354	57384
F	35 2804	4.46	5.61	4.55	5.07	5.11	5.42	5.56	5.99	5.99	6.59	6.41	6.59
F	35 2985	-	-13.18	-12.88	-12.90	-12.70	-12.68	-13.12	-12.08	-12.27	-12.61	-12.31	-12.47
F	40 809	5.76	6.51	7.29	8.04	8.84	9.47	10.30	11.27	11.93	12.61	13.32	14.04
F	40 810	-	32.98	33.76	34.62	35.16	35.71	36.49	37.41	38.03	38.60	39.18	39.66
F	40 889	22.84	23.29	23.58	23.89	24.10	24.40	24.84	25.19	25.51	25.81	26.13	26.63
F	40 890	16.60	16.77	16.89	17.07	17.20	17.22	17.39	17.54	17.68	17.76	17.92	18.11
HKO	35 2425	0.39*	-0.38*	-0.13*	0.15*	0.02*	-0.42*	-0.48	-	-0.87	-1.26	-0.95	-1.82
HKO	35 2884	-0.12*	-0.38*	-0.17*	0.08*	-0.21*	0.65*	0.39	0.07	-0.63	0.30	0.62	0.55
IFAG	36 1167	-3.37	-4.11	-3.11	-3.53	-1.84	0.26	-0.01	-1.82	-1.79	-2.11	-1.99	-1.68
IFAG	36 1173	-	-	-	-	-	-4.30	-7.03	-8.50	-5.93	-3.46	-3.49	-3.76
IFAG	36 1629	9.33	9.51	9.80	9.37	9.73	10.61	11.56	11.52	10.73	10.15	13.25	12.75
IFAG	36 1732	13.22	13.22	14.56	14.19	13.51	15.25	14.55	15.18	13.81	14.44	13.58	13.83
IFAG	36 1798	-2.11	-2.82	-1.68	-2.77	-2.44	-2.16	-1.89	-2.61	-2.24	-1.87	-1.71	-1.33
IFAG	40 4418	7.71	7.82	8.17	8.24	8.30	8.41	8.53	8.89	8.95	9.40	9.26	9.71
IFAG	40 4439	-27.09*	-27.40*	-27.47*	-	-21.67*	-16.95*	-12.22*	-8.08*	-4.57*	-0.94*	2.29	5.82
IMBH	35 2685	-	-	-	-	-	-5.87	-19.61	32.14	-1.25	-119.47	10.86	-6.66
IMBH	35 2909	-	-	-	-	-	9.70*	9.54*	2.98*	4.76*	-9.12*	-3.54	-2.73
INPL	35 2480	-1.82*	-0.48*	0.44*	0.47	0.02	1.44	0.16	0.87	0.49	0.64	1.15	0.72
INPL	35 2481	-4.04	-4.23	-3.44	-4.16	-4.52	-5.00	-3.32	-2.97	-3.71	-3.33	-2.39	-2.58
INTI	35 2377	-3.66	-	-	-	-	-	-	-	-	-	-	-
INTI	36 2377	-	-	1.49	2.24	-1.15	-1.43	1.42	-0.84	-1.51	-1.54	-0.21	-0.58
INXE	35 2393	-1.59	1.36	-0.27	0.02	-1.19	0.93	-0.34	0.29	0.00	0.55	-0.58	0.43
IT	35 219	1.96	1.32	1.65	2.86	2.33	2.11	1.81	2.14	1.85	3.09	1.67	2.33
IT	35 505	-25.34	-24.63	-24.51	-25.16	-25.00	-24.27	-24.28	-25.17	-23.90	-25.41	-24.73	-24.46
IT	35 1115	-4.72	-4.93	-4.77	-3.10	-3.51	-2.46	-2.08	-1.92	-2.21	-1.72	-1.87	-1.79
IT	35 1373	-7.09	-7.16	-7.18	-7.21	-7.11	-7.10	-7.04	-	-	-	0.64	0.31
IT	35 2118	12.27	12.23	11.79	11.60	11.84	11.09	11.26	10.23	9.47	9.69	10.35	10.64
IT	35 2487	-5.60	-4.06	-4.57	-4.69	-4.43	-4.21	-4.88	-4.20	-3.63	-	-	-
IT	40 1101	54.00	58.68	63.26	67.88	72.41	76.73	81.74	86.56	91.02	95.28	99.71	103.94
IT	40 1102	55.54	59.97	64.18	68.81	73.38	77.51	82.13	86.74	90.84	95.02	99.06	102.79

Table 8. (Cont.)

Lab.	Clock	57049	57079	57109	57139	57169	57199	57234	57264	57294	57324	57354	57384
IT	40 1103	44.44	45.36	46.35	47.33	48.24	48.94	50.12	51.02	51.92	52.77	53.65	54.61
IT	40 1104	-44.23	-51.79	-56.29	-54.84	-52.98	-51.09	-48.52	-45.84	-43.18	-40.66	-37.70	-36.45
JV	36 1277	-13.20	-14.31	-15.39	-14.65	-16.02	-15.29	-13.88	-12.84	-12.84	-15.41	-13.35	-13.71
JV	36 2617	13.60	13.76	12.72	12.11	12.23	13.07	12.27	14.88	13.68	12.53	11.62	12.64
JV	36 2629	-4.55	-3.01	-4.75	-5.64	-5.29	-4.32	-4.05	-3.50	-5.33	-4.67	-5.00	-4.37
JV	40 8713	7.71	6.57	4.33	2.77	2.12	1.87	-0.33	-1.35	-2.37	-3.40	-3.37	-3.81
KEBS	35 2518	-	-56.93	-	-	-	-	-	-	-	-	-	46.68
KRIS	35 321	7.01	6.25	5.76	5.96	5.67	5.63	5.16	4.24	4.91	4.45	4.15	4.43
KRIS	35 739	-0.34	-0.11	-0.56	-0.79	-1.38	-0.93	-0.40	0.09	0.45	0.99	0.63	1.03
KRIS	35 1135	14.56	16.20	16.83	16.91	17.01	17.09	18.44	20.89	20.12	21.84	23.03	26.61
KRIS	35 1693	8.93	9.24	8.61	8.37	9.09	8.88	8.60	8.88	9.01	10.07	9.12	9.39
KRIS	35 1783	21.63	22.35	22.37	21.46	22.29	22.38	21.47	21.70	21.50	21.57	22.27	22.58
KRIS	40 5625	13.74	14.03	14.05	14.20	14.43	14.88	14.81	-	-	-	-	-
KRIS	40 5626	3.27	3.56	3.76	3.97	4.10	4.31	4.52	4.64	4.85	5.09	5.28	5.44
KZ	35 2202	2.43	2.06	2.06	2.27	1.17	2.21	2.14	1.72	1.43	2.15	2.13	0.92
KZ	35 2665	5.14	5.46	5.56	5.88	5.38	5.84	5.61	7.77	4.37	5.90	5.10	5.30
KZ	35 2667	4.75	4.98	4.98	3.99	3.94	4.24	4.01	5.46	3.78	4.28	4.45	3.27
LT	35 1362	1.03	1.91	1.32	-0.73	0.15	-0.12	1.31	0.34	0.69	1.74	3.04	2.98
LT	35 1868	0.77	0.75	0.20	0.41	0.55	0.93	1.34	0.58	0.62	0.63	1.04	1.04
MASM	35 2900	-5.62	-	-5.90	-5.64	-	-	-	-	-	-	-	-
MBM	24 125	-	-	-	-	-	-	-	-	-	-	0.37	-
MIKE	36 986	1.73	4.46	-	1.75	3.95	3.87	3.02	0.74	1.80	1.65	2.22	3.11
MIKE	40 4108	3.02	3.08	-	3.19	3.25	3.20	3.40	3.52	3.64	3.74	3.93	4.17
MIKE	40 4113	9.16	10.51	-	13.96	15.98	17.47	18.45	20.35	19.74	17.22	20.13	21.74
MIKE	40 4180	0.03	0.80	-	1.95	2.27	3.07	3.43	3.71	4.23	4.71	5.18	5.69
MIKE	40 4189	-	-	-	-	-	-	-2.12	-2.44	-0.85	1.26	3.43	4.66
MKEH	36 849	-40.75	-40.41	-41.11	-40.58	-39.77	-40.31	-41.80	-41.61	-41.60	-40.69	-41.14	-40.34
MTC	35 3000	-	-	0.69	1.14	1.10	1.13	1.00	0.47	1.14	-	1.22	1.17
MTC	35 3002	0.92	1.11	1.60	2.20	1.10	1.64	1.26	1.94	2.07	-	2.27	2.66
MTC	35 3003	1.60	2.65	2.41	2.22	-	-	-	-	-	-	-	-

Table 8. (Cont.)

Lab.	Clock	57049	57079	57109	57139	57169	57199	57234	57264	57294	57324	57354	57384
MTC	35 3004	-0.73	0.62	1.42	1.33	0.89	1.01	-	-	-	-	-	-
MTC	35 3005	0.12	1.19	0.67	0.37	0.51	0.82	0.89	0.88	1.13	-	1.44	1.11
NAO	35 779	2.25	-0.31	-0.98	0.42	1.25	0.61	0.57	0.84	-0.52	-1.74	0.42	-0.05
NAO	35 1206	-3.99	3.91	4.86	3.17	3.60	4.78	6.19	6.21	3.67	-0.03	-7.31	-8.49
NAO	35 1214	0.27	-0.01	-0.84	0.02	0.09	-0.40	-0.57	-0.40	1.56	4.98	4.60	4.53
NAO	35 1689	-0.28	-0.81	-0.28	-0.19	-0.95	-1.47	-0.55	-	-	-	2.66	2.70
NAO	40 1301	3.45	1.15	-2.19	-5.02	-1.37	-	4.44	5.53	1.48	-3.23	-1.15	1.26
NICT	35 332	4.76	-	-	6.89	6.24	6.74	6.87	7.27	7.32	7.55	7.41	7.63
NICT	35 343	7.06	-	-	34.63	35.13	35.31	35.33	35.78	35.86	36.03	35.46	36.18
NICT	35 715	8.88	9.22	8.46	9.14	9.01	9.02	9.86	9.57	8.91	8.59	9.26	8.83
NICT	35 732	-6.59	-8.20	-7.37	-7.21	-8.03	-7.58	-7.37	-7.76	-7.73	-6.84	-7.91	-7.84
NICT	35 907	16.50	16.57	16.57	16.77	16.96	17.09	17.93	17.16	16.58	15.85	16.34	16.61
NICT	35 913	-15.36	-13.92	-14.92	-14.91	-13.80	-14.42	-14.53	-13.78	-13.20	-14.16	-12.92	-13.70
NICT	35 916	1.82	1.95	1.55	1.86	2.03	2.39	2.18	2.12	1.97	2.36	3.67	3.62
NICT	35 1225	20.33	-	28.18	27.28	27.71	27.67	27.90	26.83	27.09	27.84	27.94	27.77
NICT	35 1226	5.37	6.11	7.16	5.20	5.48	6.16	5.36	5.25	5.84	7.15	5.76	4.99
NICT	35 1611	2.34	3.24	1.66	0.58	3.16	2.75	0.98	0.39	0.88	0.87	-9.49	-
NICT	35 1778	-24.56	-24.16	-24.76	-25.12	-24.70	-24.52	-24.35	-24.09	-23.51	-25.12	-24.15	-24.93
NICT	35 1789	-9.29	-9.80	-8.84	-9.26	-8.51	-9.55	-10.09	-8.91	-9.14	-8.93	-9.31	-9.70
NICT	35 1790	7.91	7.06	7.49	7.84	7.67	6.78	7.49	6.80	7.10	7.31	6.50	5.93
NICT	35 1866	3.18	2.91	2.00	2.21	2.47	2.15	2.78	2.27	2.36	2.65	3.11	3.02
NICT	35 1882	-1.48	-1.10	-1.13	-1.72	-2.21	-1.90	-0.58	-1.12	-0.29	0.16	1.00	2.63
NICT	35 1887	-18.58	-	-	11.28	11.51	11.92	11.95	12.67	12.65	12.48	13.31	13.28
NICT	35 1944	10.79	11.32	11.04	11.04	10.98	11.10	11.31	10.92	12.80	11.96	11.48	12.03
NICT	35 2010	-1.06	-1.15	-1.71	-0.82	-0.52	-0.28	-0.28	-0.51	-0.02	0.42	0.56	-0.11
NICT	35 2011	2.44	2.34	3.12	2.75	2.41	2.03	3.24	3.02	2.75	2.96	3.25	2.74
NICT	35 2056	-19.49	-18.31	-18.39	-18.52	-18.63	-17.55	-17.72	-16.90	-16.53	-16.64	-16.61	-16.33
NICT	35 2113	6.94	6.42	7.65	8.07	7.98	8.40	9.20	10.06	10.16	11.06	11.22	11.38
NICT	35 2116	-9.71	-9.52	-10.18	-10.23	-9.82	-10.22	-10.21	-9.98	-9.91	-9.49	-10.02	-9.25
NICT	35 2570	10.54	9.79	9.26	8.95	9.20	9.18	8.63	8.80	8.67	9.12	9.06	9.51

Table 8. (Cont.)

Lab.	Clock	57049	57079	57109	57139	57169	57199	57234	57264	57294	57324	57354	57384
NICT	35 2574	1.57	0.57	0.90	0.57	-0.03	-0.28	1.72	0.65	0.64	0.92	2.12	2.99
NICT	35 2627	1.33	1.43	2.05	1.92	1.38	1.26	1.19	0.96	0.96	1.40	1.52	2.34
NICT	35 2628	2.19	1.41	1.37	2.25	5.62	5.76	5.26	5.59	6.23	6.36	6.70	6.86
NICT	35 2784	6.89	7.27	6.96	8.04	8.01	7.20	7.83	7.83	7.57	8.04	8.31	8.54
NICT	35 2876	-9.43	-9.22	-9.20	-9.20	-8.95	-9.46	-9.24	-8.87	-9.61	-8.80	-8.60	-9.19
NICT	35 2903	-6.33	-6.54	-6.29	-6.29	-6.57	-6.29	-5.60	-6.85	-6.09	-5.62	-6.49	-5.78
NICT	36 1217	5.73	5.36	2.97	3.46	5.16	4.18	3.18	3.97	5.51	4.30	4.43	5.07
NICT	40 2003	-34.18	-33.96	-33.91	-36.68	-41.40	-42.47	-	-44.06	-44.60	-44.82	-44.71	-44.67
NICT	40 2004	49.43	51.49	53.48	55.41	57.48	59.52	61.76	63.95	66.08	68.45	70.90	73.46
NICT	40 2005	116.40	117.28	118.48	120.12	121.16	122.57	124.12	124.87	-	-	-	-
NICT	40 2006	55.43	57.40	59.11	60.73	62.38	64.20	-	68.45	69.87	71.50	73.09	74.27
NIM	35 1235	18.71	17.51	17.68	17.97	16.72	18.05	18.93	18.07	18.26	18.68	18.20	19.17
NIM	35 2239	2.34	-	-	-	-	-	-	-	-	-	-	-
NIM	35 2256	12.98	12.94	12.84	13.52	13.55	13.39	13.49	14.19	14.74	14.96	15.24	14.53
NIM	35 2483	2.89	2.65	3.01	2.53	2.97	2.31	2.74	2.48	2.62	1.74	2.68	2.44
NIM	35 2643	-5.67	-4.93	-4.78	-4.63	-5.29	-4.47	-4.57	-4.40	-4.27	-3.26	-3.30	-3.19
NIM	35 2744	-2.55	-2.44	-2.85	-1.67	-2.68	-1.70	-2.56	-1.59	-2.45	-2.87	-2.15	-2.93
NIM	35 2767	-29.21	-29.03	-29.23	-28.81	-27.78	-27.63	-27.12	-27.11	-27.78	-27.79	-26.92	-26.71
NIM	35 2769	16.13	15.48	15.59	15.90	15.62	15.71	16.12	15.74	16.40	17.22	16.26	16.96
NIM	40 4832	174.65	177.41	180.35	183.85	187.65	191.39	194.84	198.19	201.21	203.82	206.84	209.80
NIM	40 4835	-	-	42.98	60.83	75.41	89.25	104.25	119.15	132.66	146.96	159.26	174.51
NIM	40 4871	235.64	239.72	243.79	247.84	251.81	255.91	260.60	265.12	269.25	273.08	276.92	280.68
NIM	40 4878	129.14	133.24	136.89	140.90	145.25	149.04	153.35	157.88	161.74	165.72	169.63	173.38
NIM	40 4879	-	181.26	185.30	194.48	196.34	197.03	199.72	200.24	203.30	204.73	205.47	208.48
NIM	40 4880	-105.43*	25.91*	334.72*	339.84*	41.50	44.88	49.61	53.86	57.03	60.31	62.91	66.94
NIMB	35 600	3.22	-	2.34	5.67	1.98	1.31	0.76	-0.71	-1.68	1.97	3.02	2.48
NIMT	35 2246	4.29	5.46	4.15	3.43	4.98	4.39	4.26	3.38	4.73	4.15	5.99	5.33
NIMT	35 2247	0.32	0.36	-0.53	0.24	-1.72	-0.16	2.08	0.51	-0.85	-0.82	0.04	-0.10
NIS	35 1126	0.59	2.59	0.63	2.62	1.95	2.37	1.79	-	-	-	-	-
NIST	35 282	-11.91	-12.27	-11.60	-11.90	-11.82	-11.99	-11.87	-11.83	-11.71	-10.88	-11.09	-10.58

Table 8. (Cont.)

Lab.	Clock	57049	57079	57109	57139	57169	57199	57234	57264	57294	57324	57354	57384
NIST	35 408	-20.27	-19.34	-19.74	-19.77	-19.49	-20.36	-20.26	-19.84	-20.35	-19.92	-19.92	-19.58
NIST	35 1074	-7.93	-6.93	-7.01	-7.49	-7.89	-6.72	-7.29	-6.98	-6.88	-7.65	-7.19	-7.29
NIST	35 1519	-0.31	-1.38	0.15	-0.26	-0.50	0.03	-0.11	0.14	0.30	0.53	0.81	0.71
NIST	35 2031	-12.91	-13.18	-13.04	-12.61	-12.52	-12.29	-11.46	-10.85	-11.54	-11.39	-11.66	-10.81
NIST	35 2032	-1.84	-2.12	-1.45	-2.07	-2.13	-1.76	-1.70	-1.94	-2.14	-2.05	-1.13	-1.66
NIST	35 2034	-11.74	-10.72	-12.23	-11.82	-11.33	-11.08	-11.54	-11.45	-11.62	-11.51	-12.35	-11.03
NIST	35 2579	-1.90	-2.04	-2.31	-1.30	-2.31	-2.63	-2.02	-1.94	-1.45	-1.10	-1.75	-4.31
NIST	35 2672	2.32	1.24	-0.70	-1.55	-0.91	-0.04	-0.95	1.07	0.02	-0.16	-1.13	-1.60
NIST	35 2935	-16.31	-16.00	-16.01	-16.02	-16.32	-16.15	-16.39	-16.76	-16.87	-15.97	-15.98	-16.37
NIST	40 205	-24.49	-24.43	-24.38	-24.42	-24.38	-24.49	-24.46	-24.39	-24.31	-24.30	-24.26	-24.17
NIST	40 206	-31.59	-30.69	-30.21	-29.77	-28.86	-28.11	-27.06	-26.28	-25.47	-25.06	-24.30	-22.92
NIST	40 207	162.31	166.31	170.28	174.37	178.42	182.60	186.44	190.95	195.27	199.58	203.77	208.09
NIST	40 210	-	-	-	-	-	-	-	-	-	86.04	93.87	101.62
NIST	40 212	221.09	228.55	236.16	243.68	251.08	258.08	265.64	273.41	280.68	-	-	302.75
NIST	40 222	34.90	35.06	35.20	35.32	35.47	35.50	35.63	35.87	35.92	36.06	36.20	36.42
NMIJ	35 224	-15.06	-16.17	-15.04	-15.32	-15.89	-15.68	-15.91	-15.64	-14.99	-15.50	-15.46	-15.53
NMIJ	35 523	15.51	14.63	14.26	14.32	13.39	14.19	13.32	13.44	13.15	17.10	24.68	23.31
NMIJ	40 5002	-6.68	-8.01	-9.60	-10.74	-11.87	-11.76	-11.81	-12.05	-11.75	-11.71	-11.37	-10.92
NMIJ	40 5003	0.75	1.00	1.05	1.07	1.00	0.93	0.96	1.05	1.24	1.09	1.32	1.38
NMIJ	40 5015	-	-	-	-	-	7.08	11.05	14.62	18.23	21.54	24.74	28.14
NMLS	35 328	-4.43	-6.50	3.27	3.24	1.31	1.76	1.05	-0.45	-0.51	-0.79	0.10	0.34
NPL	35 1275	4.44	4.53	3.60	4.83	3.97	2.87	4.14	5.03	4.49	5.09	5.95	5.34
NPL	40 1701	40.44*	40.53*	40.99*	41.45*	41.73*	42.00*	42.06*	0.39*	0.96	1.20	1.47	3.54
NPL	40 1708	-1.57*	-1.27*	-2.41*	-1.97*	-1.46*	-1.10*	-1.70*	-2.43*	-1.89*	-1.48*	-0.80*	-0.40
NPLI	35 57	95.20	94.69	-	94.07	96.22	97.74	98.96	100.30	99.11	99.09	101.98	103.93
NPLI	35 140	13.44	14.55	-	13.13	11.84	15.23	13.71	15.11	13.39	14.89	16.75	19.90
NPLI	35 1324	-2.54	-1.54	-	-3.39	-2.57	-1.95	-2.14	-2.83	-4.07	-2.03	-3.29	-0.56
NPLI	35 2245	0.19	0.22	-	0.34	0.39	-0.37	0.28	0.32	0.21	0.91	0.44	-0.62
NPLI	35 2796	-23.09	-23.47	-	-23.11	-23.29	-22.22	-23.45	-22.26	-22.32	-22.11	-22.57	-22.28
NPLI	40 5201	5.45	9.01	-	16.18	-11.06	-11.02	-6.89	-2.75	1.12	5.09	8.35	11.08

Table 8. (Cont.)

Lab.	Clock	57049	57079	57109	57139	57169	57199	57234	57264	57294	57324	57354	57384
NRC	35 2115	-	-	-1.31*	-0.91*	-1.02*	-0.14*	-0.62*	-0.73*	-0.52*	0.37*	0.14*	0.14
NRC	35 2150	1.32	1.09	1.59	1.97	1.56	2.74	0.70	1.45	0.73	0.78	1.87	1.44
NRC	35 2152	3.32*	3.12	-3.74	-4.18	-4.47	-4.09	-3.82	-4.33	-4.95	-4.78	-4.84	-4.17
NRC	36 2219	4.44	3.95	4.38	3.55	3.94	4.02	4.67	4.08	3.81	3.94	4.04	2.70
NRC	40 304	-	-	-	-	-	-	-	-	-	-	-	16.61
NRC	40 306	-41.87*	30.63*	14.15	2.25	5.26	7.81	10.02	11.95	13.14	14.47	7.45	0.66
NRL	35 714	-	2.46	2.49	1.73	1.20	-0.46	-	-	-	-	-3.38	-3.50
NRL	35 719	-	-0.38	-0.61	-1.28	0.21	2.06	-	-	-	-	1.25	3.06
NRL	35 1245	-	-2.95	-5.35	-7.38	-9.75	-9.99	-	-	-	-	20.81	16.89
NRL	35 2460	-	2.51	2.09	19.13	36.49	39.91	38.38	-	-	-	-	30.06
NRL	35 2464	-	0.97	-0.09	1.25	-4.91	-4.84	-5.58	-	-	-	-	-10.95
NRL	35 2580	-	2.45	5.78	-12.86	-10.04	-10.45	-11.17	-	-	-	-	-5.19
NRL	36 387	-	-2.51	-2.82	-2.61	-2.23	-2.26	-	-	-	-	-2.16	-0.64
NRL	36 2788	-	-1.71	-0.06	-0.25	-0.02	-0.58	-	-	-	-	0.81	2.18
NRL	36 2791	-	-1.24	-0.06	1.18	0.31	1.52	-	-	-	-	-0.09	0.53
NRL	36 2799	-	1.58	0.82	2.70	4.68	-	-	-	-	-	2.17	3.21
NRL	36 2800	-	1.87	2.07	3.59	0.91	-	-	-	-	-	-0.29	0.01
NRL	36 2807	-	-2.14	-2.84	-2.32	5.58	-	-	-	-	-	9.15	8.90
NRL	36 2808	-	-2.09	-2.31	2.22	-11.05	-	-	-	-	-	-16.56	-16.57
NRL	36 2818	-	-0.73	-0.70	2.57	16.65	-	-	-	-	-	25.16	23.93
NRL	36 2820	-	4.27	4.06	4.25	3.35	4.36	-	-	-	-	5.82	3.39
NRL	36 2829	-	6.19	6.82	6.67	8.07	7.01	-	-	-	-	5.44	4.15
NRL	36 2832	-	3.18	3.44	1.95	2.22	1.32	-	-	-	-	4.22	5.68
NRL	36 2833	-	-1.33	-2.76	-7.29	-9.53	-	-	-	-	-	-8.25	-9.25
NRL	36 2834	-	3.34	3.55	2.88	1.51	4.08	-	-	-	-	11.08	11.62
NRL	40 1001	-	-0.12	-0.95	-1.45	-2.96	-3.28	-	-	-	-	-2.14	-1.52
NRL	40 1003	-	-0.31	-1.06	-1.76	-3.28	-6.82	-	-	-	-	-	-
NRL	40 1004	-	-	0.49	0.73	0.82	1.59	-	-	-	-	3.86	5.04
NRL	40 1009	-	-0.15	-1.85	-2.70	-5.38	-9.34	-	-	-	-	-9.81	-9.87
NRL	40 1010	-	4.60	10.62	7.18	-1.30	-13.80	-	-	-	-	-19.31	-15.71

Table 8. (Cont.)

Lab.	Clock	57049	57079	57109	57139	57169	57199	57234	57264	57294	57324	57354	57384
NRL	40 1012	-	-1.57	-2.34	-3.39	-4.78	-6.69	-	-	-	-	-14.54	-15.45
NTSC	35 1008	-0.77	-1.36	-2.78	-3.60	-	-	-	-	-	-	-	-
NTSC	35 1011	13.65	14.53	15.90	11.69	-	-	-	-	-	-	-	-
NTSC	35 1016	12.88	13.28	13.44	14.39	13.87	14.90	16.17	7.47	-2.29	-1.10	-1.43	0.28
NTSC	35 1018	-7.79	-8.43	-8.45	-7.86	-8.44	-7.41	-7.28	-5.51	-6.13	-6.29	-6.59	-7.42
NTSC	35 1818	-24.10	-24.94	-24.22	-23.90	-25.39	-24.66	-24.46	-24.09	-23.23	-24.80	-24.29	-25.03
NTSC	35 1823	17.30	17.61	18.01	19.02	19.03	20.56	20.62	23.89	24.08	24.37	24.46	23.32
NTSC	35 2098	5.85	5.77	5.17	5.93	5.68	5.27	4.33	4.52	5.14	5.52	5.61	5.83
NTSC	35 2131	9.92	11.50	11.56	11.81	11.92	12.03	12.76	11.45	12.25	12.77	13.31	13.22
NTSC	35 2141	0.47	4.85	2.47	3.42	-	-	-	-	-	-	-	-
NTSC	35 2142	-13.56	-13.61	-13.81	-14.41	-13.96	-14.06	-14.85	-	-	-	-	-
NTSC	35 2143	9.88	9.63	8.93	9.29	8.73	8.21	5.37	6.34	7.17	6.48	5.82	6.19
NTSC	35 2145	-7.56	-7.88	-8.48	-8.35	-8.79	-8.90	-7.32	-7.62	-7.48	-9.72	-10.20	-11.22
NTSC	35 2573	6.03	5.45	5.57	5.29	5.13	5.23	6.06	6.18	5.78	5.41	6.62	6.61
NTSC	35 2831	-	-	14.59	15.71	16.07	16.46	16.92	-	16.47	16.70	13.60	16.18
NTSC	35 2852	20.59	19.85	20.34	20.95	20.61	19.42	19.77	20.17	20.74	20.75	22.26	22.22
NTSC	35 2921	1.84	1.37	1.31	0.78	0.57	0.43	1.18	0.74	0.84	1.28	1.03	1.62
NTSC	35 2922	1.47	1.62	2.31	2.67	2.15	2.27	1.77	1.71	2.49	2.27	2.73	1.59
NTSC	35 2924	28.99	28.16	28.05	28.09	28.22	27.63	28.36	-	31.55	31.94	32.80	32.59
NTSC	35 2926	-0.29	0.68	0.24	1.13	0.70	1.43	1.78	1.23	2.69	3.10	2.15	2.98
NTSC	35 2928	2.18	2.64	2.86	3.71	3.42	3.55	3.88	3.43	3.78	3.67	4.18	4.37
NTSC	35 2933	-4.87	-4.33	-4.11	-4.18	-4.75	-4.91	-5.06	-4.71	-4.36	-4.84	-4.42	-4.76
NTSC	35 2959	8.83	8.61	8.94	9.39	9.14	8.59	8.90	-	9.43	9.68	9.75	9.88
NTSC	35 2962	-3.33	-3.68	-3.17	-2.47	-2.53	-2.81	-3.03	-2.30	-1.97	-1.77	-1.24	-1.66
NTSC	35 2964	18.66	19.24	19.68	19.17	19.36	19.77	20.15	20.52	20.76	20.40	20.63	20.78
NTSC	35 2965	13.89	13.93	14.03	13.88	14.03	13.91	13.41	14.14	14.13	14.32	14.01	14.13
NTSC	35 2976	27.14	28.11	27.57	28.23	28.60	28.59	29.23	-	28.68	28.78	29.13	29.54
NTSC	35 2978	-5.92	-5.71	-5.76	-5.37	-5.53	-4.92	-3.88	-4.14	-4.07	-3.25	-3.30	-2.98
NTSC	35 2980	-8.06	-7.64	-8.24	-7.17	-7.59	-6.93	-6.74	-6.81	-6.73	-7.14	-6.57	-6.74
NTSC	35 2981	-2.40	-1.74	-1.66	-1.85	-2.13	-1.97	-0.63	0.23	0.62	0.60	1.13	1.62

Table 8. (Cont.)

Lab.	Clock	57049	57079	57109	57139	57169	57199	57234	57264	57294	57324	57354	57384
NTSC	35 3089	-	-	-	-	-	18.54	18.61	18.00	18.41	18.29	18.72	18.40
NTSC	35 3090	-	-	-	-	-	5.98	5.94	6.53	6.27	6.49	7.14	6.55
NTSC	35 3091	-	-	-	-	-	-6.44	-6.40	-5.98	-5.78	-5.40	-4.72	-4.96
NTSC	35 3102	-	-	-	-	-	-8.17	-8.25	-8.08	-7.24	-6.95	-7.62	-7.01
NTSC	40 296	28.97	31.66	34.40	36.90	39.49	41.95	44.86	47.88	50.58	52.97	55.35	57.99
NTSC	40 297	11.21	13.99	16.85	19.90	23.16	26.37	30.07	-	-	-	-	49.16
NTSC	40 4926	-	12.76	18.03	21.54	23.92	25.50	26.80	27.57	28.11	28.34	28.39	28.40
NTSC	40 4927	-	-21.03	-25.46	-27.65	-28.88	-29.86	-31.13	-	-29.12	-29.85	-29.80	-25.78
NTSC	40 4943	0.09	-0.05	0.06	-0.03	-0.05	0.37	-0.28	0.33	0.23	-0.06	0.06	-
ONBA	36 2228	-	-	-1.46	-2.92	-2.57	-1.68	-1.39	-2.09	-1.50	-1.75	-	-
ONRJ	35 102	-1.56	-1.53	-0.64	-1.11	-1.24	-1.42	-0.99	-0.39	0.37	0.29	0.67	0.53
ONRJ	35 103	0.98	1.06	0.05	0.26	0.43	-0.42	-0.87	2.19	2.18	1.29	1.65	1.05
ONRJ	35 123	35.11	35.44	36.02	34.30	35.72	35.13	34.48	33.60	34.03	34.35	32.69	32.94
ONRJ	35 129	10.98	10.82	11.74	11.07	11.84	11.39	11.25	11.56	11.91	11.72	11.83	11.83
ONRJ	35 147	5.66	6.87	6.96	6.37	7.22	7.24	7.99	7.47	8.35	8.63	8.06	8.48
ONRJ	35 1153	3.62	4.55	3.97	3.38	3.44	3.40	3.33	3.97	4.54	5.39	5.23	5.30
ONRJ	35 1942	3.93	3.36	3.36	2.71	2.10	2.08	1.50	1.51	1.51	1.48	1.52	-
ONRJ	40 1950	6.72	12.77	15.71	16.01	17.40	19.29	21.84	23.79	25.32	27.10	29.60	32.36
ONRJ	40 1958	42.92	42.40	42.44	42.42	42.44	42.07	41.72	41.26	40.95	40.65	40.77	40.39
ORB	35 2722	1.41	1.10	0.13	0.84	0.31	0.84	1.29	1.53	1.11	1.56	1.79	1.84
ORB	35 2723	6.04	5.57	4.52	3.91	4.61	3.27	3.16	5.65	4.96	6.02	5.52	3.38
ORB	35 2724	2.66	2.99	1.92	3.13	2.81	3.36	3.13	3.17	3.28	3.64	3.59	3.35
ORB	36 593	77.54	76.35	77.32	76.07	75.64	76.41	77.00	73.67	75.52	76.39	74.86	75.12
PL	25 124	-5.11	-11.40	-10.11	-11.85	-12.21	-15.20	-12.99	-18.60	-18.89	-15.49	-15.11	-18.07
PL	25 125	-28.68	-28.33	-33.88	-33.71	-34.70	-35.58	-37.80	-37.08	-40.06	-38.77	-41.45	-41.87
PL	35 441	16.24	16.74	16.95	16.48	16.99	17.77	18.22	18.23	18.11	18.04	18.36	18.33
PL	35 745	-0.61	-1.72	-1.56	3.71	-20.22	-	-	-0.25	0.12	-0.39	0.38	0.54
PL	35 761	1.10	1.96	1.76	1.63	-0.64	0.57	-	-	2.20	0.09	-0.26	4.23
PL	35 1120	-0.97	-2.74	-2.38	-2.87	-4.29	-	-	-	-	-1.24	-0.81	-0.08
PL	35 1660	-	-	-	-	-	-	-	-	-	-	-1.05	-0.94

Table 8. (Cont.)

Lab.	Clock	57049	57079	57109	57139	57169	57199	57234	57264	57294	57324	57354	57384
PL	35 1746	-26.73*	-27.34*	-20.27*	5.40*	-45.57*	6.11*	-0.15*	-4.28	-2.47	-2.26	-2.39	5.03
PL	35 1934	3.84	5.08	3.70	3.74	3.28	4.25	3.65	3.71	3.81	3.64	4.34	3.94
PL	35 2175	-	-6.15	-7.12	-7.12	-6.88	-7.78	-8.09	-6.73	-6.22	-7.80	-6.94	-6.81
PL	35 2394	8.12	7.52	7.64	8.11	7.36	8.79	6.45	7.05	8.45	8.25	7.46	8.38
PL	35 2891	5.07	4.73	4.63	4.60	3.87	4.55	3.95	4.30	4.36	3.94	4.68	4.07
PL	40 4004	-335.47	-358.92	-384.09	-399.05	-419.37	-439.64	-457.14	-474.12	-488.33	-499.13	-509.91	-528.98
PL	40 4601	26.40	26.91	27.58	28.17	28.75	29.61	30.12	30.83	31.45	32.14	32.97	33.42
PL	40 4602	692.42	700.72	710.03	721.70	728.51	734.77	740.94	736.51	739.63	745.24	752.60	759.87
PTB	35 128	9.60	10.61	11.35	10.80	-	-	-	-	-	-	-	-
PTB	35 415	-8.62	-7.58	-6.35	-7.29	-6.27	-5.07	-3.79	-4.09	-2.32	-2.65	-2.72	-3.06
PTB	35 1072	11.84	12.78	11.93	11.63	11.82	12.54	12.44	12.19	12.70	12.65	12.95	12.88
PTB	35 2987	-8.26	-8.74	-7.78	-7.95	-7.83	-6.93	-7.10	-7.11	-6.97	-6.43	-6.35	-5.43
PTB	40 506	-3.61*	-1.93*	-0.21*	1.69*	-3.84	-2.21	-0.51	1.38	3.08	4.77	6.51	8.24
PTB	40 508	-0.39	2.22	4.12	6.76	9.55	12.41	-	-	18.89	20.88	23.08	25.23
PTB	40 509	5.43	5.83	6.19	6.45	6.77	7.09	7.50	7.93	8.27	8.61	8.95	9.39
PTB	92 1	1.86	1.87	2.19	2.31	1.96	2.51	2.32	1.98	2.01	2.15	-	-
PTB	92 2	2.03	1.42	1.53	1.86	1.81	1.67	1.61	1.28	1.81	1.74	1.39	1.81
ROA	35 583	7.11	6.04	7.28	7.19	6.81	8.25	7.38	7.44	8.26	7.52	5.77	6.75
ROA	35 718	5.13	5.31	5.15	4.93	4.88	5.57	5.00	4.31	5.89	4.69	5.31	5.32
ROA	35 1699	7.98	7.80	7.44	7.11	7.47	6.26	6.68	6.14	5.89	5.97	7.49	5.81
ROA	35 2270	-8.71	-8.24	-9.54	-9.34	-10.79	-8.75	-9.49	-9.97	-9.64	-10.56	-9.53	-10.34
ROA	36 1488	10.37	11.36	12.61	9.32	11.31	11.44	10.72	11.38	10.64	11.52	11.53	9.60
ROA	36 1490	13.12	11.09	11.83	12.34	10.69	10.27	11.02	13.54	12.36	12.45	12.03	11.45
ROA	40 1436	239.03	242.31	244.99	248.03	250.97	254.39	257.33	260.55	263.56	266.77	268.89	271.17
SASO	35 221	-0.17*	-0.86*	-0.03	-	-0.78	-1.22	-1.10	-0.12	1.09	1.32	1.39	0.39
SASO	35 1628	-0.16	-0.46	-0.87	-	-0.94	-1.08	0.24	-0.08	0.54	-0.42	0.41	0.09
SASO	35 2923	-0.48*	0.36*	-0.27	-	-0.33	0.09	0.39	-0.06	1.31	2.27	1.10	0.93
SASO	35 2931	-	-	-	-0.55	-0.79	-1.05	-0.68	-0.58	-0.78	-0.38	-0.99	-0.78
SASO	35 2932	-0.15*	0.01*	-1.18	-	-0.31	-0.65	-0.20	-0.27	-0.70	-0.54	-0.37	-1.17
SCL	35 2178	5.24	5.51	5.16	6.04	5.12	-	-	-	-	5.58	5.17	4.91

Table 8. (Cont.)

Lab.	Clock	57049	57079	57109	57139	57169	57199	57234	57264	57294	57324	57354	57384
SCL	35 2525	-2.24	-2.18	-1.33	-0.57	-0.04	-	-	-	-	-0.34	-1.28	-2.10
SG	35 188	13.81	13.34	13.34	13.78	13.80	14.39	14.39	14.15	14.38	14.44	14.78	14.80
SG	35 475	-1.28	-0.41	-0.53	-1.32	-0.81	-2.76	-0.39	-0.31	-0.75	-0.91	-0.46	-0.53
SG	35 696	-	-	-	-	-5.83	-6.18	-6.78	-6.29	-6.92	-6.33	-6.58	-5.57
SG	35 3135	-	-	-	-	-	-	-	2.82	3.36	3.76	3.98	4.10
SG	36 522	4.89	3.36	5.87	5.67	3.45	4.75	3.59	5.75	3.47	5.22	5.27	6.71
SG	40 7701	109.66	115.21	120.45	125.38	130.64	135.56	140.33	145.46	150.00	154.39	158.30	162.80
SIQ	36 1268	16.16	-1.01	4.67	-1.43	0.60	0.33	-1.22	-0.72	-1.78	-0.63	1.87	3.66
SMD	35 1766	10.61	9.86	10.37	10.36	10.38	10.43	10.59	10.62	11.61	10.83	10.11	10.69
SMD	35 2003	3.76	-	-	-	-	-	-	-	8.13	8.04	9.08	9.11
SMD	35 2543	17.22	16.51	16.08	16.50	16.05	15.80	16.19	15.13	15.02	16.28	16.64	17.61
SMD	40 7909	13.78*	8.17*	11.77*	17.00*	8.02*	5.89	1.58	-0.70	-2.63	-2.60	-5.28	-7.32
SMU	36 1193	-0.28	-0.27	-1.17	-0.49	-1.69	-1.76	-1.86	-2.58	-1.53	-1.18	-1.26	-0.93
SP	35 572	17.26	17.73	16.67	17.91	17.37	17.08	16.66	17.11	17.13	16.92	16.78	17.11
SP	35 641	1.94	1.41	0.85	0.39	0.91	0.45	0.08	1.09	0.77	1.45	1.15	0.92
SP	35 767	14.48	14.49	14.06	14.42	14.08	14.56	13.66	14.05	13.10	14.15	13.76	13.60
SP	35 1188	-3.48	-2.73	-3.24	-3.23	-2.32	-3.88	-3.03	-2.26	-2.62	-1.64	-1.85	-2.31
SP	35 1642	-0.44	-0.18	0.90	0.22	0.06	0.17	0.51	-0.12	0.07	0.75	0.86	0.80
SP	35 2166	9.04	8.64	8.98	9.33	9.28	9.41	8.61	9.66	9.15	8.34	10.06	8.99
SP	35 2745	-2.64	-3.11	-4.65	-3.16	-3.04	-3.68	-3.02	-3.90	-4.11	-3.30	-2.52	-2.92
SP	35 2746	25.43	24.65	24.01	24.70	24.07	22.69	23.72	23.30	22.99	23.10	22.99	21.84
SP	35 2749	4.97	5.16	5.53	5.21	5.84	4.79	5.40	5.42	4.28	4.42	5.02	5.01
SP	35 2750	-21.10	-20.85	-20.88	-20.42	-20.23	-20.05	-21.00	-20.35	-20.30	-20.23	-20.42	-20.82
SP	35 2758	19.32	18.78	19.08	19.38	19.05	18.76	18.36	18.99	18.98	18.98	19.22	19.11
SP	36 223	9.68	7.73	7.12	9.43	7.41	8.41	7.67	9.92	8.91	9.09	9.01	7.28
SP	36 1175	3.10	2.64	3.58	3.63	3.73	1.52	3.24	4.37	3.39	2.65	3.49	3.90
SP	36 1187	-45.68	-46.19	-46.24	-47.45	-47.37	-48.23	-47.43	-47.60	-46.50	-45.62	-45.00	-44.44
SP	36 1531	78.38	78.55	78.90	79.10	80.68	77.75	78.28	77.08	77.59	79.61	77.00	79.30
SP	36 2068	4.99	4.86	7.02	5.05	4.80	4.82	2.86	6.72	4.24	4.12	4.84	3.82
SP	36 2218	25.31	23.14	24.79	24.06	24.85	23.86	24.09	23.47	23.87	25.58	23.35	24.74

Table 8. (Cont.)

Lab.	Clock	57049	57079	57109	57139	57169	57199	57234	57264	57294	57324	57354	57384
SP	36 2295	12.73	12.78	14.32	14.91	15.70	14.45	15.24	15.05	14.78	16.68	17.08	16.98
SP	36 2297	-5.09	-6.00	-4.22	-4.94	-3.99	-3.72	-4.00	-3.17	-3.12	-4.12	-3.28	-2.27
SP	40 7201	247.06	250.22	253.13	256.03	258.98	261.76	265.05	268.33	271.25	274.30	277.37	280.50
SP	40 7203	48.84	49.66	50.44	51.19	51.90	52.56	53.37	54.23	54.92	55.67	56.33	57.00
SP	40 7210	-36.03	-32.97	-30.26	-29.01	-26.58	-24.24	-21.55	-19.38	-17.89	-15.87	-13.54	-10.64
SP	40 7211	93.96	95.36	96.94	98.29	99.85	101.26	103.13	-	-	-	-	-
SP	40 7212	33.42	33.73	34.28	34.99	-	-	-1.21	-0.89	-0.81	-0.49	-0.36	0.07
SP	40 7221	-36.05	-35.77	-35.57	-35.44	-35.17	-35.21	-35.04	-34.72	-34.53	-34.31	-34.21	-33.87
SP	40 7223	-8.18	-7.02	-6.08	-5.19	-4.11	-3.25	-2.01	-0.69	0.32	1.37	2.59	5.81
SP	40 7231	66.19	73.47	80.75	87.99	95.36	102.73	111.01	119.58	127.36	134.99	142.61	150.55
SP	40 7232	10.76	6.57	2.69	-0.87	-4.12	-7.09	-9.60	-11.59	-12.97	-13.80	-14.26	-13.89
SU	40 3809	-2.96	-2.84	-2.68	-2.55	-2.38	-2.18	-2.03	-1.73	-1.44	-1.18	-0.82	-0.49
SU	40 3810	5.34	5.59	5.80	6.00	6.20	6.44	6.63	6.90	7.18	7.40	7.71	8.02
SU	40 3811	-43.79	-43.00	-42.13	-41.53	-40.82	-39.98	-39.18	-38.30	-37.46	-36.62	-35.85	-34.56
SU	40 3812	10.97	11.18	11.44	11.63	11.85	12.14	12.30	12.63	12.93	13.10	13.31	13.58
SU	40 3814	47.55	48.33	49.13	49.82	50.53	51.31	52.04	52.92	53.70	54.42	55.15	55.93
SU	40 3815	-30.15	-29.66	-29.19	-28.80	-28.73	-27.84	-27.40	-26.85	-26.35	-25.92	-25.44	-24.94
SU	40 3816	-	-	-	-	-55.18	-54.30	-53.58	-52.76	-52.09	-51.49	-50.91	-50.29
SU	40 3817	30.40	30.67	31.15	31.37	31.66	31.32	-	33.11	33.34	33.56	34.22	34.71
SU	40 3818	1.80	2.16	2.52	2.81	3.13	3.54	3.89	4.33	4.68	4.98	5.35	5.79
TL	35 1012	1.58	2.30	1.44	1.85	1.14	1.06	1.38	0.98	0.25	2.03	1.73	2.02
TL	35 1498	2.96	3.14	3.33	3.81	5.48	4.86	4.19	4.78	4.64	5.23	4.46	4.64
TL	35 1500	13.02	13.92	13.21	13.28	14.13	13.70	12.70	13.59	13.06	13.40	12.72	12.93
TL	35 1712	-17.36	-15.35	-13.29	-13.13	-11.39	-10.10	-11.44	-13.81	-14.21	-13.45	-10.40	-8.92
TL	35 2365	3.81	4.34	3.13	3.52	3.51	3.53	3.40	3.13	3.38	3.23	2.96	3.25
TL	35 2366	-9.64	-9.17	-8.98	-8.68	-9.22	-9.72	-9.88	-10.08	-9.18	-9.28	-9.04	-9.78
TL	35 2367	11.00	11.54	11.56	11.08	11.57	11.43	11.61	11.59	12.45	11.65	11.47	10.85
TL	35 2368	0.26	1.15	0.23	-0.16	-0.13	-0.33	0.82	0.34	0.64	1.24	1.22	1.44
TL	35 2630	-12.26	-12.92	-11.91	-11.02	-10.86	-10.46	-9.18	-9.47	-9.97	-9.85	-10.06	-10.49
TL	35 2634	10.95	12.91	12.59	13.10	9.60	13.48	11.78	12.72	13.26	5.52	5.11	10.08

Table 8. (Cont.)

Lab.	Clock	57049	57079	57109	57139	57169	57199	57234	57264	57294	57324	57354	57384
TL	35 2636	15.93	15.81	16.12	16.75	17.07	17.25	17.66	18.94	19.01	17.12	17.60	14.69
TL	35 2853	-1.60	-1.24	-1.68	-1.77	-1.26	-1.54	-1.95	-2.96	-2.04	-2.26	-2.33	-1.26
TL	35 2910	3.88	3.27	4.09	3.20	4.07	3.39	4.68	4.80	4.60	4.41	5.33	5.02
TL	40 57	-82.86	-84.40	-86.88	-89.87	-93.23	-96.21	-99.08	-100.34	-101.51	-104.01	-106.32	-108.94
TL	40 3011	-13.01	-10.93	-8.83	-6.64	-4.09	-1.46	1.90	5.25	8.42	11.85	15.52	19.49
TL	40 3052	-20.94	-21.33	-22.25	-23.54	-24.67	-25.54	-26.24	-27.46	-27.86	-28.80	-29.76	-31.14
TP	35 163	11.69	10.77	11.61	11.34	11.82	11.54	-	9.22	9.57	9.18	9.13	8.85
TP	35 1227	6.37	6.77	6.94	6.44	5.36	5.76	-	5.15	5.68	6.01	4.45	4.99
TP	35 2476	8.36	7.35	5.87	4.31	3.28	3.21	-	-0.64	-0.33	-0.77	-1.07	-0.85
TP	35 2970	21.27	21.48	21.99	22.26	21.72	22.36	-	22.83	22.21	23.75	22.65	23.56
UA	35 2465	-11.71	-11.41	-10.76	-12.20	-8.92	-11.73	-13.51	-10.27	-15.76	-11.85	-9.93	-8.42
UA	40 7854	-0.18	0.05	0.23	0.02	0.82	-0.19	-0.08	-0.23	-1.19	-0.18	0.28	-0.12
UA	40 7881	3.49	0.72	0.60	1.81	3.22	2.02	1.95	-0.63	-1.22	-2.83	1.23	-0.45
UA	40 7882	-1.12	-0.14	-0.48	-0.75	-0.25	-0.73	-1.32	-0.35	-0.74	0.05	1.33	-0.26
UME	35 251	-0.24*	0.65*	-0.17*	0.80*	0.00*	0.25*	0.23*	0.31*	-0.06*	0.10*	-0.22	-0.37
UME	35 252	0.20*	0.09*	0.24*	0.70*	-0.01*	-0.61*	0.53*	0.29*	-0.12*	-0.07*	0.51	0.73
UME	35 872	-0.32*	0.52*	0.15*	0.39*	0.57*	0.64*	-0.32*	0.11*	-0.21*	0.33*	1.64	1.62
UME	35 2703	-0.13*	-0.09*	0.64*	-0.60*	-0.05*	-0.66*	-0.71*	-0.17*	0.84*	0.05*	1.58	2.30
UME	35 2710	-2.24	-2.10	-1.90	-2.33	-2.51	-1.93	-1.90	-2.57	-1.76	-4.01	35.38	0.76
USNO	35 101	11.89	12.45	14.21	14.81	13.86	15.05	14.02	13.54	15.57	17.79	15.45	15.17
USNO	35 104	20.41	20.14	20.49	19.85	20.44	20.43	20.40	19.71	20.17	20.65	19.70	20.38
USNO	35 106	1.47	0.08	0.67	0.17	0.21	-0.63	-	-	-	-	-	-
USNO	35 108	2.32	1.94	2.70	2.99	3.01	2.65	3.10	2.51	2.75	2.17	1.42	3.35
USNO	35 114	2.68	2.67	2.29	3.28	2.22	1.46	2.00	0.90	1.14	1.65	1.84	0.25
USNO	35 120	20.97	20.87	21.30	21.08	21.70	21.64	22.15	22.28	21.70	20.46	21.12	21.06
USNO	35 142	-14.56	-14.73	-14.25	-14.30	-12.72	-13.33	-13.13	-12.59	-13.43	-12.27	-14.48	-13.78
USNO	35 150	-3.28	-4.74	-3.68	-4.12	-3.26	-3.73	-3.95	-4.27	-4.08	-4.59	-3.40	-4.84
USNO	35 152	2.74	2.32	3.78	2.15	3.00	-	-	-	-	-	-	-
USNO	35 156	11.38	11.85	11.59	12.47	12.76	12.59	11.94	12.31	11.48	12.01	12.61	13.01
USNO	35 161	25.16	26.04	26.13	26.51	26.94	27.16	27.59	27.52	28.24	29.37	28.35	28.99

Table 8. (Cont.)

Lab.	Clock		57049	57079	57109	57139	57169	57199	57234	57264	57294	57324	57354	57384
USNO	35	164	0.58	1.38	0.49	-0.82	-1.14	1.13	1.96	1.62	0.63	0.66	0.75	0.06
USNO	35	165	6.74	-	-	-	-	-	-	-	-	-	-	-
USNO	35	166	51.41	51.80	52.58	51.36	52.38	52.25	51.90	52.25	52.48	53.68	53.35	51.27
USNO	35	169	-14.02	-13.45	-13.77	-13.52	-14.07	-14.14	-13.88	-14.53	-14.57	-14.66	-14.09	-13.45
USNO	35	173	-9.22	-8.00	-10.43	-8.75	-10.99	-9.89	-11.05	-10.97	-12.23	-10.34	-11.15	-11.78
USNO	35	226	8.36	8.74	8.49	9.18	9.29	10.22	9.52	10.10	9.87	9.72	10.11	9.74
USNO	35	231	-1.51	-2.60	-2.64	-3.26	-3.09	-3.50	-3.34	-3.46	-3.83	-3.67	-2.54	-2.31
USNO	35	233	15.36	14.92	14.84	14.75	14.23	13.81	13.93	14.01	13.39	13.31	12.40	13.15
USNO	35	244	7.38	7.01	6.73	6.51	7.89	7.62	8.54	9.73	9.70	10.64	9.68	10.12
USNO	35	253	-30.36	-30.58	-30.18	-30.89	-29.85	-31.22	-31.05	-31.27	-29.93	-39.00	-	-
USNO	35	254	7.79	7.09	6.29	7.19	8.85	9.15	9.00	8.87	9.06	8.95	8.99	8.71
USNO	35	256	22.17	21.98	22.12	22.15	22.40	21.99	22.51	23.15	23.05	22.85	22.88	21.61
USNO	35	260	38.12	39.68	37.90	39.96	31.76	30.92	31.48	30.73	36.43	45.03	26.89	27.73
USNO	35	268	-16.95	-16.76	-16.78	-16.80	-16.85	-17.54	-18.46	-18.76	-21.50	-20.85	-21.98	-20.96
USNO	35	270	15.35	15.03	15.02	14.29	14.57	13.86	14.34	15.69	15.92	14.38	13.81	13.79
USNO	35	279	28.69	27.90	28.61	28.65	26.13	27.77	31.41	32.19	32.86	32.59	32.37	30.50
USNO	35	389	-17.21	-15.80	-15.47	-15.82	-15.88	-14.48	-14.33	-15.28	-14.38	-13.95	-12.89	-13.55
USNO	35	394	-35.59	-37.07	-36.99	-37.00	-36.23	-35.30	-36.13	-35.73	-36.20	-36.59	-35.66	-35.98
USNO	35	416	-4.49	-4.46	-4.26	-6.67	-5.76	-5.66	-	-	-	-	-	-
USNO	35	417	-4.89	-5.25	-6.16	-6.75	-6.48	-6.00	-4.49	-4.98	-	-	-	-
USNO	35	703	-2.30	-3.25	-3.76	-3.39	-3.57	-3.99	-2.90	-0.90	2.27	2.29	1.60	-0.17
USNO	35	717	-10.21	-9.54	-9.79	-10.88	-11.21	-11.10	-12.20	-12.08	-13.35	-14.03	-13.11	-13.30
USNO	35	762	0.23	-1.89	-1.85	-1.06	-0.97	-1.68	-1.67	-1.51	-2.26	-1.89	-0.95	-1.47
USNO	35	765	-137.13	-	-	-	-	-	-	-	-	-	-	-
USNO	35	1096	15.08	15.06	15.12	14.40	14.88	15.16	15.05	14.76	14.67	14.78	14.90	14.50
USNO	35	1097	8.67	7.41	-	-	-	-	-	-	-	-	-	-
USNO	35	1125	-10.12	-10.67	-11.17	-9.73	-10.56	-10.53	-10.04	-10.13	-11.12	-11.32	-11.05	-11.80
USNO	35	1327	-7.23	-7.78	-8.05	-7.41	-7.44	-8.14	-9.08	-8.97	-9.12	-10.07	-10.47	-10.44
USNO	35	1328	3.83	4.03	4.29	3.36	4.71	2.96	4.25	3.58	3.98	4.00	4.43	5.79
USNO	35	1331	-38.37	-39.16	-40.71	-39.86	-41.13	-40.31	-40.64	-39.69	-39.77	-39.78	-39.14	-39.78

Table 8. (Cont.)

Lab.	Clock	57049	57079	57109	57139	57169	57199	57234	57264	57294	57324	57354	57384
USNO	35 1459	-7.33	-7.69	-7.85	-7.11	-7.86	-6.71	-8.09	-7.82	-8.35	-7.92	-7.91	-7.82
USNO	35 1462	-0.72	-1.39	-1.21	-1.88	-0.93	-1.43	-0.79	-1.62	-1.07	-0.47	-1.29	-0.94
USNO	35 1463	11.83	11.81	12.39	12.52	12.02	12.15	11.57	12.05	12.29	11.83	12.98	11.94
USNO	35 1468	5.83	5.26	6.10	7.12	6.89	7.01	6.16	6.86	6.05	6.02	5.52	5.55
USNO	35 1481	-26.49	-26.28	-26.71	-26.72	-26.91	-26.60	-27.15	-27.71	-27.96	-26.77	-27.85	-27.44
USNO	35 1543	2.53	4.67	6.81	8.31	7.46	7.72	7.51	8.12	7.58	8.09	7.43	8.77
USNO	35 1573	13.11	11.17	12.00	11.38	13.21	13.79	14.89	15.19	14.29	14.22	14.39	14.04
USNO	35 1575	-2.80	-4.15	-3.32	-4.37	-4.01	-4.21	-4.12	-3.90	-4.79	-5.40	-5.73	-6.23
USNO	35 1580	-16.32	-15.71	-15.32	-15.42	-14.81	-15.32	-15.62	-14.55	-14.71	-15.35	-15.74	-15.41
USNO	35 1585	8.16	8.03	7.48	5.89	6.31	5.55	2.36	3.39	1.83	2.33	2.16	0.22
USNO	35 1598	-12.30	-12.84	-12.82	-11.38	-10.46	-13.61	-20.41	-19.32	-20.28	-18.53	-20.48	-21.90
USNO	35 1655	-6.89	-6.60	-6.13	-5.59	-5.23	-5.11	-5.08	-5.05	-5.45	-5.51	-5.28	-5.74
USNO	35 1658	21.40	21.24	20.99	20.87	21.56	21.34	21.50	20.83	20.75	20.82	20.24	20.52
USNO	35 1692	-5.32	-5.21	-5.17	-5.24	-5.92	-5.25	-5.10	-5.39	-5.84	-7.37	-7.00	-7.79
USNO	35 1694	18.89	18.43	18.89	18.60	18.49	17.34	17.61	17.40	17.79	18.04	17.14	17.60
USNO	35 1696	10.95	8.22	8.17	8.03	8.49	9.30	10.60	11.04	13.55	13.71	13.61	13.36
USNO	35 1697	25.54	26.24	26.13	25.63	26.84	26.13	26.38	27.10	26.42	26.90	27.09	26.37
USNO	40 701	26.11	26.94	27.72	32.46	55.26	56.53	55.59	54.35	53.13	52.55	52.39	52.23
USNO	40 702	-8.07	-8.12	-7.92	-7.88	-7.22	-7.15	-7.17	-6.98	-7.03	-7.00	-6.92	-6.81
USNO	40 704	35.35	35.50	35.63	35.77	35.73	35.77	35.86	36.16	36.23	-	-	-
USNO	40 705	-71.51	-71.40	-71.25	-71.27	-71.28	-71.02	-70.88	-70.62	-70.53	-70.28	-70.36	-70.29
USNO	40 708	91.19	91.54	91.88	92.16	92.35	92.59	92.92	93.26	93.52	93.74	94.05	94.30
USNO	40 710	-	-	-	-	-	-	-	-534.29	-533.94	-533.69	-533.34	-533.04
USNO	40 711	387.75	389.19	390.76	392.12	393.76	394.88	396.39	397.93	399.37	400.74	402.12	403.55
USNO	40 712	59.87	59.79	59.65	59.70	59.82	59.92	59.88	59.72	59.78	59.74	59.71	59.77
USNO	40 713	51.97	60.48	69.86	79.04	88.07	96.99	106.42	88.56	51.32	51.98	52.75	53.32
USNO	40 714	1.31	1.49	1.93	2.12	2.18	2.89	3.12	3.48	3.79	4.10	4.49	4.85
USNO	40 715	113.47	113.78	114.30	114.79	115.21	115.65	116.19	116.71	117.23	117.65	118.17	118.69
USNO	40 716	218.45	218.60	218.73	218.88	218.88	219.11	219.22	219.40	219.51	219.68	219.85	219.96
USNO	40 717	92.48	93.94	95.47	97.01	98.60	105.57	101.73	103.46	104.92	106.35	107.66	108.73

Table 8. (Cont.)

Lab.	Clock		57049	57079	57109	57139	57169	57199	57234	57264	57294	57324	57354	57384
USNO	40	718	244.89	244.21	245.89	245.47	240.67	245.86	247.69	248.70	249.46	250.33	251.30	252.40
USNO	40	719	112.00	112.96	113.93	114.91	115.92	116.87	117.92	-	-	-	-	-
USNO	40	720	233.02	235.69	238.06	240.17	242.46	244.68	247.08	249.53	251.88	254.16	256.49	258.79
USNO	40	721	-512.69	-508.60	-504.86	-500.86	-496.72	-492.88	-488.62	-484.89	-481.27	-477.83	-474.05	-470.47
USNO	40	722	-	-	-	-	-	538.87	543.05	546.77	550.34	554.01	557.48	560.58
USNO	40	723	-65.53	-65.33	-65.14	-64.96	-64.89	-64.88	-64.67	-64.42	-64.25	-64.03	-63.80	-63.45
USNO	40	724	-101.40	-102.54	-102.60	-102.15	-100.27	-100.23	-100.32	-100.28	-100.37	-100.44	-100.45	-100.47
USNO	40	725	-36.71	-36.48	-36.46	-36.34	-36.24	-36.13	-35.89	-35.68	-35.65	-35.59	-35.49	-35.34
USNO	40	726	98.28	101.80	105.29	108.84	112.40	115.87	119.63	123.48	126.88	130.30	133.74	137.16
USNO	40	727	-763.04	-761.14	-758.41	-755.92	-752.88	-749.68	-746.56	-742.85	-739.64	-736.35	-733.07	-729.94
USNO	40	728	390.37	393.30	396.20	397.39	390.95	394.28	397.55	401.61	404.12	406.67	410.18	412.81
USNO	40	729	245.49	250.17	254.58	259.08	263.37	267.71	272.60	277.55	281.79	286.16	290.50	294.77
USNO	40	730	282.81	286.11	289.32	292.67	295.90	299.13	302.72	306.32	309.59	312.77	315.98	319.14
USNO	40	731	-177.27	-177.43	-177.55	-177.74	-177.94	-178.11	-178.13	-178.36	-178.46	-178.35	-178.34	-178.39
USNO	40	732	15.54	18.47	21.30	23.25	18.92	21.81	25.07	28.32	31.31	34.17	37.16	40.12
USNO	40	734	290.98	285.86	280.97	275.91	271.72	267.73	263.14	259.00	253.55	249.35	245.37	241.52
USNO	40	735	197.36	202.36	206.66	211.96	216.27	221.02	226.86	232.30	236.21	240.33	244.33	248.38
USNO	40	736	90.22	94.82	99.36	103.99	108.75	113.40	118.44	123.51	128.23	132.87	137.48	142.08
USNO	40	737	191.23	200.64	210.15	219.39	228.79	238.01	247.75	257.53	266.29	274.92	283.40	292.17
USNO	93	2	-5.88	-5.91	-5.95	-5.89	-5.92	-5.96	-6.02	-5.95	-5.95	-5.97	-5.93	-5.88
USNO	93	3	-5.83	-5.81	-5.83	-5.78	-5.80	-5.85	-5.89	-5.82	-5.80	-5.79	-5.77	-5.78
USNO	93	4	-5.84	-5.78	-5.74	-5.80	-5.79	-5.89	-5.92	-5.83	-5.84	-5.84	-5.81	-5.76
USNO	93	5	-5.82	-5.80	-5.77	-5.80	-5.81	-5.85	-5.92	-5.85	-5.85	-5.85	-5.82	-5.77
VMI	35	2230	-19.77	-20.04	-20.57	-	-	-20.95	-16.84	-16.17	-17.92	-15.26	-18.80	-18.45
VMI	36	1233	-6.68	-7.24	-6.71	-	-	-10.23	-1.63	-2.90	-5.56	-3.47	-4.81	-5.44
VMI	36	2314	20.88	20.00	18.49	-	-	17.96	21.65	21.65	19.23	22.16	19.60	19.09
VSL	35	179	-	-	25.11	24.45	25.15	25.09	24.88	26.49	26.57	26.70	27.35	27.23
VSL	35	456	-4.58	-3.87	-3.42	-2.96	-3.15	-3.05	-1.55	-1.90	-1.92	-2.20	-2.46	-2.48
VSL	35	548	14.92	14.45	16.80	15.55	16.24	17.42	17.97	18.59	17.70	18.04	18.45	18.48
VSL	35	731	-8.34	-7.36	-7.77	-7.91	-8.18	-7.72	-8.20	-8.36	-8.51	-7.55	-8.19	-7.65
ZA	36	1821	-7.41	-7.51	-8.53	-7.20	-6.51	-8.90	-9.36	-6.85	-7.92	-6.67	-7.12	-6.99

Table 9A. Relative weights (in percent) of contributing clocks in 2015

(File available on http://www.bipm.org under the name WTAI15.AR)

Clock weights are computed for one-month intervals ending at the MJD dates given in the table.
"-" denotes that the clock was not used

The clocks are designated by their type (2 digits) and serial number in the type. The codes for the types are:

12 HEWLETT-PACKARD 5061A	25 HEWLETT_PACKARD 5062C
13 EBAUCHES, OSCILLATOM B5000	30 HEWLETT-PACKARD 5061B
14 HEWLETT-PACKARD 5061A OPT. 4	31 HEWLETT-PACKARD 5061B OPT. 4
16 OSCILLOQUARTZ 3200	34 H-P 5061A/B with 5071A tube
17 OSCILLOQUARTZ 3000	35 H-P/AGILENT/SYMMETRICOM/MICROSEMI 5071A High perf.
15 DATUM/SYMMETRICOM Cs III	36 H-P/AGILENT/SYMMETRICOM/MICROSEMI 5071A Low perf.
18 DATUM/SYMMETRICOM/MICROSEMI Cs 4000	4x HYDROGEN MASERS
19 RHODES AND SCHWARZ XSC	50 FREQ. AND TIME SYSTEMS INC. 4065A
21 OSCILLOQUARTZ 3210	51 DATUM/SYMMETRICOM 4065 B
22 OSCILLOQUARTZ OSA 3230B	52 DATUM/SYMMETRICOM 4065 C
23 OSCILLOQUARTZ EUDICS 3020	53 DATUM/SYMMETRICOM/MICROSEMI 4310 B
24 OSCILLOQUARTZ OSA 3235B	9x PRIMARY CLOCKS AND PROTOTYPES

Lab.	Clock	57049	57079	57109	57139	57169	57199	57234	57264	57294	57324	57354	57384
APL	35 904	0.000	0.000	0.025	0.032	0.040	0.048	0.051	0.045	0.046	0.052	0.054	0.028
APL	35 1264	0.000	0.000	0.098	0.120	0.108	0.131	0.130	0.137	0.157	0.181	0.069	0.074
APL	35 1791	0.000	0.000	0.099	0.128	0.165	0.192	0.242	0.163	0.138	0.160	0.167	0.058
APL	40 3107	1.036	1.034	1.053	1.058	1.015	1.003	1.023	1.044	1.010	1.010	0.988	0.990
APL	40 3108	1.036	1.034	1.053	1.058	1.015	1.003	1.023	1.044	1.010	1.010	0.988	0.990
APL	40 3109	1.036	1.034	1.053	1.058	1.015	1.003	1.023	1.044	1.010	1.010	0.988	0.990
AUS	35 2269	0.187	0.194	0.097	0.103	0.061	0.057	-	-	0.000	0.000	-	-
AUS	36 299	0.050	0.049	0.041	0.047	0.051	0.045	-	0.000	0.000	0.000	0.000	0.000
AUS	36 340	0.024	0.012	0.013	0.014	0.016	0.017	-	0.000	0.000	0.000	0.000	0.000
AUS	36 654	0.115	0.141	0.201	0.261	0.179	0.133	-	-	0.000	0.000	0.000	0.000

Table 9A. (Cont.)

Lab.	Clock	57049	57079	57109	57139	57169	57199	57234	57264	57294	57324	57354	57384
AUS	36 1141	0.011	0.011	0.012	0.014	0.015	0.016	-	0.000	0.000	0.000	0.000	0.000
AUS	36 2269	-	-	-	-	-	-	-	-	-	-	-	0.000
BEV	35 1793	0.199	0.119	0.143	0.145	0.175	0.193	0.099	0.120	0.123	0.144	0.164	0.162
BEV	35 3009	0.179	0.163	0.198	0.171	0.207	-	0.000	0.000	0.000	0.000	0.000	0.406
BEV	40 3452	0.119	-	0.000	0.000	0.000	-	0.000	-	0.000	0.000	0.000	0.000
BIM	18 8058	0.028	0.026	0.028	0.030	0.026	0.024	0.017	0.012	0.013	0.012	0.013	0.014
BY	40 4222	0.000	0.000	0.000	0.000	0.000	0.000	0.006	0.009	0.010	-	-	-
BY	40 4227	0.000	0.004	0.005	0.006	0.007	0.006	0.007	0.010	0.010	0.013	0.015	0.018
BY	40 4229	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
BY	40 4278	-	0.000	0.000	0.000	0.000	0.000	0.136	0.144	0.029	0.038	0.045	0.022
CH	24 105	0.000	0.000	0.000	0.015	0.021	0.026	0.034	0.022	0.010	0.007	0.007	0.008
CH	35 2117	0.032	0.029	0.037	0.044	0.051	0.048	0.059	0.078	0.094	0.055	0.035	0.040
CH	35 2743	0.042	0.042	0.000	0.000	0.000	0.000	0.000	0.023	0.029	0.036	0.045	0.037
CH	40 5701	0.000	0.061	0.088	0.112	0.136	0.162	0.202	0.260	0.293	0.409	0.619	0.990
CH	40 5702	-	-	-	-	-	-	-	0.000	0.000	0.000	0.000	0.000
CNM	35 2708	-	0.000	0.000	0.000	0.000	0.000	0.088	0.113	0.102	0.132	0.147	0.180
CNM	35 2709	-	0.000	0.000	0.000	0.000	0.000	0.020	0.031	0.035	0.041	0.041	0.050
CNM	35 2885	-	0.000	0.000	0.000	0.000	0.000	0.318	0.384	0.157	0.199	0.151	0.124
CNM	35 3055	-	-	-	0.000	0.000	0.000	0.000	0.000	0.302	0.326	0.131	0.163
CNM	40 7301	-	0.000	0.000	0.000	0.000	0.000	0.220	0.325	0.414	0.235	0.268	0.313
CNM	40 7302	-	0.000	0.000	0.000	0.000	0.000	0.175	0.150	0.174	0.000	0.000	0.000
CNMP	36 1752	0.000	0.000	0.000	0.000	0.000	0.010	-	0.000	0.000	0.000	0.000	0.000
CNMP	36 1806	0.000	0.000	0.000	0.000	0.000	0.024	-	0.000	0.000	0.000	0.000	0.000
CNMP	36 2873	0.000	0.000	0.000	0.000	0.000	0.072	-	0.000	0.000	0.000	0.000	0.000
DFNT	36 2866	-	-	0.000	0.000	0.000	0.000	0.000	-	-	0.000	0.000	0.000
DMDM	35 2191	0.000	0.014	-	0.000	-	-	-	-	-	-	0.000	0.000
DMDM	36 2033	0.000	0.017	0.024	0.029	0.035	0.040	0.046	0.059	0.052	0.051	0.047	0.036
DTAG	35 2805	0.000	0.433	0.629	0.336	0.181	0.203	-	-	0.000	0.000	0.000	0.000
DTAG	35 2941	0.000	0.107	0.153	0.191	0.113	0.099	-	-	0.000	0.000	-	-
DTAG	35 2966	0.000	0.794	0.840	0.963	1.015	1.003	-	-	0.000	0.000	0.000	0.000

Table 9A. (Cont.)

Lab.	Clock	57049	57079	57109	57139	57169	57199	57234	57264	57294	57324	57354	57384
DTAG	35 3053	-	-	-	-	-	-	-	-	-	-	-	0.000
EIM	35 716	0.000	-	-	0.000	0.000	0.000	-	-	-	-	-	-
EIM	35 2060	0.000	0.000	-	0.000	0.000	0.000	-	-	-	0.000	0.000	0.000
ESTC	22 132	0.000	0.000	0.000	0.000	0.000	-	0.000	0.000	0.000	0.000	-	-
ESTC	35 1615	0.000	0.000	0.000	0.000	0.000	0.228	0.327	0.134	0.166	0.126	0.112	0.000
ESTC	35 2025	0.000	0.000	0.000	0.000	0.000	0.062	0.033	0.045	0.051	0.060	0.063	0.041
ESTC	35 2353	0.000	0.000	0.000	0.000	0.000	0.133	0.149	0.169	0.210	0.239	0.056	0.000
ESTC	40 2543	0.000	0.000	0.000	0.000	0.000	0.069	0.059	0.085	0.105	0.053	0.062	0.053
ESTC	40 2544	0.000	0.000	0.000	0.000	0.000	-	-	0.000	0.000	0.000	0.000	0.000
F	35 124	0.245	0.254	0.297	0.337	0.378	0.412	0.513	0.159	0.163	0.092	0.092	-
F	35 157	0.123	0.118	0.145	0.143	0.114	0.088	0.095	0.103	0.113	0.136	0.147	0.172
F	35 158	0.084	-	-	-	-	-	-	-	-	-	-	-
F	35 355	0.037	0.039	0.046	0.054	0.062	0.048	0.055	0.071	0.077	0.085	0.092	0.112
F	35 385	0.038	0.029	0.035	0.039	-	-	-	-	-	-	-	-
F	35 396	0.196	0.174	0.133	0.096	0.104	0.086	0.091	0.103	0.101	0.110	0.125	0.145
F	35 469	0.040	0.043	0.054	0.058	0.062	0.069	0.063	0.065	0.072	0.087	0.092	0.093
F	35 489	0.152	0.093	0.115	0.107	0.116	0.133	0.117	0.150	0.097	0.055	0.059	0.054
F	35 609	0.217	0.235	0.132	0.138	0.137	-	-	-	-	-	-	0.000
F	35 770	0.093	0.096	0.123	0.123	0.166	0.144	0.041	0.047	0.048	0.054	0.059	-
F	35 774	0.273	0.265	0.298	0.294	0.344	0.155	0.185	0.158	0.039	0.043	0.046	0.051
F	35 781	0.131	0.137	0.144	0.085	0.073	0.081	0.095	0.125	0.144	0.173	0.117	0.137
F	35 859	0.014	0.015	0.010	0.011	0.013	0.013	0.015	0.019	0.020	0.023	0.029	0.033
F	35 1177	0.020	0.017	0.015	0.016	0.018	0.018	0.020	0.025	0.030	0.036	0.030	0.039
F	35 1222	0.234	0.221	0.257	0.156	0.103	0.082	0.091	0.084	0.067	0.042	0.045	0.050
F	35 1321	0.036	0.026	0.032	0.037	0.042	0.045	0.046	0.061	0.072	0.080	0.089	0.057
F	35 1556	0.071	0.033	0.039	0.044	0.051	-	-	-	-	-	-	0.000
F	35 1644	0.120	0.064	0.060	0.066	0.079	0.075	0.087	0.110	0.125	0.140	0.123	0.131
F	35 2388	0.086	0.089	0.086	0.085	0.093	0.096	0.102	0.119	0.136	0.170	0.207	0.266
F	35 2609	0.526	0.436	0.035	0.033	0.031	0.029	0.032	0.034	0.036	0.038	0.043	0.049
F	35 2647	0.017	0.020	0.024	0.025	0.028	0.029	0.034	0.044	0.041	0.031	0.034	0.036

Table 9A. (Cont.)

Lab.	Clock	57049	57079	57109	57139	57169	57199	57234	57264	57294	57324	57354	57384
F	35 2804	0.289	0.180	0.104	0.110	0.124	0.134	0.159	0.194	0.217	0.236	0.245	0.313
F	35 2985	-	0.000	0.000	0.000	0.000	0.000	0.356	0.142	0.172	0.189	0.218	0.251
F	40 809	1.036	1.034	1.053	1.058	1.015	1.003	1.023	1.044	1.010	1.010	0.988	0.990
F	40 810	-	0.000	0.000	0.000	0.000	0.000	1.023	1.044	1.010	1.010	0.988	0.990
F	40 889	1.036	1.034	1.053	1.058	1.015	1.003	1.023	1.044	1.010	1.010	0.988	0.990
F	40 890	1.036	1.034	1.053	1.058	1.015	1.003	1.023	1.044	1.010	1.010	0.988	0.990
HKO	35 2425	0.117	0.107	0.117	0.126	0.147	0.150	0.184	-	0.000	0.000	0.000	0.000
HKO	35 2884	0.130	0.115	0.140	0.170	0.176	0.158	0.170	0.186	0.155	0.120	0.127	0.150
IFAG	36 1167	0.019	0.021	0.022	0.029	0.027	0.025	0.028	0.020	0.022	0.025	0.027	0.030
IFAG	36 1173	-	-	-	-	-	0.000	0.000	0.000	0.000	0.000	0.008	0.010
IFAG	36 1629	0.066	0.062	0.070	0.081	0.095	0.097	0.101	0.125	0.092	0.088	0.027	0.029
IFAG	36 1732	0.061	0.066	0.054	0.060	0.063	0.046	0.047	0.058	0.046	0.051	0.052	0.058
IFAG	36 1798	0.177	0.141	0.106	0.073	0.081	0.087	0.100	0.101	0.109	0.128	0.149	0.179
IFAG	40 4418	1.036	0.998	1.053	1.058	1.015	1.003	1.023	1.044	1.010	1.010	0.988	0.990
IFAG	40 4439	0.000	1.034	0.572	-	0.000	0.000	0.000	0.000	0.000	0.119	0.107	0.140
IMBH	35 2685	-	-	-	-	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000
IMBH	35 2909	-	-	-	-	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000
INPL	35 2480	0.111	0.090	0.106	0.122	0.108	0.094	0.051	0.060	0.063	0.073	0.078	0.088
INPL	35 2481	0.228	0.232	0.130	0.134	0.151	0.162	0.063	0.075	0.070	0.080	0.079	0.086
INTI	35 2377	0.000	-	-	-	-	-	-	-	-	-	-	-
INTI	36 2377	-	-	0.000	0.000	0.000	0.000	0.000	0.000	0.010	0.014	0.016	0.020
INXE	35 2393	0.023	0.016	0.016	0.018	0.020	0.016	0.018	0.022	0.025	0.029	0.029	0.032
IT	35 219	0.058	0.058	0.066	0.060	0.061	0.066	0.078	0.104	0.128	0.090	0.060	0.064
IT	35 505	0.080	0.076	0.091	0.102	0.119	0.104	0.122	0.111	0.082	0.055	0.055	0.061
IT	35 1115	0.019	0.021	0.027	0.027	0.030	0.036	0.048	0.072	0.087	0.110	0.125	0.161
IT	35 1373	0.217	0.231	0.271	0.300	0.314	0.361	0.462	-	-	-	0.000	0.000
IT	35 2118	0.384	0.417	0.516	0.610	0.433	0.345	0.341	0.231	0.212	0.191	0.120	0.121
IT	35 2487	0.214	0.108	0.093	0.096	0.110	0.122	0.113	0.119	0.124	-	-	-
IT	40 1101	1.036	1.034	1.053	1.058	1.015	1.003	1.023	1.044	1.010	1.010	0.988	0.990
IT	40 1102	0.581	0.602	0.628	0.687	0.779	0.732	0.841	1.044	1.010	1.010	0.988	0.841

Table 9A. (Cont.)

Lab.	Clock	57049	57079	57109	57139	57169	57199	57234	57264	57294	57324	57354	57384
IT	40 1103	1.036	1.034	1.053	1.058	1.015	1.003	1.023	1.044	1.010	1.010	0.988	0.990
IT	40 1104	0.004	0.004	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.036	0.034
JV	36 1277	0.033	0.028	0.028	0.033	0.033	0.032	0.027	0.034	0.038	0.020	0.019	0.021
JV	36 2617	0.034	0.041	0.042	0.050	0.059	0.050	0.057	0.030	0.028	0.027	0.027	0.027
JV	36 2629	0.074	0.043	0.028	0.029	0.035	0.033	0.039	0.049	0.032	0.037	0.041	0.045
JV	40 8713	0.066	0.053	0.068	0.083	0.071	0.054	0.057	0.073	0.084	0.102	0.082	0.092
KEBS	35 2518	-	0.000	-	-	-	-	-	-	-	-	-	0.000
KRIS	35 321	0.000	0.000	0.000	0.000	0.143	0.163	0.211	0.176	0.127	0.154	0.177	0.180
KRIS	35 739	0.000	0.000	0.000	0.000	0.051	0.061	0.069	0.086	0.103	0.124	0.111	0.131
KRIS	35 1135	0.000	0.000	0.000	0.000	0.000	0.067	0.070	0.035	0.031	0.035	0.041	0.025
KRIS	35 1693	0.000	0.000	0.000	0.000	0.097	0.129	0.166	0.211	0.256	0.155	0.107	0.126
KRIS	35 1783	0.000	0.000	0.000	0.000	0.055	0.073	0.067	0.090	0.109	0.134	0.113	0.128
KRIS	40 5625	0.000	0.000	0.000	0.000	1.015	1.003	1.023	-	-	-	-	-
KRIS	40 5626	0.000	0.000	0.000	0.000	1.015	1.003	1.023	1.044	1.010	1.010	0.988	0.990
KZ	35 2202	0.000	0.000	0.000	0.000	0.109	0.063	0.086	0.111	0.131	0.120	0.138	0.099
KZ	35 2665	0.000	0.000	0.000	0.000	0.165	0.171	0.204	0.046	0.015	0.016	0.018	0.021
KZ	35 2667	0.000	0.000	0.000	0.000	0.126	0.120	0.163	0.067	0.041	0.050	0.057	0.051
LT	35 1362	0.034	0.038	0.048	0.034	0.033	0.037	0.032	0.038	0.042	0.047	0.046	0.053
LT	35 1868	0.115	0.121	0.125	0.145	0.172	0.185	0.235	0.187	0.210	0.251	0.243	0.284
MASM	35 2900	0.000	-	0.000	0.000	-	-	-	-	-	-	-	-
MBM	24 125	-	-	-	-	-	-	-	-	-	-	0.000	-
MIKE	36 986	0.042	0.021	-	0.000	0.000	0.000	0.000	0.000	0.000	0.027	0.029	0.030
MIKE	40 4108	1.036	1.034	-	0.000	0.000	0.000	0.000	0.000	1.010	1.010	0.988	0.990
MIKE	40 4113	0.034	0.037	-	0.000	0.000	0.000	0.000	0.000	0.023	0.010	0.009	0.011
MIKE	40 4180	1.036	1.034	-	0.000	0.000	0.000	0.000	0.000	0.484	0.682	0.870	0.990
MIKE	40 4189	-	-	-	-	-	-	0.000	0.000	0.000	0.000	0.000	0.034
MKEH	36 849	0.034	0.036	0.041	0.046	0.053	0.056	0.045	0.059	0.072	0.067	0.078	0.075
MTC	35 3000	-	-	0.000	0.000	0.000	0.000	0.000	0.175	0.145	-	0.000	0.000
MTC	35 3002	0.000	0.000	0.000	0.000	0.062	0.075	0.091	0.102	0.123	-	0.000	0.000
MTC	35 3003	0.000	0.000	0.000	0.000	-	-	-	-	-	-	-	-

Table 9A. (Cont.)

Lab.	Clock	57049	57079	57109	57139	57169	57199	57234	57264	57294	57324	57354	57384
MTC	35 3004	0.000	0.000	0.000	0.000	0.045	0.058	-	-	-	-	-	-
MTC	35 3005	0.000	0.000	0.000	0.000	0.064	0.085	0.116	0.162	0.195	-	0.000	0.000
NAO	35 779	0.010	0.010	0.011	0.011	0.012	0.013	0.016	0.022	0.024	0.031	0.023	0.028
NAO	35 1206	0.000	0.000	0.000	0.000	0.000	0.000	0.060	0.085	0.019	0.010	0.000	0.000
NAO	35 1214	0.077	0.082	0.090	0.079	0.092	0.099	0.124	0.170	0.063	0.023	0.022	0.022
NAO	35 1689	0.053	0.057	0.051	0.056	0.058	0.062	0.059	-	-	-	0.000	0.000
NAO	40 1301	0.000	0.000	0.000	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000
NICT	35 332	0.094	-	-	0.000	0.000	0.000	0.000	0.000	0.112	0.157	0.180	0.230
NICT	35 343	0.139	-	-	0.000	0.000	0.000	0.000	0.000	0.190	0.270	0.180	0.165
NICT	35 715	0.323	0.318	0.247	0.194	0.220	0.238	0.178	0.197	0.149	0.164	0.140	0.154
NICT	35 732	0.092	0.051	0.052	0.057	0.055	0.057	0.065	0.079	0.092	0.090	0.074	0.092
NICT	35 907	0.176	0.173	0.201	0.214	0.240	0.268	0.217	0.150	0.130	0.124	0.114	0.119
NICT	35 913	0.101	0.070	0.061	0.071	0.063	0.062	0.072	0.079	0.087	0.075	0.064	0.062
NICT	35 916	0.524	0.580	0.505	0.484	0.542	0.487	0.515	0.633	0.668	0.604	0.155	0.168
NICT	35 1225	0.104	-	0.000	0.000	0.000	0.000	0.000	0.072	0.092	0.090	0.111	0.136
NICT	35 1226	0.121	0.087	0.069	0.043	0.047	0.047	0.049	0.061	0.062	0.056	0.043	0.045
NICT	35 1611	0.086	0.056	0.053	0.058	0.023	0.024	0.022	0.027	0.029	0.034	0.000	-
NICT	35 1778	0.142	0.145	0.141	0.158	0.164	0.181	0.210	0.262	0.276	0.079	0.070	0.070
NICT	35 1789	0.226	0.220	0.116	0.127	0.110	0.077	0.081	0.069	0.076	0.088	0.095	0.106
NICT	35 1790	0.110	0.104	0.113	0.118	0.143	0.122	0.117	0.125	0.131	0.149	0.129	0.135
NICT	35 1866	0.290	0.320	0.212	0.237	0.235	0.255	0.190	0.203	0.228	0.255	0.250	0.291
NICT	35 1882	0.124	0.125	0.154	0.155	0.176	0.194	0.098	0.110	0.107	0.124	0.127	0.093
NICT	35 1887	0.000	-	-	0.000	0.000	0.000	0.000	0.000	0.128	0.154	0.145	0.178
NICT	35 1944	0.065	0.066	0.082	0.102	0.127	0.153	0.207	0.289	0.080	0.072	0.070	0.077
NICT	35 2010	0.219	0.254	0.282	0.166	0.184	0.207	0.252	0.267	0.284	0.309	0.356	0.226
NICT	35 2011	0.220	0.239	0.223	0.221	0.230	0.232	0.119	0.145	0.153	0.177	0.196	0.183
NICT	35 2056	0.293	0.138	0.156	0.160	0.165	0.134	0.143	0.151	0.171	0.177	0.189	0.232
NICT	35 2113	0.083	0.067	0.067	0.075	0.080	0.089	0.100	0.124	0.140	0.166	0.191	0.247
NICT	35 2116	0.000	0.000	0.000	0.228	0.208	0.225	0.292	0.352	0.419	0.419	0.310	0.259
NICT	35 2570	0.174	0.136	0.145	0.170	0.181	0.199	0.232	0.270	0.319	0.302	0.355	0.362

Table 9A. (Cont.)

Lab.	Clock	57049	57079	57109	57139	57169	57199	57234	57264	57294	57324	57354	57384
NICT	35 2574	0.189	0.145	0.141	0.164	0.191	0.218	0.049	0.049	0.053	0.061	0.055	0.059
NICT	35 2627	0.044	0.044	0.046	0.053	0.059	0.069	0.089	0.130	0.175	0.230	0.286	0.239
NICT	35 2628	0.110	0.101	0.129	0.108	0.024	0.025	0.024	0.028	0.031	0.035	0.040	0.048
NICT	35 2784	0.241	0.242	0.279	0.167	0.185	0.123	0.131	0.162	0.172	0.178	0.195	0.236
NICT	35 2876	0.000	0.196	0.282	0.370	0.399	0.314	0.374	0.400	0.259	0.205	0.215	0.178
NICT	35 2903	0.282	0.215	0.251	0.272	0.269	0.293	0.248	0.117	0.107	0.114	0.093	0.090
NICT	36 1217	0.018	0.019	0.016	0.018	0.017	0.018	0.021	0.026	0.026	0.027	0.031	0.038
NICT	40 2003	1.036	1.034	1.053	0.038	0.012	0.013	-	0.000	0.000	0.000	0.000	0.000
NICT	40 2004	1.036	1.034	1.053	1.058	1.015	1.003	1.023	1.044	1.010	1.010	0.988	0.990
NICT	40 2005	0.063	0.050	0.049	0.053	0.053	0.058	0.068	0.078	-	-	-	-
NICT	40 2006	1.036	1.034	1.053	1.058	1.015	1.003	-	0.000	0.000	0.000	0.000	0.000
NIM	35 1235	0.023	0.020	0.024	0.029	0.029	0.029	0.033	0.038	0.044	0.054	0.059	0.064
NIM	35 2239	0.000	-	-	-	-	-	-	-	-	-	-	-
NIM	35 2256	0.204	0.279	0.401	0.289	0.340	0.335	0.405	0.376	0.373	0.448	0.528	0.204
NIM	35 2483	0.000	0.000	0.000	0.000	0.218	0.174	0.187	0.245	0.288	0.188	0.121	0.141
NIM	35 2643	0.449	0.229	0.257	0.283	0.203	0.155	0.173	0.213	0.241	0.176	0.187	0.219
NIM	35 2744	0.442	0.446	0.471	0.140	0.103	0.084	0.074	0.074	0.066	0.074	0.071	0.075
NIM	35 2767	0.141	0.157	0.207	0.224	0.149	0.175	0.229	0.247	0.140	0.156	0.124	0.139
NIM	35 2769	0.000	0.000	0.138	0.160	0.207	0.239	0.249	0.258	0.229	0.198	0.112	0.118
NIM	40 4832	0.303	0.327	0.385	0.262	0.169	0.150	0.171	0.191	0.191	0.170	0.184	0.214
NIM	40 4835	-	-	0.000	0.000	0.000	0.000	0.000	0.013	0.016	0.021	0.021	0.021
NIM	40 4871	1.036	1.034	1.053	1.058	1.015	1.003	1.023	1.044	1.010	1.010	0.988	0.990
NIM	40 4878	0.158	0.169	0.197	0.240	0.246	0.272	0.330	0.423	0.500	0.667	0.879	0.990
NIM	40 4879	-	0.000	0.000	0.000	0.000	0.000	0.000	0.004	0.005	0.007	0.009	0.010
NIM	40 4880	0.086	0.091	0.099	0.118	0.146	0.072	0.081	0.092	0.078	0.081	0.068	0.072
NIMB	35 600	0.045	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.007	0.008	0.011
NIMT	35 2246	0.046	0.035	0.039	0.046	0.032	0.036	0.046	0.053	0.046	0.051	0.036	0.038
NIMT	35 2247	0.009	0.010	0.012	0.014	0.014	0.015	0.015	0.016	0.016	0.020	0.023	0.027
NIS	35 1126	0.000	0.000	0.000	0.000	0.000	0.000	0.015	-	-	-	-	-
NIST	35 282	0.096	0.102	0.108	0.118	0.146	0.166	0.203	0.264	0.306	0.229	0.249	0.290

Table 9A. (Cont.)

Lab.	Clock		57049	57079	57109	57139	57169	57199	57234	57264	57294	57324	57354	57384
NIST	35	408	0.128	0.098	0.103	0.115	0.134	0.099	0.119	0.133	0.144	0.154	0.183	0.215
NIST	35	1074	0.312	0.161	0.192	0.171	0.177	0.108	0.107	0.126	0.140	0.120	0.125	0.148
NIST	35	1519	0.070	0.049	0.047	0.052	0.060	0.067	0.080	0.102	0.119	0.152	0.191	0.268
NIST	35	2031	0.000	0.000	0.172	0.217	0.288	0.346	0.256	0.316	0.154	0.182	0.186	0.155
NIST	35	2032	0.177	0.173	0.180	0.166	0.198	0.218	0.286	0.344	0.392	0.493	0.224	0.209
NIST	35	2034	0.215	0.125	0.072	0.078	0.083	0.090	0.100	0.125	0.137	0.167	0.149	0.084
NIST	35	2579	0.076	0.087	0.121	0.109	0.099	0.108	0.108	0.136	0.141	0.163	0.132	0.035
NIST	35	2672	0.086	0.070	0.053	0.058	0.040	0.029	0.033	0.026	0.025	0.028	0.028	0.032
NIST	35	2935	0.000	0.108	0.156	0.207	0.230	0.274	0.312	0.361	0.415	0.220	0.250	0.254
NIST	40	205	1.036	1.034	1.053	1.058	1.015	1.003	1.023	1.044	1.010	1.010	0.988	0.990
NIST	40	206	1.036	1.034	0.904	0.762	0.774	0.857	0.810	1.044	1.010	0.854	0.949	0.458
NIST	40	207	0.000	0.000	0.000	0.000	0.000	1.003	0.519	0.683	0.621	0.612	0.696	0.772
NIST	40	210	-	-	-	-	-	-	-	-	-	0.000	0.000	0.000
NIST	40	212	0.000	0.987	0.765	0.929	1.015	0.592	0.449	0.567	0.647	-	-	0.000
NIST	40	222	1.036	1.034	1.053	1.058	1.015	1.003	1.023	1.044	1.010	1.010	0.988	0.990
NMIJ	35	224	0.177	0.104	0.080	0.089	0.093	0.103	0.124	0.159	0.140	0.147	0.169	0.209
NMIJ	35	523	0.088	0.081	0.095	0.107	0.104	0.085	0.093	0.116	0.137	0.019	0.000	0.000
NMIJ	40	5002	0.000	0.252	0.366	0.326	0.352	0.092	0.076	0.091	0.091	0.105	0.113	0.124
NMIJ	40	5003	0.000	0.000	0.000	1.058	1.015	1.003	1.023	1.044	1.010	1.010	0.988	0.990
NMIJ	40	5015	-	-	-	-	-	0.000	0.000	0.000	0.000	0.000	0.944	0.990
NMLS	35	328	0.000	0.012	0.000	0.000	0.000	0.000	0.000	0.013	0.017	0.023	0.023	0.028
NPL	35	1275	0.116	0.130	0.120	0.077	0.079	0.072	0.054	0.056	0.057	0.063	0.066	0.061
NPL	40	1701	0.042	0.049	0.071	0.113	0.301	1.003	1.023	1.044	1.010	1.010	0.988	0.102
NPL	40	1708	1.036	1.034	1.053	1.058	1.015	1.003	1.023	1.044	1.010	1.010	0.988	0.990
NPLI	35	57	0.021	0.019	-	0.000	0.000	0.000	0.000	0.000	0.018	0.022	0.016	0.018
NPLI	35	140	0.009	0.008	-	0.000	0.000	0.000	0.000	0.000	0.008	0.011	0.012	0.010
NPLI	35	1324	0.083	0.071	-	0.000	0.000	0.000	0.000	0.000	0.031	0.021	0.023	0.014
NPLI	35	2245	0.208	0.234	-	0.000	0.000	0.000	0.000	0.000	0.161	0.146	0.141	0.084
NPLI	35	2796	0.230	0.178	-	0.000	0.000	0.000	0.000	0.000	0.046	0.065	0.072	0.090
NPLI	40	5201	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Table 9A. (Cont.)

Lab.	Clock	57049	57079	57109	57139	57169	57199	57234	57264	57294	57324	57354	57384
NRC	35 2115	-	-	0.000	0.000	0.000	0.000	0.000	0.140	0.190	0.142	0.159	0.197
NRC	35 2150	0.094	0.097	0.113	0.133	0.134	0.106	0.041	0.047	0.049	0.056	0.047	0.053
NRC	35 2152	0.076	0.080	0.000	0.000	0.000	0.000	0.000	0.020	0.026	0.035	0.043	0.047
NRC	36 2219	0.059	0.058	0.068	0.064	0.071	0.079	0.085	0.100	0.118	0.159	0.191	0.114
NRC	40 304	-	-	-	-	-	-	-	-	-	-	-	0.000
NRC	40 306	0.187	0.191	0.000	0.000	0.000	0.000	0.000	0.000	0.009	0.012	0.000	0.000
NRL	35 714	-	0.000	0.000	0.000	0.000	0.000	-	-	-	-	0.000	0.000
NRL	35 719	-	0.000	0.000	0.000	0.000	0.000	-	-	-	-	0.000	0.000
NRL	35 1245	-	0.000	0.000	0.000	0.000	0.000	-	-	-	-	0.000	0.000
NRL	35 2460	-	0.000	0.000	0.000	0.000	0.000	0.000	-	-	-	-	0.000
NRL	35 2464	-	0.000	0.000	0.000	0.000	0.000	0.000	-	-	-	-	0.000
NRL	35 2580	-	0.000	0.000	0.000	0.000	0.000	0.000	-	-	-	-	0.000
NRL	36 387	-	0.000	0.000	0.000	0.000	0.000	-	-	-	-	0.000	0.000
NRL	36 2788	-	0.000	0.000	0.000	0.000	0.000	-	-	-	-	0.000	0.000
NRL	36 2791	-	0.000	0.000	0.000	0.000	0.000	-	-	-	-	0.000	0.000
NRL	36 2799	-	0.000	0.000	0.000	0.000	-	-	-	-	-	0.000	0.000
NRL	36 2800	-	0.000	0.000	0.000	0.000	-	-	-	-	-	0.000	0.000
NRL	36 2807	-	0.000	0.000	0.000	0.000	-	-	-	-	-	0.000	0.000
NRL	36 2808	-	0.000	0.000	0.000	0.000	-	-	-	-	-	0.000	0.000
NRL	36 2818	-	0.000	0.000	0.000	0.000	-	-	-	-	-	0.000	0.000
NRL	36 2820	-	0.000	0.000	0.000	0.000	0.000	-	-	-	-	0.000	0.000
NRL	36 2829	-	0.000	0.000	0.000	0.000	0.000	-	-	-	-	0.000	0.000
NRL	36 2832	-	0.000	0.000	0.000	0.000	0.000	-	-	-	-	0.000	0.000
NRL	36 2833	-	0.000	0.000	0.000	0.000	-	-	-	-	-	0.000	0.000
NRL	36 2834	-	0.000	0.000	0.000	0.000	0.000	-	-	-	-	0.000	0.000
NRL	40 1001	-	0.000	0.000	0.000	0.000	0.000	-	-	-	-	0.000	0.000
NRL	40 1003	-	0.000	0.000	0.000	0.000	0.000	-	-	-	-	-	-
NRL	40 1004	-	-	0.000	0.000	0.000	0.000	-	-	-	-	0.000	0.000
NRL	40 1009	-	0.000	0.000	0.000	0.000	0.000	-	-	-	-	0.000	0.000
NRL	40 1010	-	0.000	0.000	0.000	0.000	0.000	-	-	-	-	0.000	0.000

Table 9A. (Cont.)

Lab.	Clock	57049	57079	57109	57139	57169	57199	57234	57264	57294	57324	57354	57384
NRL	40 1012	-	0.000	0.000	0.000	0.000	0.000	-	-	-	-	0.000	0.000
NTSC	35 1008	0.000	0.000	0.000	0.000	-	-	-	-	-	-	-	-
NTSC	35 1011	0.033	0.034	0.039	0.012	-	-	-	-	-	-	-	-
NTSC	35 1016	0.085	0.090	0.106	0.120	0.092	0.094	0.092	0.000	0.000	0.000	0.000	0.000
NTSC	35 1018	0.110	0.102	0.131	0.145	0.157	0.121	0.153	0.089	0.071	0.073	0.069	0.063
NTSC	35 1818	0.097	0.087	0.084	0.087	0.065	0.059	0.068	0.085	0.083	0.053	0.057	0.060
NTSC	35 1823	0.217	0.229	0.269	0.182	0.208	0.125	0.129	0.041	0.041	0.043	0.040	0.030
NTSC	35 2098	0.183	0.190	0.175	0.144	0.158	0.164	0.132	0.156	0.130	0.133	0.151	0.182
NTSC	35 2131	0.112	0.057	0.067	0.076	0.087	0.097	0.117	0.079	0.079	0.088	0.092	0.108
NTSC	35 2141	0.000	0.000	0.000	0.000	-	-	-	-	-	-	-	-
NTSC	35 2142	0.171	0.188	0.237	0.219	0.240	0.279	0.229	-	-	-	-	-
NTSC	35 2143	0.066	0.070	0.082	0.089	0.096	0.108	0.037	0.034	0.030	0.034	0.038	0.042
NTSC	35 2145	0.064	0.065	0.076	0.085	0.100	0.117	0.059	0.075	0.089	0.038	0.040	0.043
NTSC	35 2573	0.116	0.109	0.127	0.137	0.153	0.172	0.130	0.167	0.165	0.172	0.115	0.136
NTSC	35 2831	-	-	0.000	0.000	0.000	0.000	0.000	-	0.000	0.000	0.000	0.000
NTSC	35 2852	0.141	0.110	0.130	0.147	0.156	0.092	0.101	0.116	0.109	0.128	0.082	0.088
NTSC	35 2921	0.119	0.125	0.151	0.158	0.190	0.232	0.146	0.175	0.197	0.213	0.225	0.235
NTSC	35 2922	0.166	0.182	0.176	0.202	0.186	0.219	0.194	0.255	0.177	0.205	0.206	0.114
NTSC	35 2924	0.000	0.000	0.000	0.000	0.000	0.176	0.115	-	0.000	0.000	0.000	0.000
NTSC	35 2926	0.218	0.185	0.164	0.162	0.145	0.154	0.187	0.161	0.101	0.115	0.074	0.078
NTSC	35 2928	0.214	0.208	0.254	0.202	0.202	0.231	0.292	0.263	0.280	0.324	0.296	0.346
NTSC	35 2933	0.182	0.158	0.189	0.217	0.192	0.209	0.247	0.259	0.254	0.265	0.277	0.287
NTSC	35 2959	0.172	0.185	0.230	0.255	0.246	0.192	0.225	-	0.000	0.000	0.000	0.000
NTSC	35 2962	0.275	0.268	0.267	0.239	0.258	0.222	0.226	0.226	0.242	0.282	0.290	0.228
NTSC	35 2964	0.248	0.264	0.342	0.182	0.215	0.238	0.302	0.377	0.450	0.322	0.360	0.429
NTSC	35 2965	0.092	0.108	0.138	0.163	0.195	0.210	0.229	0.202	0.233	0.280	0.292	0.377
NTSC	35 2976	0.070	0.082	0.050	0.061	0.072	0.078	0.093	-	0.000	0.000	0.000	0.000
NTSC	35 2978	0.077	0.088	0.114	0.125	0.146	0.152	0.161	0.167	0.183	0.196	0.205	0.259
NTSC	35 2980	0.282	0.295	0.201	0.138	0.143	0.143	0.166	0.198	0.224	0.226	0.224	0.257
NTSC	35 2981	0.127	0.132	0.170	0.198	0.218	0.242	0.117	0.122	0.140	0.146	0.160	0.187

Table 9A. (Cont.)

Lab.	Clock	57049	57079	57109	57139	57169	57199	57234	57264	57294	57324	57354	57384
NTSC	35 3089	-	-	-	-	-	0.000	0.000	0.000	0.000	0.000	0.171	0.211
NTSC	35 3090	-	-	-	-	-	0.000	0.000	0.000	0.000	0.000	0.209	0.146
NTSC	35 3091	-	-	-	-	-	0.000	0.000	0.000	0.000	0.000	0.715	0.360
NTSC	35 3102	-	-	-	-	-	0.000	0.000	0.000	0.000	0.000	0.111	0.137
NTSC	40 296	1.036	1.034	1.053	1.058	1.015	1.003	1.023	1.044	1.010	1.010	0.988	0.990
NTSC	40 297	1.036	1.034	1.053	1.058	0.863	0.821	0.657	-	-	-	-	0.000
NTSC	40 4926	-	0.000	0.000	0.000	0.000	0.000	0.013	0.014	0.016	0.019	0.021	0.025
NTSC	40 4927	-	0.000	0.000	0.000	0.000	0.000	0.018	-	0.000	0.000	0.000	0.000
NTSC	40 4943	0.455	0.537	0.777	1.058	1.015	1.003	0.462	0.357	0.377	0.374	0.396	-
ONBA	36 2228	-	-	0.000	0.000	0.000	0.000	0.000	0.063	0.077	0.094	-	-
ONRJ	35 102	0.000	0.000	0.000	0.000	0.096	0.111	0.137	0.155	0.139	0.161	0.185	0.184
ONRJ	35 103	0.050	0.054	0.056	0.064	0.072	0.082	0.101	0.025	0.028	0.028	0.030	0.031
ONRJ	35 123	0.132	0.139	0.154	0.066	0.049	0.051	0.056	0.066	0.067	0.074	0.058	0.063
ONRJ	35 129	0.442	0.449	0.280	0.196	0.169	0.151	0.166	0.200	0.205	0.231	0.260	0.317
ONRJ	35 147	0.115	0.072	0.083	0.085	0.078	0.086	0.096	0.102	0.102	0.123	0.111	0.136
ONRJ	35 1153	0.207	0.195	0.138	0.110	0.126	0.137	0.160	0.145	0.143	0.141	0.142	0.160
ONRJ	35 1942	0.112	0.109	0.128	0.129	0.136	0.144	0.171	0.202	0.226	0.288	0.375	-
ONRJ	40 1950	0.000	0.000	0.012	0.006	0.006	0.007	0.009	0.012	0.015	0.017	0.022	0.027
ONRJ	40 1958	0.030	0.035	0.047	0.061	0.089	0.160	0.335	0.518	0.589	0.696	0.520	0.607
ORB	35 2722	0.083	0.084	0.080	0.072	0.080	0.079	0.086	0.110	0.113	0.137	0.173	0.234
ORB	35 2723	0.231	0.234	0.177	0.206	0.116	0.097	0.107	0.032	0.032	0.034	0.034	0.021
ORB	35 2724	1.036	1.034	0.181	0.116	0.119	0.115	0.125	0.154	0.172	0.192	0.219	0.258
ORB	36 593	0.021	0.021	0.025	0.027	0.033	0.037	0.046	0.021	0.018	0.019	0.018	0.021
PL	25 124	0.000	0.000	0.000	0.000	0.000	0.000	0.007	0.000	0.000	0.000	0.000	0.000
PL	25 125	0.000	0.000	0.000	0.000	0.010	0.013	0.017	0.016	0.014	0.013	0.013	0.015
PL	35 441	0.279	0.285	0.361	0.261	0.271	0.240	0.278	0.332	0.314	0.314	0.344	0.405
PL	35 745	0.030	0.032	0.042	0.000	0.000	-	-	0.000	0.000	0.000	0.000	0.000
PL	35 761	0.022	0.023	0.027	0.031	0.026	0.024	-	-	0.000	0.000	0.000	0.000
PL	35 1120	0.020	0.018	0.020	0.023	0.022	-	-	-	-	0.000	0.000	0.000
PL	35 1660	-	-	-	-	-	-	-	-	-	-	0.000	0.000

Table 9A. (Cont.)

Lab.	Clock	57049	57079	57109	57139	57169	57199	57234	57264	57294	57324	57354	57384
PL	35 1746	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
PL	35 1934	0.314	0.160	0.076	0.084	0.088	0.073	0.079	0.097	0.110	0.130	0.125	0.145
PL	35 2175	-	0.000	0.000	0.000	0.000	0.000	0.063	0.040	0.049	0.036	0.039	0.048
PL	35 2394	0.105	0.085	0.103	0.120	0.119	0.071	0.033	0.038	0.032	0.037	0.038	0.039
PL	35 2891	0.186	0.174	0.213	0.253	0.211	0.176	0.185	0.205	0.228	0.245	0.191	0.180
PL	40 4004	0.000	0.000	0.030	0.000	0.000	0.000	0.000	0.000	0.004	0.000	0.000	0.000
PL	40 4601	1.036	1.034	1.053	1.058	1.015	1.003	1.023	1.044	1.010	1.010	0.988	0.990
PL	40 4602	0.018	0.014	0.010	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
PTB	35 128	0.041	0.042	0.051	0.039	-	-	-	-	-	-	-	-
PTB	35 415	0.075	0.058	0.049	0.046	0.049	0.050	0.056	0.060	0.057	0.052	0.053	0.055
PTB	35 1072	0.072	0.067	0.070	0.083	0.100	0.098	0.127	0.168	0.185	0.226	0.270	0.340
PTB	35 2987	0.000	0.000	0.000	0.000	0.126	0.106	0.127	0.166	0.202	0.223	0.256	0.193
PTB	40 506	0.059	0.069	0.098	0.151	0.000	0.000	0.000	0.000	0.000	0.026	0.036	0.048
PTB	40 508	0.150	0.172	0.115	0.130	0.145	0.155	-	-	0.000	0.000	0.000	0.000
PTB	40 509	0.333	0.322	0.343	0.341	0.373	0.412	0.495	0.646	0.799	1.010	0.988	0.990
PTB	92 1	0.705	0.737	0.575	0.589	0.585	0.418	0.431	0.435	0.485	0.533	-	-
PTB	92 2	0.607	0.376	0.446	0.418	0.493	0.531	0.635	0.619	0.423	0.497	0.473	0.432
ROA	35 583	0.209	0.136	0.076	0.084	0.092	0.063	0.057	0.069	0.070	0.069	0.044	0.041
ROA	35 718	0.241	0.244	0.291	0.338	0.404	0.247	0.226	0.213	0.085	0.067	0.066	0.074
ROA	35 1699	0.118	0.117	0.136	0.158	0.148	0.114	0.116	0.145	0.171	0.195	0.074	0.047
ROA	35 2270	0.053	0.052	0.053	0.060	0.054	0.028	0.032	0.039	0.044	0.047	0.045	0.051
ROA	36 1488	0.074	0.071	0.065	0.020	0.017	0.019	0.021	0.025	0.027	0.030	0.035	0.028
ROA	36 1490	0.015	0.012	0.015	0.018	0.019	0.022	0.025	0.020	0.021	0.026	0.028	0.031
ROA	40 1436	0.131	0.102	0.118	0.118	0.127	0.119	0.137	0.174	0.201	0.242	0.175	0.177
SASO	35 221	0.042	0.048	0.055	-	0.000	0.000	0.000	0.000	0.000	0.079	0.096	0.051
SASO	35 1628	0.035	0.044	0.061	-	0.000	0.000	0.000	0.000	0.000	0.048	0.057	0.070
SASO	35 2923	0.336	0.284	0.119	-	0.000	0.000	0.000	0.000	0.000	0.071	0.041	0.051
SASO	35 2931	-	-	-	0.000	0.000	0.000	0.000	0.000	0.319	0.331	0.215	0.268
SASO	35 2932	0.112	0.144	0.074	-	0.000	0.000	0.000	0.000	0.000	0.302	0.377	0.193
SCL	35 2178	0.000	0.000	0.000	0.000	0.000	-	-	-	-	0.000	0.000	0.000

Table 9A. (Cont.)

Lab.	Clock	57049	57079	57109	57139	57169	57199	57234	57264	57294	57324	57354	57384
SCL	35 2525	0.000	0.000	0.000	0.000	0.000	-	-	-	-	0.000	0.000	0.000
SG	35 188	0.217	0.177	0.242	0.254	0.316	0.272	0.323	0.320	0.447	0.528	0.524	0.636
SG	35 475	0.177	0.145	0.167	0.124	0.129	0.050	0.026	0.031	0.033	0.038	0.041	0.047
SG	35 696	-	-	-	-	0.000	0.000	0.000	0.000	0.000	0.032	0.043	0.044
SG	35 3135	-	-	-	-	-	-	-	0.000	0.000	0.000	0.000	0.000
SG	36 522	0.028	0.024	0.019	0.021	0.016	0.017	0.018	0.017	0.015	0.015	0.017	0.019
SG	40 7701	0.000	0.076	0.099	0.105	0.133	0.147	0.126	0.159	0.175	0.199	0.178	0.218
SIQ	36 1268	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.055	0.045	0.019	0.019
SMD	35 1766	0.311	0.221	0.201	0.224	0.256	0.282	0.332	0.427	0.233	0.160	0.126	0.127
SMD	35 2003	0.113	-	-	-	-	-	-	-	0.000	0.000	0.000	0.000
SMD	35 2543	0.024	0.017	0.018	0.020	0.023	0.026	0.032	0.040	0.052	0.052	0.058	0.063
SMD	40 7909	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.009	0.012	0.016
SMU	36 1193	0.000	0.000	0.000	0.069	0.057	0.072	0.093	0.117	0.075	0.084	0.095	0.119
SP	35 572	0.148	0.145	0.110	0.077	0.081	0.087	0.098	0.112	0.127	0.153	0.181	0.219
SP	35 641	0.221	0.165	0.169	0.192	0.155	0.173	0.211	0.128	0.139	0.137	0.139	0.149
SP	35 767	0.240	0.265	0.302	0.267	0.291	0.228	0.167	0.182	0.141	0.095	0.101	0.115
SP	35 1188	0.134	0.136	0.121	0.137	0.136	0.063	0.063	0.068	0.072	0.071	0.076	0.076
SP	35 1642	0.152	0.159	0.117	0.109	0.126	0.144	0.164	0.169	0.184	0.169	0.195	0.237
SP	35 2166	0.218	0.191	0.222	0.242	0.273	0.315	0.193	0.145	0.141	0.129	0.059	0.053
SP	35 2745	0.070	0.073	0.061	0.038	0.043	0.046	0.050	0.054	0.061	0.062	0.063	0.072
SP	35 2746	0.121	0.099	0.104	0.090	0.099	0.075	0.057	0.070	0.078	0.091	0.106	0.090
SP	35 2749	0.080	0.084	0.099	0.122	0.141	0.107	0.128	0.165	0.111	0.125	0.108	0.123
SP	35 2750	0.173	0.182	0.223	0.256	0.325	0.432	0.172	0.187	0.214	0.245	0.259	0.260
SP	35 2758	0.458	0.314	0.342	0.349	0.339	0.338	0.350	0.277	0.312	0.372	0.406	0.452
SP	36 223	0.055	0.035	0.043	0.025	0.022	0.022	0.025	0.022	0.022	0.025	0.028	0.025
SP	36 1175	0.052	0.056	0.061	0.072	0.088	0.038	0.031	0.034	0.035	0.037	0.038	0.044
SP	36 1187	0.020	0.018	0.020	0.017	0.020	0.022	0.023	0.030	0.032	0.036	0.042	0.053
SP	36 1531	0.072	0.076	0.090	0.104	0.064	0.021	0.024	0.026	0.027	0.021	0.016	0.014
SP	36 2068	0.027	0.030	0.023	0.021	0.023	0.026	0.024	0.012	0.011	0.013	0.014	0.015
SP	36 2218	0.139	0.043	0.033	0.036	0.037	0.036	0.042	0.050	0.054	0.040	0.027	0.027

Table 9A. (Cont.)

Lab.	Clock	57049	57079	57109	57139	57169	57199	57234	57264	57294	57324	57354	57384
SP	36 2295	0.040	0.043	0.036	0.039	0.043	0.032	0.037	0.046	0.052	0.038	0.043	0.051
SP	36 2297	0.067	0.061	0.044	0.047	0.047	0.052	0.058	0.071	0.082	0.070	0.071	0.071
SP	40 7201	0.505	0.554	0.467	0.415	0.445	0.457	0.565	0.710	0.812	0.967	0.988	0.990
SP	40 7203	0.000	0.000	0.000	1.058	1.015	1.003	1.023	1.044	1.010	1.010	0.988	0.990
SP	40 7210	0.000	0.000	0.000	0.000	0.000	0.096	0.133	0.184	0.155	0.192	0.213	0.153
SP	40 7211	1.036	1.034	1.053	1.058	1.015	1.003	1.023	-	-	-	-	-
SP	40 7212	1.036	1.034	1.053	1.058	-	-	0.000	0.000	0.000	0.000	0.000	0.990
SP	40 7221	1.036	1.034	1.053	1.058	1.015	1.003	1.023	1.044	1.010	1.010	0.988	0.990
SP	40 7223	1.036	1.034	1.053	1.058	1.015	1.003	1.023	1.044	1.010	1.010	0.988	0.076
SP	40 7231	0.410	0.489	0.650	0.797	0.956	1.003	0.868	0.580	0.579	0.681	0.759	0.823
SP	40 7232	0.006	0.007	0.009	0.012	0.014	0.015	0.017	0.020	0.023	0.026	0.028	0.027
SU	40 3809	1.036	1.034	1.053	1.058	1.015	1.003	1.023	1.044	1.010	1.010	0.988	0.990
SU	40 3810	1.036	1.034	1.053	1.058	1.015	1.003	1.023	1.044	1.010	1.010	0.988	0.990
SU	40 3811	1.036	1.034	1.053	1.058	1.015	1.003	1.023	1.044	1.010	1.010	0.988	0.990
SU	40 3812	1.036	1.034	1.053	1.058	1.015	1.003	1.023	1.044	1.010	1.010	0.988	0.990
SU	40 3814	0.000	0.000	0.000	0.000	0.000	1.003	1.023	1.044	1.010	1.010	0.988	0.990
SU	40 3815	1.036	1.034	1.053	1.058	1.015	0.833	0.933	1.044	1.010	1.010	0.988	0.990
SU	40 3816	-	-	-	-	0.000	0.000	0.000	0.000	0.000	1.010	0.988	0.990
SU	40 3817	0.328	0.276	0.323	0.324	0.378	0.267	-	0.000	0.000	0.000	0.000	0.000
SU	40 3818	1.036	1.034	1.053	1.058	1.015	1.003	1.023	1.044	1.010	1.010	0.988	0.990
TL	35 1012	0.075	0.073	0.077	0.086	0.092	0.111	0.139	0.206	0.196	0.065	0.069	0.077
TL	35 1498	0.131	0.150	0.206	0.246	0.087	0.075	0.063	0.075	0.081	0.088	0.085	0.099
TL	35 1500	0.269	0.127	0.122	0.135	0.123	0.113	0.088	0.084	0.087	0.096	0.099	0.116
TL	35 1712	0.077	0.038	0.031	0.033	0.035	0.038	0.022	0.015	0.016	0.017	0.011	0.011
TL	35 2365	0.123	0.125	0.100	0.116	0.143	0.160	0.190	0.236	0.267	0.330	0.384	0.449
TL	35 2366	0.191	0.176	0.221	0.271	0.210	0.189	0.229	0.296	0.150	0.173	0.189	0.146
TL	35 2367	0.064	0.064	0.078	0.081	0.092	0.105	0.130	0.179	0.159	0.136	0.160	0.162
TL	35 2368	0.173	0.122	0.117	0.133	0.148	0.169	0.094	0.110	0.121	0.133	0.146	0.179
TL	35 2630	0.162	0.120	0.106	0.106	0.117	0.130	0.122	0.109	0.090	0.105	0.113	0.128
TL	35 2634	0.014	0.013	0.016	0.018	0.011	0.007	0.008	0.010	0.011	0.000	0.000	0.000

Table 9A. (Cont.)

Lab.	Clock	57049	57079	57109	57139	57169	57199	57234	57264	57294	57324	57354	57384
TL	35 2636	0.107	0.111	0.124	0.123	0.143	0.165	0.210	0.181	0.204	0.053	0.056	0.025
TL	35 2853	0.304	0.283	0.276	0.320	0.262	0.283	0.304	0.212	0.128	0.145	0.155	0.101
TL	35 2910	0.104	0.091	0.094	0.072	0.071	0.070	0.059	0.074	0.083	0.097	0.093	0.102
TL	40 57	0.030	0.031	0.033	0.029	0.026	0.028	0.034	0.030	0.028	0.033	0.038	0.045
TL	40 3011	0.000	0.090	0.102	0.122	0.129	0.136	0.118	0.131	0.140	0.151	0.149	0.143
TL	40 3052	0.105	0.099	0.117	0.137	0.158	0.172	0.196	0.255	0.242	0.304	0.369	0.356
TP	35 163	0.054	0.049	0.050	0.057	0.064	0.075	-	0.000	0.000	0.000	0.000	0.000
TP	35 1227	0.179	0.153	0.174	0.191	0.181	0.163	-	0.000	0.000	0.000	0.000	0.000
TP	35 2476	0.052	0.054	0.064	0.075	0.091	0.070	-	0.000	0.000	0.000	0.000	0.000
TP	35 2970	0.152	0.170	0.192	0.221	0.204	0.202	-	0.000	0.000	0.000	0.000	0.000
UA	35 2465	0.015	0.018	0.023	0.023	0.014	0.010	0.010	0.009	0.000	0.000	0.000	0.000
UA	40 7854	0.124	0.126	0.149	0.161	0.165	0.103	0.124	0.163	0.138	0.094	0.089	0.099
UA	40 7881	0.021	0.015	0.017	0.016	0.017	0.016	0.019	0.016	0.017	0.020	0.000	0.000
UA	40 7882	0.000	0.000	0.000	0.000	0.000	0.008	0.012	0.015	0.019	0.023	0.023	0.021
UME	35 251	0.000	0.000	0.000	0.000	0.051	0.069	0.094	0.130	0.144	0.172	0.187	0.221
UME	35 252	0.000	0.000	0.000	0.000	0.132	0.113	0.071	0.097	0.110	0.136	0.137	0.161
UME	35 872	0.000	0.000	0.000	0.000	0.257	0.336	0.118	0.142	0.165	0.158	0.087	0.102
UME	35 2703	0.000	0.000	0.000	0.000	0.060	0.068	0.092	0.100	0.076	0.074	0.056	0.065
UME	35 2710	0.000	0.000	0.000	0.000	0.000	0.206	0.293	0.217	0.153	0.040	0.000	0.000
USNO	35 101	0.111	0.116	0.091	0.105	0.055	0.058	0.043	0.049	0.032	0.025	0.016	0.018
USNO	35 104	0.090	0.094	0.112	0.115	0.119	0.134	0.166	0.162	0.173	0.193	0.142	0.135
USNO	35 106	0.209	0.099	0.101	0.109	0.125	0.118	-	-	-	-	-	-
USNO	35 108	0.089	0.094	0.087	0.102	0.128	0.147	0.195	0.188	0.214	0.220	0.195	0.054
USNO	35 114	0.122	0.146	0.206	0.148	0.114	0.106	0.105	0.100	0.102	0.094	0.100	0.062
USNO	35 120	0.208	0.225	0.243	0.286	0.249	0.297	0.357	0.484	0.272	0.118	0.101	0.112
USNO	35 142	0.174	0.206	0.198	0.233	0.092	0.079	0.092	0.114	0.086	0.078	0.037	0.038
USNO	35 150	0.119	0.075	0.058	0.064	0.053	0.057	0.066	0.079	0.089	0.104	0.073	0.058
USNO	35 152	0.064	0.063	0.053	0.040	0.042	-	-	-	-	-	-	-
USNO	35 156	0.198	0.207	0.214	0.189	0.220	0.213	0.154	0.188	0.145	0.137	0.120	0.127
USNO	35 161	0.172	0.186	0.224	0.274	0.347	0.453	0.616	0.570	0.507	0.289	0.105	0.115

Table 9A. (Cont.)

Lab.	Clock	57049	57079	57109	57139	57169	57199	57234	57264	57294	57324	57354	57384
USNO	35 164	0.259	0.158	0.136	0.093	0.105	0.033	0.034	0.040	0.034	0.038	0.042	0.048
USNO	35 165	0.030	-	-	-	-	-	-	-	-	-	-	-
USNO	35 166	0.023	0.023	0.026	0.022	0.025	0.026	0.030	0.038	0.045	0.049	0.058	0.035
USNO	35 169	0.353	0.272	0.263	0.296	0.211	0.225	0.246	0.248	0.282	0.336	0.253	0.210
USNO	35 173	0.123	0.085	0.038	0.029	0.023	0.021	0.023	0.028	0.029	0.022	0.023	0.027
USNO	35 226	0.054	0.056	0.068	0.072	0.088	0.087	0.082	0.111	0.123	0.147	0.158	0.179
USNO	35 231	0.054	0.038	0.044	0.044	0.050	0.058	0.067	0.089	0.107	0.140	0.104	0.131
USNO	35 233	0.295	0.241	0.287	0.334	0.327	0.358	0.363	0.421	0.386	0.461	0.291	0.169
USNO	35 244	0.070	0.072	0.086	0.104	0.081	0.097	0.105	0.114	0.111	0.123	0.070	0.080
USNO	35 253	0.154	0.168	0.180	0.189	0.120	0.076	0.087	0.109	0.067	0.000	-	-
USNO	35 254	0.141	0.128	0.133	0.093	0.047	0.050	0.056	0.064	0.071	0.083	0.094	0.111
USNO	35 256	0.137	0.142	0.185	0.230	0.285	0.300	0.346	0.373	0.388	0.388	0.414	0.126
USNO	35 260	0.018	0.017	0.018	0.015	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
USNO	35 268	0.019	0.016	0.017	0.019	0.022	0.024	0.029	0.040	0.030	0.031	0.037	0.030
USNO	35 270	0.105	0.116	0.148	0.155	0.184	0.194	0.176	0.092	0.103	0.055	0.053	0.059
USNO	35 279	0.050	0.052	0.060	0.077	0.033	0.026	0.013	0.015	0.017	0.017	0.017	0.014
USNO	35 389	0.095	0.088	0.099	0.085	0.091	0.074	0.088	0.073	0.075	0.090	0.085	0.079
USNO	35 394	0.070	0.048	0.057	0.064	0.060	0.055	0.055	0.070	0.073	0.084	0.077	0.093
USNO	35 416	0.048	0.044	0.045	0.032	0.030	0.033	-	-	-	-	-	-
USNO	35 417	0.052	0.052	0.050	0.053	0.060	0.062	0.043	0.051	-	-	-	-
USNO	35 703	0.055	0.054	0.066	0.069	0.080	0.092	0.073	0.048	0.026	0.027	0.022	0.015
USNO	35 717	0.088	0.083	0.098	0.083	0.094	0.096	0.096	0.108	0.102	0.120	0.073	0.084
USNO	35 762	0.104	0.049	0.051	0.038	0.038	0.041	0.048	0.060	0.062	0.071	0.066	0.077
USNO	35 765	0.000	-	-	-	-	-	-	-	-	-	-	-
USNO	35 1096	0.404	0.421	0.484	0.224	0.216	0.219	0.254	0.295	0.334	0.403	0.461	0.484
USNO	35 1097	0.027	0.024	-	-	-	-	-	-	-	-	-	-
USNO	35 1125	0.064	0.059	0.063	0.050	0.052	0.058	0.066	0.085	0.075	0.093	0.111	0.121
USNO	35 1327	0.147	0.124	0.140	0.133	0.158	0.140	0.123	0.151	0.177	0.182	0.204	0.216
USNO	35 1328	0.468	0.485	0.515	0.233	0.104	0.053	0.045	0.051	0.054	0.062	0.066	0.059
USNO	35 1331	0.042	0.043	0.043	0.036	0.041	0.033	0.039	0.042	0.048	0.058	0.065	0.069

Table 9A. (Cont.)

Lab.	Clock	57049	57079	57109	57139	57169	57199	57234	57264	57294	57324	57354	57384
USNO	35 1459	0.075	0.080	0.096	0.081	0.087	0.071	0.054	0.070	0.075	0.081	0.090	0.104
USNO	35 1462	0.123	0.104	0.121	0.116	0.089	0.094	0.095	0.092	0.097	0.107	0.095	0.114
USNO	35 1463	0.139	0.145	0.163	0.189	0.148	0.165	0.160	0.177	0.195	0.219	0.126	0.093
USNO	35 1468	0.210	0.177	0.141	0.097	0.106	0.116	0.084	0.098	0.089	0.104	0.112	0.131
USNO	35 1481	0.209	0.196	0.219	0.248	0.279	0.284	0.282	0.315	0.371	0.126	0.101	0.102
USNO	35 1543	0.214	0.051	0.037	0.038	0.028	0.028	0.028	0.035	0.037	0.043	0.046	0.044
USNO	35 1573	0.087	0.044	0.047	0.054	0.035	0.036	0.039	0.047	0.037	0.041	0.047	0.055
USNO	35 1575	0.133	0.083	0.075	0.068	0.072	0.080	0.092	0.114	0.104	0.113	0.132	0.168
USNO	35 1580	0.042	0.043	0.052	0.058	0.068	0.075	0.087	0.088	0.107	0.114	0.130	0.149
USNO	35 1585	0.000	0.000	0.000	0.000	0.000	0.007	0.007	0.009	0.010	0.012	0.014	0.015
USNO	35 1598	0.134	0.153	0.174	0.064	0.056	0.020	0.000	0.000	0.000	0.000	0.000	0.015
USNO	35 1655	0.000	0.000	0.000	0.000	0.296	0.365	0.356	0.412	0.297	0.363	0.380	0.371
USNO	35 1658	0.287	0.340	0.484	0.562	0.242	0.259	0.297	0.229	0.252	0.293	0.284	0.271
USNO	35 1692	0.313	0.328	0.393	0.473	0.393	0.234	0.270	0.317	0.297	0.110	0.104	0.112
USNO	35 1694	0.277	0.271	0.247	0.284	0.349	0.164	0.172	0.219	0.184	0.191	0.143	0.149
USNO	35 1696	0.115	0.030	0.035	0.038	0.038	0.034	0.031	0.039	0.031	0.034	0.033	0.034
USNO	35 1697	0.377	0.288	0.371	0.291	0.147	0.116	0.133	0.137	0.115	0.125	0.137	0.120
USNO	40 701	0.058	0.049	0.055	0.014	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
USNO	40 702	1.036	1.034	1.053	1.058	0.843	0.867	0.830	0.998	0.912	1.010	0.988	0.990
USNO	40 704	1.036	1.034	1.053	1.058	1.015	1.003	1.023	1.044	1.010	-	-	-
USNO	40 705	1.036	1.034	1.053	1.058	1.015	1.003	1.023	1.044	1.010	1.010	0.988	0.990
USNO	40 708	1.036	1.034	1.053	1.058	1.015	1.003	1.023	1.044	1.010	1.010	0.988	0.990
USNO	40 710	-	-	-	-	-	-	-	0.000	0.000	0.000	0.000	0.000
USNO	40 711	1.036	1.034	1.053	1.058	1.015	1.003	1.023	1.044	1.010	1.010	0.988	0.990
USNO	40 712	1.036	1.034	1.053	1.058	1.015	1.003	1.023	1.044	1.010	1.010	0.988	0.990
USNO	40 713	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
USNO	40 714	0.940	0.961	1.050	1.058	1.015	0.720	0.834	1.044	1.010	1.010	0.988	0.990
USNO	40 715	0.306	0.486	0.896	1.058	1.015	1.003	1.023	1.044	1.010	1.010	0.988	0.990
USNO	40 716	1.036	1.034	1.053	1.058	1.015	1.003	1.023	1.044	1.010	1.010	0.988	0.990
USNO	40 717	1.036	1.034	1.053	1.058	1.015	0.000	0.000	0.000	0.000	0.000	0.000	0.990

Table 9A. (Cont.)

Lab.	Clock		57049	57079	57109	57139	57169	57199	57234	57264	57294	57324	57354	57384
USNO	40	718	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.024	0.030	0.040
USNO	40	719	1.036	1.034	1.053	1.058	1.015	1.003	1.023	-	-	-	-	-
USNO	40	720	0.769	0.649	0.786	0.739	0.847	0.904	1.023	1.044	1.010	1.010	0.988	0.990
USNO	40	721	0.865	0.828	0.980	1.058	1.015	1.003	1.023	0.840	0.756	0.685	0.710	0.805
USNO	40	722	-	-	-	-	-	0.000	0.000	0.000	0.000	0.000	0.988	0.573
USNO	40	723	1.036	1.034	1.053	1.058	1.015	1.003	1.023	1.044	1.010	1.010	0.988	0.990
USNO	40	724	0.143	0.079	0.090	0.094	0.047	0.051	0.056	0.065	0.069	0.082	0.096	0.124
USNO	40	725	1.036	1.034	1.053	1.058	1.015	1.003	1.023	1.044	1.010	1.010	0.988	0.990
USNO	40	726	1.036	1.034	1.053	1.058	1.015	1.003	1.023	1.044	1.010	1.010	0.988	0.990
USNO	40	727	0.142	0.148	0.115	0.120	0.110	0.096	0.110	0.123	0.139	0.168	0.199	0.250
USNO	40	728	1.036	1.034	1.053	0.114	0.000	0.000	0.000	0.000	0.000	0.011	0.015	0.020
USNO	40	729	1.036	1.034	1.053	1.058	1.015	1.003	1.023	1.044	1.010	1.010	0.988	0.990
USNO	40	730	1.036	1.034	1.053	1.058	1.015	1.003	1.023	1.044	1.010	1.010	0.988	0.990
USNO	40	731	0.480	0.656	1.053	1.058	1.015	1.003	1.023	1.044	1.010	1.010	0.988	0.990
USNO	40	732	0.405	0.442	0.556	0.234	0.000	0.000	0.000	0.000	0.000	0.020	0.027	0.036
USNO	40	734	0.000	0.000	0.000	0.676	0.172	0.112	0.129	0.138	0.090	0.109	0.117	0.120
USNO	40	735	0.222	0.194	0.230	0.176	0.193	0.219	0.186	0.227	0.147	0.141	0.129	0.140
USNO	40	736	0.058	0.068	0.099	0.137	0.201	0.307	0.501	0.870	1.010	1.010	0.988	0.990
USNO	40	737	0.229	0.259	0.337	0.479	0.713	0.960	0.881	1.042	0.736	0.569	0.448	0.503
USNO	93	2	1.036	1.034	1.053	1.058	1.015	1.003	1.023	1.044	1.010	1.010	0.988	0.990
USNO	93	3	1.036	1.034	1.053	1.058	1.015	1.003	1.023	1.044	1.010	1.010	0.988	0.990
USNO	93	4	1.036	1.034	1.053	1.058	1.015	1.003	1.023	1.044	1.010	1.010	0.988	0.990
USNO	93	5	1.036	1.034	1.053	1.058	1.015	1.003	1.023	1.044	1.010	1.010	0.988	0.990
VMI	35	2230	0.013	0.014	0.017	-	-	0.000	0.000	0.000	0.000	0.000	0.000	0.006
VMI	36	1233	0.000	0.000	0.000	-	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000
VMI	36	2314	0.009	0.009	0.010	-	-	0.000	0.000	0.000	0.000	0.000	0.000	0.007
VSL	35	179	-	-	0.000	0.000	0.000	0.000	0.000	0.054	0.073	0.095	0.114	0.121
VSL	35	456	0.077	0.059	0.061	0.066	0.075	0.085	0.074	0.085	0.099	0.115	0.121	0.148
VSL	35	548	0.060	0.066	0.028	0.028	0.031	0.031	0.037	0.046	0.041	0.050	0.058	0.075
VSL	35	731	0.091	0.061	0.071	0.081	0.092	0.099	0.114	0.156	0.204	0.153	0.144	0.147
ZA	36	1821	0.141	0.155	0.127	0.073	0.071	0.033	0.037	0.023	0.023	0.023	0.024	0.027

Table 9B: Statistical data on the weights attributed to the clocks in 2015

Interval		Number of Clocks			Number of clocks with a given weight									Max relative weight
					Weight = 0*			Weight = 0**			Max weight			
		HM	5071A	Total	HM	5071A	Total	HM	5071A	Total	HM	5071A	Total	
2015	Jan.	112	293	452	15	44	66	12	9	25	47	1	52	1.036
2015	Feb.	123	292	475	22	47	88	10	5	19	47	1	52	1.034
2015	Mar.	122	290	474	25	47	94	9	8	21	45	0	49	1.053
2015	Apr.	125	298	484	26	59	106	11	9	23	49	0	53	1.058
2015	May	126	295	482	26	41	88	15	10	27	49	1	54	1.015
2015	Jun.	125	294	476	22	41	77	14	7	23	49	1	54	1.003
2015	Jul.	119	278	441	13	29	50	14	9	24	47	0	51	1.023
2015	Aug.	119	272	440	17	29	57	13	5	21	47	0	51	1.044
2015	Sep.	121	282	453	16	30	57	12	6	20	49	0	53	1.010
2015	Oct.	119	282	452	15	29	56	9	7	17	50	0	54	1.010
2015	Nov.	124	289	475	18	30	70	10	13	26	52	0	56	0.988
2015	Dec.	126	292	480	18	36	76	10	12	24	54	0	58	0.990

Wmax=A/N, here N is the number of clocks, excluding those with *a priori* null weight, A=4.00.
* *A priori* null weight (test interval of new clocks).
** Null weight resulting from the statistics.
HM designates hydrogen masers and 5071A designates CS 5071A units with high performance tube.
Clocks with missing data during a one-month interval of computation are excluded.

Table 10. Relative drifts of contributing clocks in 2015

(File available on http://www.bipm.org under the name DTAI15.AR)

Clock drifts are computed using a monthly realization of TT(BIPM) as reference for 6-months intervals ending at the MJD dates given in the table. "-" denotes that the clock was not used.
"*" denotes that the absolute clock drift was greater than 100ns/day/30days. Unit is ns/day/30days.

The clocks are designated by their type (2 digits) and serial number in the type. The codes for the types are:

12 HEWLETT-PACKARD 5061A
13 EBAUCHES, OSCILLATOM B5000
14 HEWLETT-PACKARD 5061A OPT. 4
16 OSCILLOQUARTZ 3200
17 OSCILLOQUARTZ 3000
15 DATUM/SYMMETRICOM Cs III
18 DATUM/SYMMETRICOM/MICROSEMI Cs 4000
19 RHODES AND SCHWARZ XSC
21 OSCILLOQUARTZ 3210
22 OSCILLOQUARTZ OSA 3230B
23 OSCILLOQUARTZ EUDICS 3020
24 OSCILLOQUARTZ OSA 3235B
25 HEWLETT_PACKARD 5062C
30 HEWLETT-PACKARD 5061B
31 HEWLETT-PACKARD 5061B OPT. 4
34 H-P 5061A/B with 5071A tube
35 H-P/AGILENT/SYMMETRICOM/MICROSEMI 5071A High perf.
36 H-P/AGILENT/SYMMETRICOM/MICROSEMI 5071A Low perf.
4x HYDROGEN MASERS
50 FREQ. AND TIME SYSTEMS INC. 4065A
51 DATUM/SYMMETRICOM 4065 B
52 DATUM/SYMMETRICOM 4065 C
53 DATUM/SYMMETRICOM/MICROSEMI 4310 B
9x PRIMARY CLOCKS AND PROTOTYPES

Lab.	Clock	57049	57079	57109	57139	57169	57199	57234	57264	57294	57324	57354	57384
APL	35 0904	1.3075	0.8550	0.7834	0.6840	0.4997	0.6025	0.5023	0.0854	-0.3386	-0.5827	-0.6168	-0.2868
APL	35 1264	0.3530	0.3329	0.1927	0.2289	-0.0045	-0.0500	-0.1782	-0.2588	-0.4118	-0.3808	-0.1626	0.1656
APL	35 1791	0.1125	-0.0118	-0.0249	0.0385	0.0436	0.0917	0.2223	0.1002	0.0839	0.1253	0.1031	0.3521
APL	40 3107	0.2213	0.1645	0.1611	0.1552	0.1595	0.1931	0.2011	0.1531	0.1560	0.1402	0.1542	0.1575
APL	40 3108	2.8591	2.7894	2.7735	2.7686	2.7776	2.7902	2.7985	2.7548	2.7553	2.7281	2.7052	2.6639
APL	40 3109	-0.4724	-0.5098	-0.4866	-0.4504	-0.4084	-0.3772	-0.3502	-0.3833	-0.3669	-0.3805	-0.3700	-0.3721
AUS	35 2269	-0.0772	-0.1708	-0.0016	0.0677	-0.1347	-0.1116	-	-	-0.7905	-0.5054	-	-
AUS	36 0299	-0.2126	-0.5338	-0.5129	-0.5491	-0.5870	-0.2968	-	0.2622	-2.9480	-0.5439	-0.0370	-0.0996
AUS	36 0340	0.4836	0.0116	0.0625	-0.0327	-0.4450	-0.3369	-	-1.5206	-1.8277	-0.5737	-0.0777	0.0579
AUS	36 0654	-0.2534	-0.2725	-0.2728	-0.2304	-0.1710	0.0368	-	-	-0.7562	-0.5809	-0.1732	-0.0221

Table 10. (Cont.)

Lab.	Clock	57049	57079	57109	57139	57169	57199	57234	57264	57294	57324	57354	57384
AUS	36 1141	0.1438	0.4812	0.5081	0.2230	-0.3911	-0.3278	-	-3.8178	-2.0920	-1.5656	0.1691	0.3857
AUS	36 2269	-	-	-	-	-	-	-	-	-	-	-	1.7586
BEV	35 1793	0.1297	0.0078	-0.1294	-0.3199	-0.3627	-0.4042	-0.1344	-0.0742	0.1087	0.2111	0.2326	0.1005
BEV	35 3009	0.2310	0.1786	0.0946	0.1845	0.2333	-	0.8588	0.1773	0.0598	0.0835	0.0782	0.0215
BEV	40 3452	5.5697	-	4.3171	4.5602	4.5906	-	4.4502	-	5.0587	5.0645	4.8608	5.1524
BIM	18 8058	-0.3337	-0.0477	0.1329	0.2320	0.0856	0.2141	-0.0192	0.1198	0.2786	0.3033	0.1165	0.3956
BY	40 4222	3.7291	1.9447	0.7109	-0.6116	-2.5467	-1.7082	-0.8770	-0.6218	0.0872	-	-	-
BY	40 4227	-1.5827	-0.5803	-0.4730	-0.4998	-0.1717	-0.1067	-0.9678	-1.3575	-1.1420	-0.9698	-0.4508	-0.0956
BY	40 4229	-1.9032	-6.9878	-10.0589	-10.0872	-7.6092	-1.9002	0.8178	0.8016	-1.2203	-2.7081	-3.7087	-4.2208
BY	40 4278	-	0.4177	0.0065	-0.4006	-0.7159	-0.8868	-0.9670	-1.2039	-1.6239	-1.8810	-2.1092	-1.9178
CH	24 0105	1.4397	2.3815	2.2738	2.3450	2.6603	2.4919	2.3223	2.8295	3.5659	3.6134	3.2436	2.8521
CH	35 2117	0.0323	-0.0788	-0.1096	-0.0799	-0.3872	-0.1843	-0.0040	-0.0138	0.0095	0.2901	0.1243	0.0631
CH	35 2743	-0.4013	-0.5837	-1.5847	-2.2363	-2.0846	-1.7884	-1.1586	-0.2778	-0.3202	-0.3226	-0.1233	-0.1003
CH	40 5701	-0.0386	-0.2160	-0.4857	-0.5116	-0.4097	-0.2709	-0.2324	-0.2179	-0.1952	-0.1553	-0.1072	-0.0872
CH	40 5702	-	-	-	-	-	-	-	1.7982	1.9611	1.9450	2.0160	2.0878
CNM	35 2708	-	1.6588	0.4747	-0.1778	-0.0578	-0.1437	-0.2494	-0.3196	-0.1513	-0.0676	0.0260	0.0284
CNM	35 2709	-	2.8451	0.1185	0.0576	0.3742	0.2494	-0.0808	-0.2284	-0.2981	-0.2205	-0.0838	-0.0134
CNM	35 2885	-	0.0268	-0.3964	-0.0592	-0.0872	0.0073	0.0566	0.0875	-0.0990	-0.2236	-0.2465	-0.3512
CNM	35 3055	-	-	-	0.2103	0.5284	0.5336	0.5283	0.3913	0.3767	0.3149	0.1047	0.0079
CNM	40 7301	-	-0.1343	-0.4291	-0.2942	-0.2135	-0.1672	-0.0410	0.0424	0.0949	0.0151	-0.0386	-0.1526
CNM	40 7302	-	11.4611	10.8367	10.5394	10.4580	10.3857	10.2448	10.0134	9.8514	-5.4839	-15.4762	-19.4376
CNMP	36 1752	0.8682	-1.0562	-0.6439	-0.4856	-0.3706	0.1762	-	3.0291	0.8438	0.2744	0.2835	0.4645
CNMP	36 1806	-0.6301	-0.5543	0.1233	0.3344	-0.0911	-0.0917	-	-1.1984	-0.5379	-0.0986	0.0930	-0.3026
CNMP	36 2873	1.1699	-0.0026	0.1276	0.2838	0.0789	0.1179	-	-2.6795	-0.1741	-0.4808	-0.2009	0.4375
DFNT	36 2866	-	-	-2.8418	-0.2897	-0.0644	-0.3574	-0.3391	-	-	1.1112	0.6663	0.5474
DMDM	35 2191	-0.0780	-0.3358	-	4.0743	-	-	-	-	-	-	-0.1562	0.0812
DMDM	36 2033	-0.0376	0.1574	0.4013	0.2150	-0.0024	-0.1105	-0.2652	-0.1532	0.1114	0.1114	-0.1001	-0.1045
DTAG	35 2805	0.1024	0.0502	-0.0368	-0.1532	-0.0689	0.0397	-	-	-1.1162	0.0476	0.2960	0.2963
DTAG	35 2941	0.0016	-0.1354	-0.3224	-0.3559	-0.1800	0.0553	-	-	-2.0892	-0.1656	-	-
DTAG	35 2966	0.1960	0.2145	0.2048	0.1887	0.1603	0.1272	-	-	-1.0579	-0.3535	0.2711	0.0533

Table 10. (Cont.)

Lab.	Clock	57049	57079	57109	57139	57169	57199	57234	57264	57294	57324	57354	57384
DTAG	35 3053	-	-	-	-	-	-	-	-	-	-	-	-1.2928
EIM	35 0716	1.6225	-	-	-2.0731	-0.9708	-0.2166	-	-	-	-	-	-
EIM	35 2060	-0.0350	-0.0329	-	0.9612	-0.1702	0.0200	-	-	-	2.3763	0.0004	-0.0615
ESTC	22 0132	6.8134	5.5841	6.2819	5.4737	2.4089	-	*	58.7307	31.5350	21.7057	-	-
ESTC	35 1615	1.5814	0.5059	0.5506	0.4268	0.4878	0.4599	0.4214	0.2528	0.1509	0.1424	0.3058	-0.7650
ESTC	35 2025	-1.5352	0.1367	0.2615	0.4455	0.2478	0.2250	-0.1067	-0.3748	-0.5085	-0.3730	-0.2188	0.2941
ESTC	35 2353	-0.4415	-0.4453	-0.2905	0.0317	0.0898	0.2073	0.2827	0.1903	0.0414	0.0567	-0.1944	1.2285
ESTC	40 2543	0.1242	0.2982	0.2659	0.2780	-0.0028	-0.1681	-0.5215	-0.7105	-0.7692	-0.4308	-0.2283	0.1506
ESTC	40 2544	-5.0118	-0.6467	0.1650	-0.0745	-0.2533	-	-	-4.3286	-2.1500	-0.9531	-1.0631	-0.9536
HKO	35 2425	-0.1788	-0.2018	-0.1200	-0.0641	0.0397	-0.0582	-0.0387	-	1.1398	0.0455	0.0547	-0.1955
HKO	35 2884	0.4598	0.3818	0.3935	0.3329	0.1041	0.1576	0.1910	0.1058	-0.0756	-0.0515	-0.0327	0.0817
IFAG	36 1167	-0.8341	-0.7621	-0.3204	-0.1874	0.1601	0.7581	0.9554	0.5669	0.2583	-0.2388	-0.4822	-0.2882
IFAG	36 1173	-	-	-	-	-	-0.8690	-2.4028	-1.8948	-0.5655	0.2471	0.4580	0.9113
IFAG	36 1629	-0.5688	-0.3062	-0.0331	0.0482	0.1174	0.1964	0.3812	0.4626	0.3484	0.0613	0.2159	0.2648
IFAG	36 1732	0.0093	-0.1230	0.0526	0.0696	0.1623	0.3231	0.2293	0.1673	0.0640	0.0127	-0.2917	-0.2401
IFAG	36 1798	0.0275	0.0650	0.2505	0.0984	0.0493	0.0297	0.1367	-0.0142	0.0823	0.0659	0.0799	0.1586
IFAG	40 4418	0.3045	0.3071	0.2848	0.2268	0.2075	0.1560	0.1403	0.1450	0.1597	0.2088	0.1936	0.2062
IFAG	40 4439	-0.5770	-0.5501	-0.4388	-	5.4049	4.8225	4.5816	4.3344	4.1160	3.9869	3.7042	3.5319
IMBH	35 2685	-	-	-	-	-	*	-6.1024	17.5073	6.5467	-19.4856	-6.9337	-2.4375
IMBH	35 2909	-	-	-	-	-	25.6324	-0.6026	-2.8909	-1.9838	0.4698	1.8273	3.0383
INPL	35 2480	0.2514	0.3805	0.4791	0.5117	0.4912	0.5290	0.1669	0.0833	0.0427	0.0247	0.0006	0.1082
INPL	35 2481	-0.5416	-0.4351	-0.1787	-0.0772	-0.1108	-0.1626	0.0250	0.1514	0.2480	0.2814	0.3296	0.1543
INTI	35 2377	-0.3765	-	-	-	-	-	-	-	-	-	-	-
INTI	36 2377	-	-	-5.1286	-0.0938	-1.4056	-1.1410	-0.3011	-0.3536	-0.3648	-0.1116	-0.1009	-0.2544
INXE	35 2393	0.0919	0.1613	0.1551	-0.0376	-0.1946	0.1224	-0.1791	0.0766	0.0419	0.1618	-0.1336	0.0514
IT	35 0219	-0.1259	-0.1574	0.1118	0.3262	0.2486	0.1670	0.1042	-0.0143	-0.1587	0.0844	0.0203	0.0487
IT	35 0505	0.0211	-0.1462	-0.2352	-0.2117	-0.0974	0.1308	0.1034	0.0146	0.1644	-0.0559	-0.1317	-0.0676
IT	35 1115	-0.3832	0.1104	0.3312	0.5394	0.4187	0.4977	0.5966	0.5178	0.2598	0.2530	0.0816	0.0325
IT	35 1373	-0.1353	-0.2559	-0.2686	-0.2589	-0.0716	0.0179	0.0318	-	-	-	-0.7630	-0.3967
IT	35 2118	-0.2166	-0.3108	-0.3789	-0.3706	-0.2078	-0.2007	-0.1735	-0.2399	-0.4054	-0.4358	-0.2675	-0.1016

Table 10. (Cont.)

Lab.	Clock	57049	57079	57109	57139	57169	57199	57234	57264	57294	57324	57354	57384
IT	35 2487	0.2605	0.4838	0.4097	0.3358	0.2357	0.1635	-0.0585	0.0396	0.1371	-	-	-
IT	40 1101	4.7725	4.6816	4.6434	4.6167	4.5967	4.5613	4.5403	4.5137	4.4852	4.4504	4.4260	4.3590
IT	40 1102	4.6063	4.5048	4.4377	4.4290	4.4287	4.4315	4.3955	4.3574	4.2572	4.1977	4.1656	4.0722
IT	40 1103	0.9410	0.9057	0.9201	0.9324	0.9425	0.9298	0.9341	0.9130	0.8974	0.8920	0.8909	0.8691
IT	40 1104	-10.9878	-10.2136	-8.4528	-5.6971	-3.4055	-1.0396	0.9968	2.0391	2.2650	2.4187	2.5783	2.4593
JV	36 1277	0.3419	0.3655	0.0727	-0.1403	-0.4799	-0.4803	-0.0142	0.3742	0.5048	0.3087	0.1594	-0.0743
JV	36 2617	0.0911	0.1310	-0.1273	-0.2397	-0.4175	-0.1898	-0.1374	0.3132	0.3703	0.1420	-0.1958	-0.2337
JV	36 2629	-0.0055	0.3435	0.3113	-0.0833	-0.2562	-0.1762	-0.0811	0.3194	0.1807	0.0220	-0.1669	-0.1437
JV	40 8713	-2.2742	-1.9022	-1.8134	-1.7461	-1.6259	-1.2531	-1.1945	-1.0660	-1.0699	-1.1309	-0.9963	-0.7031
KEBS	35 2518	-	1.7205	-	-	-	-	-	-	-	-	-	-1.2928
KRIS	35 0321	-1.2745	-0.9616	-0.7873	-0.5382	-0.4510	-0.2237	-0.1554	-0.2615	-0.2653	-0.2612	-0.2463	-0.1360
KRIS	35 0739	0.1365	0.3767	0.1373	0.0305	-0.0883	-0.1787	-0.0597	0.1404	0.2884	0.4300	0.3226	0.2429
KRIS	35 1135	-0.9162	0.6045	0.8285	0.7193	0.6140	0.4679	0.3814	0.7192	0.8023	0.9824	1.0847	1.3632
KRIS	35 1693	-0.3099	-0.0496	-0.1431	-0.1782	-0.0668	-0.0239	-0.0373	0.0537	0.0624	0.1450	0.1566	0.1553
KRIS	35 1783	-0.7933	-0.2737	-0.0734	-0.1820	-0.0924	0.0788	-0.0998	-0.0857	-0.0772	-0.1771	-0.0264	0.1730
KRIS	40 5625	0.1579	0.1855	0.1393	0.1353	0.1518	0.2023	0.1887	-	-	-	-	-
KRIS	40 5626	0.1961	0.2088	0.2075	0.2094	0.2035	0.2106	0.1971	0.1801	0.1714	0.1807	0.1807	0.1816
KZ	35 2202	0.0119	-0.1293	-0.1409	-0.0662	-0.2139	-0.0993	-0.0150	-0.0430	-0.0926	0.0085	-0.0507	-0.1449
KZ	35 2665	-0.7308	-0.3015	-0.1030	-0.0033	-0.0215	0.1171	0.0354	0.3117	0.0197	0.0339	-0.1480	-0.2027
KZ	35 2667	-1.0027	-0.5035	-0.2987	-0.3672	-0.3430	-0.1694	-0.1618	0.1382	0.1797	0.1459	0.0891	-0.1016
LT	35 1362	0.3577	0.1572	-0.0733	-0.4388	-0.3239	-0.3236	-0.1120	0.0582	0.2549	0.2528	0.4599	0.4828
LT	35 1868	0.2795	0.1601	-0.0140	-0.1273	-0.0980	0.0560	0.1678	0.1385	0.0235	-0.0697	-0.0917	-0.0744
MASM	35 2900	0.1015	-	0.7582	0.1555	-	-	-	-	-	-	-	-
MBM	24 0125	-	-	-	-	-	-	-	-	-		-313.3113	-
MIKE	36 0986	-0.1558	0.1954	-	-4.3634	0.6572	0.5896	0.1296	-0.3745	-0.3303	-0.5721	-0.3183	0.0901
MIKE	40 4108	0.3680	0.2874	-	-0.1154	0.0308	0.0333	0.0794	0.0870	0.0922	0.1071	0.1276	0.1372
MIKE	40 4113	1.0089	0.8326	-	4.8938	2.1026	1.8479	1.5071	1.4879	1.1622	0.4240	0.2726	0.3839
MIKE	40 4180	0.4335	0.4991	-	-0.4788	0.2758	0.5546	0.5100	0.4532	0.4410	0.4381	0.4080	0.4454
MIKE	40 4189	-	-	-	-	-	-	-1.7940	-0.3897	0.5146	1.0689	1.3770	1.4604
MKEH	36 0849	0.1617	-0.0051	-0.1788	0.1198	0.1886	0.1681	-0.1027	-0.1981	-0.3388	-0.2377	-0.0485	0.2491

Table 10. (Cont.)

Lab.	Clock	57049	57079	57109	57139	57169	57199	57234	57264	57294	57324	57354	57384
MTC	35 3000	-	-	-1.2715	-0.0988	0.1102	0.0762	0.0278	-0.0466	-0.0620	-	1.2598	0.1534
MTC	35 3002	-0.4207	-0.1576	0.0458	0.2028	0.0668	0.1111	-0.0091	-0.0227	0.0337	-	-0.0601	0.1253
MTC	35 3003	2.8411	1.8172	1.1105	0.7153	-	-	-	-	-	-	-	-
MTC	35 3004	0.1596	0.8115	0.8540	0.6742	0.4839	0.2818	-	-	-	-	-	-
MTC	35 3005	0.8431	0.9131	0.4900	0.2545	0.1703	0.0901	0.0319	0.1237	0.1669	-	-0.3550	-0.3367
NAO	35 0779	-1.1216	-1.1200	-0.7764	-0.1994	-0.2368	-0.0490	0.2730	0.2374	-0.1639	-0.4941	-0.2670	-0.1883
NAO	35 1206	-0.0893	0.3924	0.7476	0.6447	0.8763	1.1931	0.3919	0.4929	0.2927	-0.5886	-2.2237	-3.1800
NAO	35 1214	-0.0432	0.0597	-0.1916	-0.0552	-0.0442	-0.0819	-0.0569	-0.0422	0.1556	0.8071	1.1868	1.2231
NAO	35 1689	-0.8347	-0.7635	-0.4013	-0.0271	-0.0768	-0.1887	-0.0719	-	-	-	0.8107	0.2469
NAO	40 1301	-0.2223	1.7508	2.2155	1.4201	1.1352	-	3.2202	1.0200	-1.3423	-2.4736	-1.8778	-1.1358
NICT	35 0332	-0.1910	-	-	-2.2205	-0.8646	-0.1896	-0.0201	0.0983	0.1220	0.2209	0.1359	0.1184
NICT	35 0343	-0.0536	-	-	-1.4114	0.1877	0.3063	0.2105	0.2197	0.2062	0.1774	0.0749	0.0839
NICT	35 0715	-0.0251	-0.0222	-0.0943	-0.0921	-0.0574	0.0190	0.1514	0.2106	0.0326	-0.0812	-0.1071	-0.1939
NICT	35 0732	0.0994	-0.0437	0.0266	0.1337	-0.0120	-0.1173	0.0763	-0.0467	-0.0468	0.1357	-0.0005	-0.0574
NICT	35 0907	-0.2626	-0.2507	-0.1746	-0.1123	-0.0575	0.1144	0.2505	0.1885	0.0041	-0.2186	-0.3026	-0.2786
NICT	35 0913	0.1067	0.2578	0.1180	-0.0456	0.0785	0.1103	-0.0169	0.1683	0.2145	0.0549	0.2230	0.1406
NICT	35 0916	-0.0699	-0.0029	-0.0403	-0.0542	-0.0001	0.0733	0.0917	0.1065	0.0039	0.0038	0.1897	0.3325
NICT	35 1225	0.0894	-	0.8199	-0.5897	-0.1402	-0.0099	0.0373	-0.0941	-0.0676	-0.0434	0.0266	0.0519
NICT	35 1226	-0.5255	-0.3181	-0.0137	-0.1083	-0.0532	0.0319	-0.1439	-0.1933	0.0671	0.2021	0.1222	0.0563
NICT	35 1611	-0.5756	-0.3539	-0.4642	-0.5600	-0.2795	-0.0002	-0.1727	-0.1680	-0.2523	-0.4910	-1.6981	-
NICT	35 1778	0.0953	0.1100	-0.0373	-0.1121	-0.1685	-0.0387	0.0244	0.1729	0.2660	0.0203	-0.0182	-0.1582
NICT	35 1789	-0.2345	-0.3033	-0.2062	-0.0757	0.1701	0.0716	-0.0835	-0.1065	-0.0272	0.0184	0.1301	0.0373
NICT	35 1790	-0.0035	-0.1953	-0.2630	-0.1536	-0.0761	-0.0713	0.0201	-0.1096	-0.1148	-0.0046	-0.0355	-0.2324
NICT	35 1866	-0.0458	0.0192	-0.0693	-0.1649	-0.1694	-0.1668	0.0067	0.0657	0.0098	0.0277	0.1031	0.0836
NICT	35 1882	-0.0213	-0.0821	0.0268	-0.0658	-0.1533	-0.1448	0.0451	0.1342	0.3279	0.4454	0.4658	0.6216
NICT	35 1887	-2.7393	-	-	-1.8571	0.0362	0.3086	0.2236	0.2866	0.2687	0.2097	0.2291	0.2330
NICT	35 1944	-0.0502	-0.0731	-0.0490	-0.0268	0.0322	0.0395	0.0206	0.0224	0.2387	0.2462	0.1325	0.1092
NICT	35 2010	-0.0110	-0.0399	-0.1401	-0.0021	0.0760	0.1897	0.2383	0.2175	0.1150	0.1443	0.1754	0.1148
NICT	35 2011	0.1844	0.0871	0.1306	0.0749	0.0493	-0.0616	0.0444	0.0315	0.0753	0.1115	0.1170	-0.0599
NICT	35 2056	0.0072	0.2449	0.3230	0.3228	0.2857	0.2615	0.1649	0.2952	0.4082	0.3776	0.2331	0.2206

Table 10. (Cont.)

Lab.	Clock	57049	57079	57109	57139	57169	57199	57234	57264	57294	57324	57354	57384
NICT	35 2113	0.4986	0.3755	0.3852	0.4725	0.5206	0.3595	0.4771	0.4582	0.4852	0.5822	0.5393	0.4195
NICT	35 2116	-0.1669	-0.0412	-0.1298	-0.1412	-0.0340	-0.0883	-0.0569	0.0497	0.0492	0.0849	0.1004	0.1591
NICT	35 2570	0.1109	0.0790	-0.0906	-0.1916	-0.2785	-0.2626	-0.1758	-0.1083	-0.1037	-0.0618	0.0085	0.1480
NICT	35 2574	-0.1501	-0.3755	-0.4271	-0.3941	-0.3858	-0.3061	0.0718	0.0657	0.1104	0.1433	0.2217	0.2451
NICT	35 2627	-0.3871	-0.2930	0.0234	0.0496	-0.0947	-0.0245	-0.1163	-0.1958	-0.1520	-0.0396	0.0393	0.1949
NICT	35 2628	-0.0141	-0.1354	-0.1467	-0.0224	0.5967	0.9012	0.9863	0.8238	0.5197	0.1334	0.2110	0.2932
NICT	35 2784	-0.0016	0.0264	0.0655	0.1852	0.2001	0.1774	0.1366	0.0955	-0.0512	0.0340	0.1460	0.1177
NICT	35 2876	-0.0434	-0.0576	-0.0677	-0.0590	0.0203	0.0249	-0.0124	0.0296	-0.0416	0.0223	0.1300	0.0549
NICT	35 2903	0.4364	0.4381	0.2949	0.1679	0.0294	0.0254	0.1451	0.0057	0.0160	0.1000	-0.0311	-0.0190
NICT	36 1217	0.1823	0.3749	-0.1134	-0.2834	-0.0020	-0.2133	-0.1568	0.0813	0.1563	0.0350	0.1591	0.3168
NICT	40 2003	0.1637	0.1968	0.2056	-0.2493	-1.2002	-1.8883	-	-0.5778	-0.5531	-0.3856	-0.2254	-0.1441
NICT	40 2004	1.9855	2.0039	2.0116	1.9973	2.0144	2.0201	2.0333	2.0464	2.0621	2.1067	2.1843	2.2906
NICT	40 2005	2.0993	2.1650	2.0755	1.8987	1.4773	1.2656	1.3545	1.2703	-	-	-	-
NICT	40 2006	1.7142	1.7465	1.7736	1.7780	1.7571	1.7353	-	1.5822	1.4186	1.5186	1.5468	1.4759
NIM	35 1235	0.4805	0.3425	0.2424	0.1000	0.0103	-0.0901	0.2968	0.2358	0.2115	0.2853	0.0555	0.1036
NIM	35 2239	0.2078	-	-	-	-	-	-	-	-	-	-	-
NIM	35 2256	-0.1410	-0.0855	-0.0445	0.1195	0.1805	0.1503	0.1518	0.1970	0.2163	0.3072	0.3633	0.2268
NIM	35 2483	-0.1832	-0.2606	-0.0517	-0.1034	-0.0238	-0.0466	0.0001	-0.0385	-0.0049	-0.1360	-0.0286	-0.0552
NIM	35 2643	-0.1138	-0.0602	0.0103	0.1243	0.0325	0.1317	0.0510	0.0782	0.1138	0.2822	0.2706	0.3051
NIM	35 2744	-0.0695	-0.1063	-0.1684	0.0538	0.0117	0.1310	0.0336	0.1264	-0.0447	-0.0690	-0.1165	-0.1064
NIM	35 2767	-0.0649	-0.0969	-0.1024	-0.0230	0.1822	0.3738	0.4521	0.4453	0.2274	-0.0061	0.0096	0.0455
NIM	35 2769	0.1269	-0.0965	-0.1255	-0.1191	-0.1586	-0.0236	0.1249	0.0794	0.1191	0.2756	0.2012	0.2028
NIM	40 4832	2.6384	2.6558	2.7282	2.8480	3.0880	3.3766	3.5084	3.4943	3.3473	3.1227	2.9688	2.9136
NIM	40 4835	-	-	19.7319	17.9771	16.3299	15.4339	14.8568	14.5718	13.8973	13.8175	13.6176	13.6998
NIM	40 4871	4.0995	4.0986	4.1142	4.0618	4.0412	4.0604	4.1051	4.1431	4.1699	4.1440	4.0609	3.9426
NIM	40 4878	4.1337	4.0030	3.8774	3.8340	3.9539	3.9981	4.0060	4.0574	4.0240	3.9817	3.9838	3.9312
NIM	40 4879	-	17.2999	5.3053	6.6153	5.5171	4.3578	3.6825	2.5602	1.7087	1.7546	1.7257	1.7450
NIM	40 4880	4.9883	4.9118	4.9502	4.9905	5.0443	4.8813	4.6074	4.2750	3.9525	3.6887	3.4764	3.3106
NIMB	35 0600	0.6714	-	0.3879	2.6365	-0.1971	-0.5622	-0.7264	-0.8235	-1.2327	-0.3320	0.2371	0.5313
NIMT	35 2246	-0.3070	-0.2795	-0.3437	-0.4350	-0.2131	-0.0226	-0.0537	-0.0078	0.0859	-0.0797	0.2787	0.3669

Table 10. (Cont.)

Lab.	Clock	57049	57079	57109	57139	57169	57199	57234	57264	57294	57324	57354	57384
NIMT	35 2247	-0.0169	-0.1058	-0.3415	0.1766	-0.1729	-0.1805	0.2792	0.3965	0.1391	0.0440	-0.2421	-0.3124
NIS	35 1126	-5.5709	-4.5536	-2.3316	0.1582	0.1824	0.2557	0.0284	-	-	-	-	-
NIST	35 0282	0.0070	-0.0042	0.1424	0.1801	0.1769	0.0262	0.0172	-0.0359	0.0216	0.1355	0.1801	0.2322
NIST	35 0408	-0.0250	0.2278	0.2668	0.3222	0.2105	-0.0128	-0.1576	-0.0706	-0.1019	-0.0383	0.0780	0.0964
NIST	35 1074	0.0359	0.1807	0.2090	0.1066	-0.0087	0.1009	-0.0169	0.0576	0.1418	0.0336	-0.0797	-0.0324
NIST	35 1519	0.4986	0.2707	0.2434	0.2018	0.1790	0.1122	0.1744	0.0301	0.1165	0.1545	0.1400	0.1424
NIST	35 2031	0.3900	0.2062	0.1487	0.1078	0.0903	0.1698	0.3273	0.4147	0.3185	0.2349	0.0728	0.0226
NIST	35 2032	0.1568	0.0933	0.0882	0.0758	0.0305	0.0082	0.0420	-0.0228	-0.0002	-0.0497	0.0256	0.0332
NIST	35 2034	-0.0801	0.0509	-0.0262	-0.0550	-0.0530	0.0573	-0.0040	0.1325	-0.0031	-0.0799	-0.1872	-0.0308
NIST	35 2579	0.2432	0.0765	-0.1026	-0.1103	-0.1017	-0.1167	-0.0323	-0.0041	0.0339	0.2624	0.2046	-0.2802
NIST	35 2672	-0.0290	-0.4056	-0.8246	-1.1782	-1.0535	-0.5184	-0.1971	0.3423	0.3704	0.1884	-0.0920	-0.2707
NIST	35 2935	-0.1118	-0.0490	-0.0194	0.0581	0.0886	0.0357	-0.0353	-0.0906	-0.1321	-0.0007	0.0788	0.1001
NIST	40 0205	0.0873	0.0564	0.0386	0.0331	0.0284	0.0148	0.0010	0.0027	0.0187	0.0299	0.0435	0.0454
NIST	40 0206	0.9101	0.8569	0.7897	0.6806	0.6750	0.6809	0.7357	0.8008	0.8344	0.7606	0.7127	0.7545
NIST	40 0207	4.0328	3.9754	3.9615	4.0021	4.0277	4.0645	4.0022	3.9872	4.0051	4.0689	4.1368	4.2459
NIST	40 0210	-	-	-	-	-	-	-	-	-	7.7832	7.8101	7.7723
NIST	40 0212	7.2324	7.2690	7.3816	7.4588	7.4904	7.4390	7.3062	7.1913	7.1315	-	-	7.3026
NIST	40 0222	0.1490	0.1274	0.1177	0.1213	0.1286	0.1366	0.1252	0.1293	0.1230	0.1238	0.1291	0.1351
NMIJ	35 0224	0.0781	-0.0750	0.0022	0.0057	-0.0201	-0.0545	-0.0231	-0.1166	0.0657	0.1289	0.0881	0.0651
NMIJ	35 0523	-0.1830	-0.2667	-0.1827	-0.1764	-0.2405	-0.2687	-0.2033	-0.1677	-0.1840	0.4328	1.7119	2.3631
NMIJ	40 5002	-1.6432	-1.6063	-1.5979	-1.4544	-1.3438	-1.0806	-0.7183	-0.4097	-0.1521	0.0159	0.0634	0.1703
NMIJ	40 5003	0.0077	0.0427	0.0568	0.0589	0.0558	0.0398	-0.0014	0.0021	0.0320	0.0411	0.0643	0.0680
NMIJ	40 5015	-	-	-	-	-	3.4476	3.6202	3.4806	3.4895	3.4599	3.4123	3.3545
NMLS	35 0328	-3.2876	-1.3470	-0.2870	0.4895	1.1344	1.4985	0.8220	-0.6251	-0.6835	-0.5092	-0.4001	-0.0863
NPL	35 1275	0.1438	-0.0340	-0.2223	-0.1816	-0.1661	-0.2124	-0.1195	0.1257	0.0850	0.3183	0.4789	0.2572
NPL	40 1701	0.3613	0.2975	0.2694	0.2820	0.3201	0.3547	0.3168	0.2448	0.2400	0.2597	0.2797	0.5611
NPL	40 1708	0.3732	0.3315	0.3251	0.3471	0.4169	0.4632	0.4995	0.5262	0.5572	0.5621	0.5839	0.5931
NPLI	35 0057	0.7527	0.6697	-	-0.1599	2.5465	1.9288	1.6006	1.4536	1.0747	0.5736	0.5686	0.8356
NPLI	35 0140	-0.9647	-0.5853	-	1.2149	-1.5376	0.5301	0.4076	0.5744	0.2938	0.3108	0.2852	1.0566
NPLI	35 1324	0.0211	0.2548	-	-1.8742	0.6236	0.8390	0.4445	0.1666	-0.1190	-0.1275	-0.2360	0.1628

Table 10. (Cont.)

Lab.	Clock	57049	57079	57109	57139	57169	57199	57234	57264	57294	57324	57354	57384
NPLI	35 2245	0.0711	0.0814	-	0.6321	0.2464	-0.2523	-0.0013	0.0264	0.0191	0.1356	0.1733	-0.0702
NPLI	35 2796	0.3322	0.1887	-	0.4161	-0.0339	0.4864	0.0142	0.1511	0.1610	0.1799	0.0607	0.1441
NPLI	40 5201	-0.0761	0.3290	-	3.6286	-22.0908	-12.3894	-5.9609	-2.9897	-1.1687	3.2678	3.7804	3.5864
NRC	35 2115	-	-	-0.4349	0.0288	0.0642	0.3194	0.2031	0.1284	0.0604	0.1475	0.1165	0.1866
NRC	35 2150	0.1179	0.0489	0.0693	0.2876	0.2107	0.2814	0.0361	-0.0840	-0.2230	-0.2411	-0.1150	0.1439
NRC	35 2152	-0.0051	-0.0264	-0.9791	-1.7894	-2.0228	-1.6895	-0.9559	-0.0437	-0.0770	-0.1109	-0.2111	-0.1204
NRC	36 2219	0.1089	0.0999	0.1778	-0.1366	-0.2420	-0.0821	0.0983	0.0689	0.0811	-0.0482	-0.0682	-0.2767
NRC	40 0304	-	-	-	-	-	-	-	-	-	-	-	-10.1351
NRC	40 0306	8.3309	8.1954	6.5570	2.8849	0.2154	-1.2399	-1.1658	0.3832	2.1069	1.7521	0.2986	-1.5976
NRL	35 0714	-	-0.5766	-0.0120	-0.4355	-0.4935	-0.7006	-	-	-	-	1.1227	-0.2209
NRL	35 0719	-	-1.1492	-0.5025	-0.4610	0.1402	0.5749	-	-	-	-	0.7661	1.5388
NRL	35 1245	-	-3.2269	-2.5538	-2.2032	-2.2302	-1.8062	-	-	-	-	7.1124	-3.4983
NRL	35 2460	-	0.6919	0.0849	9.1386	12.0277	10.9603	8.6092	-	-	-	-	-0.6311
NRL	35 2464	-	-3.8509	-1.3127	0.2992	-1.4882	-1.5431	-1.4134	-	-	-	-	1.3575
NRL	35 2580	-	-0.1618	3.8041	-6.5891	-5.1865	-3.9454	-3.0069	-	-	-	-	1.1586
NRL	36 0387	-	0.5582	-0.2281	-0.0302	0.1103	0.1166	-	-	-	-	4.7056	1.7826
NRL	36 2788	-	1.9742	1.0932	0.5192	0.4470	0.2448	-	-	-	-	1.6953	1.2355
NRL	36 2791	-	-2.7709	0.5720	0.9532	0.4793	0.5400	-	-	-	-	-2.3744	0.3384
NRL	36 2799	-	0.2668	-0.4014	0.7738	1.1490	-	-	-	-	-	1.9524	1.4545
NRL	36 2800	-	-5.5892	-0.8235	0.5254	-0.3189	-	-	-	-	-	1.1878	-0.1332
NRL	36 2807	-	-1.3309	-0.8319	-0.3750	2.3135	-	-	-	-	-	-6.1527	-0.8159
NRL	36 2808	-	-1.5469	0.1265	2.1965	-2.4867	-	-	-	-	-	0.2758	0.2515
NRL	36 2818	-	1.3880	-0.1110	1.8549	5.7526	-	-	-	-	-	-2.5390	-1.0827
NRL	36 2820	-	2.9102	0.3954	0.1226	-0.1872	0.0091	-	-	-	-	0.9170	-1.2199
NRL	36 2829	-	0.1468	1.1771	0.4423	0.5734	0.3500	-	-	-	-	-5.8784	-1.8913
NRL	36 2832	-	-1.3858	0.4286	-0.2471	-0.2713	-0.3692	-	-	-	-	-0.2419	1.2896
NRL	36 2833	-	-2.4178	-1.7743	-3.4802	-3.0653	-	-	-	-	-	3.9033	-0.4093
NRL	36 2834	-	2.0702	-0.0523	-0.1940	-0.5104	-0.0124	-	-	-	-	4.2564	1.3122
NRL	40 1001	-	-0.6452	-0.8046	-0.6769	-0.9164	-0.8168	-	-	-	-	1.3421	0.5284
NRL	40 1003	-	-1.3000	-0.7849	-0.7576	-0.9860	-1.5198	-	-	-	-	-	-

Table 10. (Cont.)

Lab.	Clock	57049	57079	57109	57139	57169	57199	57234	57264	57294	57324	57354	57384
NRL	40 1004	-	-	0.6896	0.3111	0.1728	0.3697	-	-	-	-	1.4896	1.0483
NRL	40 1009	-	0.5651	-1.3169	-1.1975	-1.6216	-2.1587	-	-	-	-	3.7730	0.1726
NRL	40 1010	-	7.5217	5.4526	1.0146	-2.2789	-4.9232	-	-	-	-	3.8450	3.2855
NRL	40 1012	-	-1.6361	-0.9372	-0.9985	-1.1089	-1.2739	-	-	-	-	0.3513	-0.9220
NTSC	35 1008	-0.2941	-0.8355	-0.9126	-1.0109	-	-	-	-	-	-	-	-
NTSC	35 1011	0.6192	0.6556	0.4502	-0.2029	-	-	-	-	-	-	-	-
NTSC	35 1016	0.3099	0.5073	0.5450	0.6640	0.4262	0.3812	0.5367	-0.6906	-2.7810	-3.7454	-4.0480	-3.1495
NTSC	35 1018	0.1529	0.0632	-0.0190	0.0197	-0.0128	0.0802	0.2669	0.5215	0.5174	0.4760	0.2176	-0.0519
NTSC	35 1818	-0.0290	-0.1827	-0.2871	-0.1382	-0.2330	-0.0734	0.0281	0.0383	0.2359	0.2425	0.0390	-0.1410
NTSC	35 1823	0.1204	0.1396	0.0938	0.2779	0.3944	0.6171	0.6539	0.9926	1.1018	1.1248	0.8600	0.4722
NTSC	35 2098	0.0164	0.0580	-0.0527	0.0399	-0.0406	-0.0359	-0.1840	-0.2342	-0.2205	-0.0159	0.1687	0.3043
NTSC	35 2131	-0.1570	-0.0115	0.2975	0.4289	0.4634	0.3391	0.2137	0.0608	0.0199	0.0621	0.1730	0.2185
NTSC	35 2141	-2.4320	-2.2780	-1.3477	-0.9559	-	-	-	-	-	-	-	-
NTSC	35 2142	-0.0331	0.0291	0.0535	0.0066	-0.0400	-0.1013	-0.1753	-	-	-	-	-
NTSC	35 2143	-0.3312	-0.2142	-0.1279	0.0024	-0.2165	-0.2897	-0.6804	-0.6947	-0.5657	-0.3409	-0.2027	0.0581
NTSC	35 2145	-0.7500	-0.4079	-0.2387	-0.2242	-0.2252	-0.2534	0.0530	0.2078	0.2435	-0.0364	-0.3937	-0.8282
NTSC	35 2573	-0.0254	0.0293	0.0543	0.0755	-0.0049	-0.1440	0.0779	0.1615	0.1816	0.0790	0.1112	0.0913
NTSC	35 2831	-	-	4.1319	1.5757	0.9842	0.7338	0.5819	-	0.0872	0.3694	-1.1425	-0.3031
NTSC	35 2852	0.1833	0.1569	0.2116	0.2470	0.1617	-0.0648	-0.0701	-0.1239	-0.0372	0.1585	0.4918	0.5197
NTSC	35 2921	-0.0923	-0.0372	-0.0308	-0.1056	-0.1405	-0.2837	-0.0865	-0.0364	0.0385	0.1273	0.0950	0.0868
NTSC	35 2922	-0.0139	0.0416	0.1112	0.1575	0.2056	0.1830	0.0092	-0.1364	-0.0778	0.0334	0.1203	0.0463
NTSC	35 2924	0.2339	-0.7054	-0.4700	-0.2775	-0.1484	-0.1755	0.0249	-	0.7935	0.2146	0.6673	0.4012
NTSC	35 2926	0.3278	0.3438	0.2756	0.3610	0.2812	0.2923	0.2681	0.2336	0.2822	0.4204	0.2387	0.2422
NTSC	35 2928	0.0657	0.0791	0.0805	0.2269	0.2647	0.2948	0.2403	0.1150	0.0289	0.0322	0.0530	0.0987
NTSC	35 2933	-0.1852	-0.1720	-0.0268	0.0580	-0.0397	-0.0290	-0.1577	-0.1301	-0.0128	0.0521	0.1012	0.0499
NTSC	35 2959	0.1090	0.1137	0.1369	0.2483	0.1730	0.0600	0.0348	-	0.3444	0.2683	0.1996	0.1481
NTSC	35 2962	0.0335	0.0340	0.1404	0.2875	0.3086	0.2175	0.1384	0.0714	0.0724	0.1802	0.3069	0.2581
NTSC	35 2964	0.3005	0.4162	0.4210	0.3236	0.2271	0.1641	0.1739	0.2376	0.3379	0.2433	0.1581	0.1033
NTSC	35 2965	-0.0343	-0.0405	0.0604	0.1118	0.1660	0.0174	-0.0730	-0.0205	0.0339	0.0750	0.0808	0.0916
NTSC	35 2976	1.0506	1.1127	0.8300	0.4957	0.4272	0.2960	0.2972	-	-0.6636	0.1500	0.2311	0.3103

Table 10. (Cont.)

Lab.	Clock	57049	57079	57109	57139	57169	57199	57234	57264	57294	57324	57354	57384
NTSC	35 2978	-0.0394	-0.0381	-0.0961	0.0379	0.1920	0.2083	0.3672	0.3955	0.3403	0.3826	0.2771	0.2167
NTSC	35 2980	0.1332	0.1834	0.1237	0.1200	0.1354	0.1928	0.2426	0.2655	0.1411	0.0999	0.0515	0.0266
NTSC	35 2981	0.2120	0.1931	0.0527	0.0525	-0.0125	0.0158	0.1335	0.3744	0.5685	0.6107	0.5398	0.3906
NTSC	35 3089	-	-	-	-	-	0.9722	0.2148	-0.1764	-0.0994	-0.0633	0.0035	0.0079
NTSC	35 3090	-	-	-	-	-	0.7802	-0.0799	0.2374	0.1435	0.1375	0.2015	0.1489
NTSC	35 3091	-	-	-	-	-	-0.2861	0.1482	0.2524	0.2401	0.2861	0.3322	0.3226
NTSC	35 3102	-	-	-	-	-	-0.3239	-0.0450	0.0394	0.2810	0.3302	0.2060	0.2299
NTSC	40 0296	2.5787	2.6072	2.6333	2.6514	2.6493	2.6086	2.5938	2.6117	2.6542	2.6454	2.6014	2.5526
NTSC	40 0297	2.7741	2.7887	2.7851	2.8415	2.9575	3.0511	3.1901	-	-	-	-	4.2752
NTSC	40 4926	-	5.7662	5.2159	4.3894	3.7141	3.1670	2.6610	1.8140	1.2458	0.8440	0.5401	0.3044
NTSC	40 4927	-	-6.3743	-4.5817	-3.3355	-2.5637	-2.0872	-1.7965	-	0.5192	-0.6267	-0.3430	0.9576
NTSC	40 4943	0.0325	-0.0048	-0.0212	-0.0340	-0.0280	0.0485	0.0008	0.0358	0.0464	0.0015	-0.0269	-
ONBA	36 2228	-	-	-1.8921	-0.7873	-0.5310	-0.0465	0.1603	0.0785	0.2416	0.0977	-	-
ONRJ	35 0102	0.9115	0.5669	0.6165	0.4172	0.2775	0.0478	0.0368	0.0548	0.2845	0.3659	0.4024	0.3021
ONRJ	35 0103	0.0343	-0.0369	-0.3456	-0.4553	-0.2812	-0.2623	-0.3184	0.1507	0.3690	0.4072	0.4513	0.2121
ONRJ	35 0123	0.1567	0.1870	0.0832	-0.1019	-0.0575	-0.0816	-0.2245	-0.3807	-0.2962	-0.3577	-0.3886	-0.3245
ONRJ	35 0129	0.1998	0.0997	0.1604	0.0809	0.1532	0.1429	0.0683	-0.0213	0.0745	0.0156	0.0768	0.0638
ONRJ	35 0147	-0.1270	-0.0692	0.0002	-0.0420	0.0762	0.2382	0.2198	0.2219	0.3178	0.2794	0.1953	0.1399
ONRJ	35 1153	0.3608	0.4937	0.3829	0.1485	-0.0606	-0.1244	-0.1915	0.0097	0.1930	0.3766	0.4327	0.3949
ONRJ	35 1942	-0.1237	-0.0914	-0.0786	-0.1119	-0.3838	-0.3898	-0.3856	-0.3568	-0.2382	-0.1466	-0.0907	-
ONRJ	40 1950	3.9832	4.6508	4.7276	4.0698	3.1125	2.2210	1.6578	1.6689	1.8706	1.8792	1.8968	2.0074
ONRJ	40 1958	-0.4844	-0.5593	-0.4932	-0.3704	-0.2161	-0.1142	-0.1252	-0.2265	-0.3103	-0.3543	-0.2941	-0.2587
OP	35 0124	-0.0475	-0.0887	-0.1002	-0.0769	0.0464	0.0436	0.0153	-0.1612	-0.3060	-0.2688	-0.1317	-
OP	35 0157	-0.0746	-0.0500	-0.0486	0.1557	0.0350	-0.1295	-0.2524	-0.1843	-0.1074	0.1111	0.1660	0.0449
OP	35 0158	0.2211	-	-	-	-	-	-	-	-	-	-	-
OP	35 0355	0.5451	0.2392	-0.0986	-0.1689	-0.1229	-0.2959	-0.4760	-0.5374	-0.3733	-0.3128	-0.1890	-0.2476
OP	35 0385	0.1283	0.0501	0.0584	-0.1278	-	-	-	-	-	-	-	-
OP	35 0396	0.0935	0.0937	0.0683	0.1598	0.2336	0.0599	-0.1330	-0.0956	-0.1330	-0.0657	0.0149	0.0507
OP	35 0469	0.4474	0.0834	-0.1828	-0.1780	-0.1452	-0.1343	-0.0308	-0.1230	-0.0951	0.0073	-0.1377	-0.1700
OP	35 0489	0.2590	0.4610	0.5433	0.4202	0.3610	0.2731	-0.0285	-0.0853	0.0793	-0.0591	-0.1277	0.0214

Table 10. (Cont.)

Lab.	Clock	57049	57079	57109	57139	57169	57199	57234	57264	57294	57324	57354	57384
OP	35 0609	-0.5732	-0.6445	-0.4301	-0.3242	-0.3544	-	-	-	-	-	-	-1.0425
OP	35 0770	-0.1232	-0.0560	0.0787	0.0678	-0.0006	0.1521	-0.1694	-0.2394	-0.1610	-0.1878	-0.1638	-
OP	35 0774	-0.0165	-0.0651	0.0191	-0.0675	-0.1365	-0.0190	0.0977	0.0196	0.3490	0.5870	0.6755	0.8373
OP	35 0781	0.2159	0.2490	0.1084	0.2344	0.2059	0.1730	0.1229	0.0818	-0.0653	0.0599	-0.1005	-0.1923
OP	35 0859	0.5707	0.5194	0.1340	0.0519	-0.5500	-0.5835	-0.3156	0.2626	0.1318	0.1077	-0.0438	-0.2105
OP	35 1177	0.6481	0.8773	0.5240	0.1504	-0.5326	-0.5858	-0.4223	-0.2005	-0.1487	-0.2356	-0.0818	0.1874
OP	35 1222	-0.0977	-0.0919	-0.0493	0.1936	0.0842	0.1595	0.1605	0.3236	0.2014	-0.0351	-0.3984	-0.6155
OP	35 1321	-0.1922	-0.1926	0.0272	0.0408	0.0272	-0.1897	-0.3155	-0.1540	0.0697	0.1231	0.0639	0.0982
OP	35 1556	-0.4944	-0.3434	-0.1974	0.0982	0.2308	-	-	-	-	-	-	0.4558
OP	35 1644	-0.1925	0.0218	0.0745	0.1576	0.0778	-0.0163	-0.1259	-0.0251	-0.0689	0.0696	0.0811	0.0810
OP	35 2388	0.2203	0.3412	0.2329	-0.0578	-0.2406	-0.1732	-0.1274	0.0833	0.1845	0.2265	0.1819	0.1133
OP	35 2609	0.0137	0.1000	-0.2344	-0.6945	-0.8712	-0.7925	-0.5533	0.0183	0.3077	0.2087	0.1428	0.0245
OP	35 2647	-0.0932	-0.0885	-0.1013	0.3165	0.2356	0.2608	0.2091	0.0775	0.1772	0.1147	-0.0409	-0.4615
OP	35 2804	0.2269	0.2580	0.1422	0.1590	0.0966	0.1316	0.0935	0.2509	0.1895	0.2407	0.1976	0.1673
OP	35 2985	-	-0.3160	0.0979	0.0743	0.0977	0.1255	0.0378	0.0889	0.1197	0.0780	0.1015	0.0689
OP	40 0809	0.7547	0.7320	0.7406	0.7473	0.7581	0.7628	0.7566	0.7679	0.7610	0.7482	0.7411	0.7172
OP	40 0810	-	0.5411	0.6664	0.7746	0.7303	0.6979	0.6875	0.6848	0.6789	0.6901	0.6692	0.6085
OP	40 0889	0.3290	0.3212	0.3259	0.3339	0.3196	0.3129	0.3098	0.3208	0.3271	0.3355	0.3237	0.3317
OP	40 0890	0.1415	0.1225	0.1291	0.1397	0.1447	0.1429	0.1334	0.1286	0.1218	0.1216	0.1282	0.1274
ORB	35 2722	-0.1069	-0.0911	-0.2560	-0.2849	-0.1515	-0.1330	0.0778	0.2545	0.1540	0.1952	0.1301	0.0862
ORB	35 2723	-0.0403	-0.1461	-0.3487	-0.5395	-0.4480	-0.4907	-0.4152	0.0565	0.2264	0.4062	0.5323	0.0758
ORB	35 2724	0.2248	0.2552	0.1045	0.1016	0.0467	0.1138	0.1211	0.1723	0.0188	0.0862	0.0520	0.0491
ORB	36 0593	0.1989	-0.0970	-0.0273	-0.1751	-0.2077	-0.1884	0.0647	-0.3298	-0.1973	-0.0356	-0.1544	-0.1100
PL	25 0124	2.2286	1.2932	0.1710	-0.5016	-0.4610	-1.4018	-0.5165	-1.1443	-1.2523	-0.7941	-0.1437	-0.2538
PL	25 0125	-1.5247	-1.6008	-1.8657	-1.7046	-1.0951	-1.4238	-1.4507	-0.7508	-1.0303	-0.8198	-0.8975	-0.8159
PL	35 0441	0.1978	0.2475	0.2122	0.1269	0.1685	0.2251	0.2938	0.3501	0.3464	0.1766	0.0631	0.0237
PL	35 0745	0.1162	-0.2216	-0.3484	0.4136	-2.4573	-	-	1.6679	0.1586	-0.1505	0.0763	0.1271
PL	35 0761	0.4423	0.1447	-0.1963	-0.3514	-0.3810	-0.2204	-	-	2.7581	-0.9552	-0.8567	0.6059
PL	35 1120	-0.2798	-0.2717	-0.1433	-0.0106	-0.1697	-	-	-	-	0.9706	0.3999	0.5995
PL	35 1660	-	-	-	-	-	-	-	-	-	-	2.3261	0.2318

Table 10. (Cont.)

Lab.	Clock	57049	57079	57109	57139	57169	57199	57234	57264	57294	57324	57354	57384
PL	35 1746	-4.0962	-3.4673	-2.0699	3.3573	-0.9429	-0.8554	-2.6012	-4.6847	-4.7920	0.2908	-1.4452	0.7992
PL	35 1934	0.1602	0.2629	0.1517	0.0479	-0.0638	-0.0745	-0.1454	0.0260	0.0214	-0.0027	-0.0098	0.0632
PL	35 2175	-	1.8234	-0.7039	-0.4473	-0.2092	-0.2773	-0.2935	-0.0480	0.1339	0.0565	0.1704	0.1469
PL	35 2394	0.4349	0.2937	0.1662	0.0129	-0.0462	0.0891	-0.0847	-0.1718	-0.0521	0.0941	0.0194	0.2996
PL	35 2891	0.1691	0.1145	0.0165	-0.0494	-0.1191	-0.1229	-0.1190	-0.0833	-0.0357	-0.0136	0.0024	0.0238
PL	40 4004	-25.4731	-24.6964	-24.3479	-23.5117	-21.9593	-20.5993	-19.1550	-17.8706	-17.2818	-15.4240	-13.6014	-13.4703
PL	40 4601	0.7381	0.7157	0.6950	0.6652	0.6572	0.6559	0.6662	0.6556	0.6420	0.6347	0.6445	0.6565
PL	40 4602	5.5942	5.5999	6.4191	7.8117	8.7236	8.8357	7.9806	5.5074	3.3456	2.5545	2.8330	4.0041
PTB	35 0128	0.8007	1.0455	1.2027	0.9629	-	-	-	-	-	-	-	-
PTB	35 0415	-0.3015	-0.2455	0.1848	0.3114	0.4155	0.6034	0.7162	0.6846	0.9113	0.7382	0.4724	0.2170
PTB	35 1072	0.1190	0.0305	-0.0528	-0.1851	-0.1097	0.0059	0.0130	0.1203	0.1601	0.1071	0.0786	0.1240
PTB	35 2987	0.1944	-0.2187	0.0809	0.1021	0.1128	0.2475	0.2780	0.1756	0.1613	0.1643	0.1151	0.2760
PTB	40 0506	1.5721	1.5819	1.6176	1.6915	0.7339	0.1495	-0.0331	0.1556	0.7105	1.6680	1.6890	1.7083
PTB	40 0508	3.2074	3.0474	2.7079	2.5175	2.5092	2.5465	-	-	1.6918	1.9735	2.0834	2.1084
PTB	40 0509	0.6351	0.6378	0.5930	0.4864	0.3326	0.3364	0.3346	0.3480	0.3602	0.3616	0.3540	0.3527
PTB	92 0001	-0.0994	-0.1485	-0.1244	-0.0598	0.0090	0.1024	0.0648	-0.0177	-0.0592	-0.0331	-	-
PTB	92 0002	0.0237	-0.0423	-0.0717	-0.0483	-0.0044	-0.0014	0.0421	-0.0521	-0.0506	-0.0108	-0.0133	0.0319
ROA	35 0583	-0.1176	-0.3001	-0.2204	-0.0721	0.0387	0.2237	0.2667	0.1004	0.1828	0.1013	-0.2885	-0.2402
ROA	35 0718	-0.1110	-0.0339	-0.1033	-0.1554	-0.1157	0.0448	0.0134	-0.0662	0.0673	-0.0274	-0.0167	0.0826
ROA	35 1699	0.1967	-0.0592	-0.2206	-0.3487	-0.2503	-0.2473	-0.2136	-0.2378	-0.2426	-0.2429	0.1095	0.0158
ROA	35 2270	-0.3466	-0.1550	-0.2923	-0.1472	-0.4442	-0.2472	-0.1739	-0.0364	-0.0096	-0.0593	-0.1723	-0.1027
ROA	36 1488	0.1618	0.1046	0.3064	-0.0630	0.0621	0.0332	-0.1331	-0.0657	0.1748	0.0017	0.0861	-0.0727
ROA	36 1490	0.4131	0.2498	-0.1055	-0.0389	-0.1018	-0.3640	-0.1573	0.1403	0.2812	0.4768	0.3392	-0.0050
ROA	40 1436	2.3471	2.3513	2.4026	2.5197	2.7298	3.0398	3.0190	3.0382	3.0073	3.0162	2.8751	2.7515
SASO	35 0221	-0.0766	0.0160	-0.1124	-	0.6358	-0.5570	-0.1487	0.1951	0.4386	0.4961	0.5832	0.3666
SASO	35 1628	-0.0089	-0.2301	-0.3754	-	1.5375	0.0959	0.5286	0.3951	0.3682	0.1988	0.1581	0.0053
SASO	35 2923	0.3846	0.4784	0.4350	-	1.5752	0.2067	0.3934	0.1660	0.2989	0.4420	0.3250	0.2150
SASO	35 2931	-	-	-	0.8618	-0.2466	-0.1797	-0.0319	0.0278	0.0096	0.0866	0.0353	-0.0194
SASO	35 2932	0.1772	0.1462	-0.0475	-	-0.7700	-0.2909	0.1303	0.0835	-0.0216	-0.0168	0.0158	-0.1124
SCL	35 2178	0.8271	0.6784	-0.0394	0.2337	0.0523	-	-	-	-	-4.7482	-0.9705	-0.5053

Table 10. (Cont.)

Lab.	Clock	57049	57079	57109	57139	57169	57199	57234	57264	57294	57324	57354	57384
SCL	35 2525	1.1357	0.5546	0.4918	0.6299	0.6367	-	-	-	-	-2.3277	-1.0699	-0.9401
SG	35 0188	0.1395	0.1008	0.0430	0.0695	0.0705	0.1549	0.2454	0.1750	0.0880	0.0473	0.0320	0.0785
SG	35 0475	0.1214	0.2493	0.1863	0.0447	0.0938	-0.2737	-0.1528	0.0514	0.1615	0.1415	0.2246	-0.0617
SG	35 0696	-	-	-	-	-4.6374	-0.6107	-0.5041	-0.2243	-0.2419	-0.1371	-0.0438	0.1376
SG	35 3135	-	-	-	-	-	-	-	0.7697	0.5912	0.4022	0.3640	0.2896
SG	36 0522	0.0778	0.1709	0.3679	0.5284	0.3256	0.0862	-0.0813	-0.1040	-0.1091	0.2109	0.1504	0.4463
SG	40 7701	6.7115	5.6875	5.5542	5.4189	5.2809	5.1742	4.9802	4.8486	4.7292	4.5851	4.4336	4.3663
SIQ	36 1268	1.7963	0.8021	0.7238	-0.2749	-1.2887	-2.5070	-0.2760	-0.6709	-0.1726	-0.2846	0.2702	0.9169
SMD	35 1766	-0.0205	-0.1591	-0.1459	-0.0482	0.0362	0.0364	0.1287	0.0727	0.1972	0.1637	0.0032	-0.0633
SMD	35 2003	-0.2025	-	-	-	-	-	-	-	-1.1882	0.0308	0.3930	0.3276
SMD	35 2543	1.6717	1.0279	0.2489	0.0243	-0.1769	-0.1962	-0.0534	-0.1435	-0.2566	-0.0570	0.1055	0.3187
SMD	40 7909	-2.5004	-2.7548	-1.9750	-0.3317	-0.1354	-1.0307	-1.7332	-3.0139	-3.4654	-2.2151	-1.9125	-1.6601
SMU	36 1193	0.1076	0.1071	-0.1314	-0.0631	-0.2499	-0.3196	-0.2895	-0.3071	-0.2112	0.0592	0.1320	0.2150
SP	35 0572	-0.0755	0.0401	-0.0798	-0.0164	-0.0533	-0.0037	-0.1070	-0.0358	-0.1275	-0.0395	-0.0281	0.0282
SP	35 0641	0.2462	0.0019	-0.2116	-0.3376	-0.2822	-0.2687	-0.2026	0.0027	0.0544	0.1422	0.1957	0.1432
SP	35 0767	-0.1423	-0.1829	-0.1736	-0.1094	-0.1798	-0.0260	-0.1047	-0.0628	-0.2128	-0.0998	-0.1021	-0.0117
SP	35 1188	0.3481	0.3586	0.2956	0.2494	0.1958	-0.0138	-0.0526	0.1163	0.1136	0.2137	0.3733	0.1609
SP	35 1642	0.1008	-0.0052	0.0971	0.0534	0.0046	0.0620	0.0283	-0.0961	-0.0269	0.0656	0.1137	0.1361
SP	35 2166	0.1997	0.0690	0.0095	0.1398	0.1479	0.1405	0.0407	0.0430	-0.0137	-0.1253	0.0406	0.0493
SP	35 2745	-0.1882	-0.2310	-0.5108	-0.3054	-0.2553	-0.1013	0.0987	0.0992	-0.1660	-0.0950	0.1167	0.1265
SP	35 2746	0.0968	-0.0403	-0.2533	-0.3114	-0.1963	-0.3842	-0.2208	-0.1975	-0.2566	-0.1343	-0.0496	-0.2942
SP	35 2749	-0.1964	-0.1199	-0.0539	0.0440	0.1165	0.0445	0.0225	-0.0147	-0.1426	-0.2299	-0.1009	-0.1250
SP	35 2750	0.0444	0.1489	0.1422	0.1303	0.1708	0.2356	0.0672	0.0530	-0.0058	0.0062	0.0140	0.0238
SP	35 2758	0.0599	0.0249	-0.0137	0.0666	0.0369	-0.0319	-0.0781	-0.0839	-0.0502	0.0482	0.1208	0.1268
SP	36 0223	0.1502	-0.1195	-0.2902	-0.0946	-0.1873	-0.1143	0.0748	0.3256	0.1734	0.3601	0.1946	-0.0767
SP	36 1175	0.0417	0.1733	0.1726	0.1633	0.1309	-0.0777	-0.0240	0.0533	0.0965	0.0294	0.1613	-0.0188
SP	36 1187	1.2835	1.1720	1.1451	0.5996	0.0805	-0.4563	-0.2960	-0.1735	0.1340	0.3674	0.6041	0.6048
SP	36 1531	0.1823	0.0838	0.0883	-0.0186	0.3676	0.0894	-0.0665	-0.3735	-0.4647	-0.1732	0.0218	0.1873
SP	36 2068	0.1658	-0.2346	0.1270	0.2359	0.1210	0.0148	-0.3809	-0.1604	0.0452	-0.0134	0.0624	-0.0081
SP	36 2218	0.2123	-0.1943	-0.1907	-0.1465	-0.0730	-0.1096	0.0323	-0.2418	-0.1363	0.0773	0.0608	0.1098

Table 10. (Cont.)

Lab.	Clock	57049	57079	57109	57139	57169	57199	57234	57264	57294	57324	57354	57384
SP	36 2295	-0.0362	-0.1492	-0.1081	0.1573	0.6191	0.5373	0.3859	0.0811	-0.0694	0.1708	0.4723	0.4540
SP	36 2297	0.1961	-0.1253	-0.0157	0.0642	0.1005	0.3056	0.2981	0.2044	0.2864	0.0481	0.0824	0.2362
SP	40 7201	3.3660	3.3937	3.3461	3.2050	3.0588	2.9490	2.9238	2.9427	2.9528	2.9740	3.0031	3.0209
SP	40 7203	0.8792	0.8282	0.8113	0.8004	0.7717	0.7564	0.7368	0.7363	0.7313	0.7368	0.7282	0.7055
SP	40 7210	3.5117	3.0402	2.8168	2.3703	2.2929	2.2832	2.2176	2.2062	2.1997	2.0533	1.9912	2.0769
SP	40 7211	1.4836	1.4485	1.4819	1.4686	1.4623	1.4777	1.5232	-	-	-	-	-
SP	40 7212	0.3717	0.3369	0.3603	0.4264	-	-	0.1645	0.2815	0.1994	0.2169	0.2016	0.2268
SP	40 7221	0.1992	0.1868	0.1912	0.1936	0.2043	0.1890	0.1583	0.1640	0.1725	0.1853	0.2013	0.2085
SP	40 7223	1.0855	1.0722	1.0392	1.0091	1.0050	0.9938	0.9980	1.0480	1.0770	1.0853	1.1164	1.4002
SP	40 7231	7.1819	7.2432	7.2963	7.3015	7.2938	7.3126	7.3870	7.5074	7.6307	7.7066	7.7330	7.7445
SP	40 7232	-2.5027	-3.3773	-3.8195	-3.9088	-3.8103	-3.5572	-3.1695	-2.7715	-2.3419	-1.8679	-1.3913	-0.8883
SU	40 3809	0.3731	0.3061	0.2278	0.1743	0.1533	0.1678	0.1780	0.1924	0.2144	0.2344	0.2627	0.2934
SU	40 3810	0.2517	0.2453	0.2385	0.2420	0.2311	0.2273	0.2230	0.2245	0.2297	0.2345	0.2443	0.2630
SU	40 3811	0.8688	0.8496	0.8456	0.8204	0.7815	0.7628	0.7589	0.7624	0.7922	0.8087	0.8041	0.8804
SU	40 3812	0.2693	0.2452	0.2367	0.2388	0.2358	0.2421	0.2394	0.2427	0.2549	0.2500	0.2365	0.2384
SU	40 3814	0.7619	0.7426	0.7660	0.7538	0.7471	0.7577	0.7432	0.7441	0.7552	0.7580	0.7504	0.7537
SU	40 3815	0.5083	0.4879	0.4811	0.4747	0.4136	0.4337	0.4544	0.4788	0.5081	0.5237	0.4662	0.4708
SU	40 3816	-	-	-	-	0.8312	0.8961	0.7886	0.7636	0.7368	0.7123	0.6585	0.6329
SU	40 3817	0.7812	0.7101	0.5997	0.4152	0.3251	0.2397	-	0.4885	0.2429	0.2443	0.3545	0.4013
SU	40 3818	0.3120	0.3148	0.3257	0.3407	0.3441	0.3521	0.3554	0.3641	0.3699	0.3606	0.3476	0.3560
TL	35 1012	0.0019	-0.0584	-0.0546	0.0109	-0.0718	-0.1403	-0.1285	-0.0646	-0.2106	0.0366	0.0739	0.1459
TL	35 1498	0.0381	0.0165	0.0112	0.0099	0.3106	0.4931	0.3099	0.2022	0.0366	-0.0323	0.0308	0.0390
TL	35 1500	-0.2835	-0.0346	0.0635	0.1270	0.2349	0.1153	-0.0954	-0.0062	-0.1006	-0.1279	-0.0738	-0.0139
TL	35 1712	-0.1197	0.2054	0.6838	0.8135	1.2552	1.3972	0.8295	0.1014	-0.3758	-0.6742	-0.2701	0.5620
TL	35 2365	-0.0508	-0.0315	-0.1087	-0.1149	-0.0531	-0.0801	-0.0622	0.0171	-0.0325	-0.0371	-0.0636	-0.0316
TL	35 2366	-0.0851	0.0834	0.1376	0.2173	0.1028	-0.0031	-0.1687	-0.2588	-0.1405	0.0442	0.1619	0.0866
TL	35 2367	-0.1025	-0.0219	0.1399	0.1354	-0.0201	-0.0033	-0.0177	0.0279	0.1832	0.1096	0.0553	-0.1031
TL	35 2368	-0.1093	-0.1068	-0.2259	-0.2966	-0.2783	-0.2061	-0.0569	0.1181	0.1919	0.2574	0.2588	0.1677
TL	35 2630	0.2166	0.1190	0.2617	0.4478	0.4759	0.4690	0.6647	0.5133	0.3035	0.1582	-0.0552	-0.2679
TL	35 2634	0.3822	0.3781	0.5212	0.4195	-0.3056	0.0589	-0.2310	-0.0272	0.1858	-0.6034	-1.6492	-1.0965

Table 10. (Cont.)

Lab.	Clock	57049	57079	57109	57139	57169	57199	57234	57264	57294	57324	57354	57384
TL	35 2636	0.0271	-0.0948	0.0313	0.1879	0.2097	0.3233	0.3535	0.4479	0.4582	0.1753	-0.0019	-0.5590
TL	35 2853	-0.0029	0.0483	-0.0810	-0.1264	-0.0278	-0.0049	-0.0892	-0.2082	-0.2121	-0.2321	-0.1531	0.0720
TL	35 2910	0.1481	0.1451	0.3299	0.0891	0.0240	-0.0105	0.1787	0.2102	0.2931	0.1476	0.2291	0.0799
TL	40 0057	-1.6402	-1.3008	-1.3020	-1.7231	-2.4033	-2.7449	-2.9333	-2.7032	-2.2602	-1.9447	-1.8474	-1.9569
TL	40 3011	1.3176	1.4739	1.7839	1.9870	2.1537	2.3108	2.5313	2.7435	2.9280	3.0898	3.2568	3.4291
TL	40 3052	-1.0253	-1.0912	-1.1590	-1.1731	-1.1234	-0.9662	-0.9809	-0.9526	-0.8408	-0.7996	-0.8230	-0.9276
TP	35 0163	0.0489	-0.1900	-0.1592	-0.1126	-0.1308	0.0617	-	-1.5069	-0.1574	-0.1356	-0.1130	-0.1459
TP	35 1227	-0.2478	-0.2324	-0.1609	-0.1652	-0.2163	-0.2182	-	1.3594	0.7053	0.4048	-0.1824	-0.1693
TP	35 2476	-0.5560	-0.8615	-1.0275	-1.1960	-1.3339	-1.1023	-	0.6599	0.3201	-0.2063	-0.2533	-0.1672
TP	35 2970	0.1521	0.1246	0.0873	0.2063	0.1307	0.1782	-	-1.0338	-0.5845	0.3954	0.0858	0.1789
UA	35 2465	-0.2144	0.0509	0.0406	-0.0315	0.5515	0.1495	-0.2955	-0.1401	-0.6756	-0.6450	0.1758	0.7947
UA	40 7854	0.0559	0.0388	0.1876	0.2725	0.1918	0.0412	-0.0426	-0.1123	-0.2597	-0.2979	-0.0421	0.0128
UA	40 7881	-0.0833	-0.3551	-0.3772	0.0385	0.2707	0.0263	0.3063	-0.2119	-0.7651	-1.2686	-0.6065	-0.3058
UA	40 7882	-1.5327	-2.5328	-2.9631	-2.7973	-1.8337	0.0152	-0.1851	-0.0556	-0.0206	0.0397	0.3292	0.2671
UME	35 0251	0.6304	0.6808	0.2911	0.3216	0.1805	0.0709	-0.0287	0.0341	-0.0962	-0.0174	-0.0874	-0.1364
UME	35 0252	0.4919	0.3443	0.2630	0.2677	0.1474	-0.0900	0.0094	0.0046	-0.0400	0.0393	0.1076	0.0769
UME	35 0872	0.2011	0.4322	0.2231	0.1862	0.1832	0.1625	-0.0518	-0.0416	-0.1190	-0.0716	0.1963	0.4266
UME	35 2703	0.2146	0.1396	0.3121	0.0336	0.0407	-0.1065	-0.1855	-0.1553	0.1522	0.1381	0.3880	0.5321
UME	35 2710	0.9539	0.0284	0.0173	-0.0529	-0.0975	-0.0014	0.0379	-0.0259	0.0734	-0.2068	4.9714	3.5419
USNO	35 0101	0.5005	0.5971	0.6738	0.8759	0.7416	0.5897	0.2510	-0.1177	0.0618	0.5581	0.4322	0.3826
USNO	35 0104	0.0146	0.0295	0.0048	0.0291	0.1373	0.0789	0.1109	-0.0054	0.0318	0.0122	-0.0651	-0.0007
USNO	35 0106	-0.0199	-0.0878	-0.0714	-0.1177	-0.1870	-0.3153	-	-	-	-	-	-
USNO	35 0108	-0.0747	-0.2345	-0.0429	0.1095	0.1362	0.1130	0.1454	-0.0142	-0.0618	-0.1278	-0.2573	-0.0913
USNO	35 0114	0.0106	-0.0801	-0.0578	0.0403	-0.0626	-0.1517	-0.1673	-0.2970	-0.3680	-0.1420	0.0093	-0.1721
USNO	35 0120	-0.0023	-0.0367	-0.0180	-0.0335	0.0473	0.1636	0.2411	0.2278	0.1407	-0.1563	-0.2229	-0.2922
USNO	35 0142	-0.0788	-0.1594	-0.0439	0.0020	0.3301	0.3776	0.3642	0.3195	0.1559	0.0834	-0.1055	-0.2041
USNO	35 0150	-0.1234	-0.3836	-0.3785	-0.4529	-0.1839	0.0724	0.1465	-0.0622	-0.0791	-0.2030	0.0010	-0.0723
USNO	35 0152	0.1754	0.0536	0.0404	-0.0602	-0.0894	-	-	-	-	-	-	-
USNO	35 0156	0.2765	0.2622	0.2240	0.2220	0.3241	0.2869	0.1008	0.0629	-0.1843	-0.1821	-0.0226	0.1633
USNO	35 0161	0.4624	0.4171	0.3388	0.3057	0.3462	0.3804	0.3375	0.3061	0.3258	0.4538	0.3698	0.3293

Table 10. (Cont.)

Lab.	Clock	57049	57079	57109	57139	57169	57199	57234	57264	57294	57324	57354	57384
USNO	35 0164	-0.1559	-0.0360	-0.1012	-0.2969	-0.3833	-0.1493	0.1787	0.4709	0.4561	0.1929	-0.2044	-0.3538
USNO	35 0165	-0.0628	-	-	-	-	-	-	-	-	-	-	-
USNO	35 0166	0.1324	0.4642	0.7148	0.7221	0.5935	0.1414	-0.0022	-0.0148	0.1160	0.1989	0.2980	0.0713
USNO	35 0169	-0.0084	0.1601	0.1838	0.2330	0.0974	-0.0558	-0.0977	-0.1267	-0.1763	-0.1352	-0.0557	0.0883
USNO	35 0173	-0.2889	0.0019	-0.1972	-0.1220	-0.3084	-0.3017	-0.4397	-0.2612	-0.5346	-0.1274	-0.1735	-0.0991
USNO	35 0226	0.0554	-0.0900	-0.0163	0.0092	0.0760	0.3638	0.2815	0.3031	0.1745	0.0583	0.0061	0.0377
USNO	35 0231	0.5725	0.5099	0.3257	-0.1437	-0.3478	-0.3547	-0.1822	-0.1427	-0.1236	-0.1231	0.0929	0.2207
USNO	35 0233	0.1207	0.0308	-0.0209	-0.1049	-0.2438	-0.2587	-0.2263	-0.1789	-0.1989	-0.1672	-0.2726	-0.2648
USNO	35 0244	0.1488	0.2099	0.1777	0.0588	0.1135	0.1411	0.3664	0.5992	0.6077	0.5713	0.4515	0.2555
USNO	35 0253	-0.0743	-0.1797	-0.1575	-0.1120	-0.0067	-0.0944	-0.1181	-0.2017	0.0329	-1.3162	-	-
USNO	35 0254	-0.1216	-0.2163	-0.3003	-0.3315	0.0298	0.3541	0.5386	0.5163	0.2733	0.0226	-0.0112	-0.0274
USNO	35 0256	0.2697	0.1691	0.0596	0.0365	0.0614	0.0454	0.1149	0.1858	0.2116	0.1741	0.1448	-0.1327
USNO	35 0260	0.1979	-0.1652	-0.3644	0.1279	-0.8377	-1.6808	-2.0363	-1.7732	-0.5397	2.1628	0.7714	-0.4818
USNO	35 0268	-1.6793	-1.5149	-0.7685	-0.1738	0.0127	-0.0697	-0.3033	-0.4331	-0.8326	-0.8730	-0.8829	-0.6244
USNO	35 0270	-0.1175	-0.1764	-0.0572	-0.1316	-0.1619	-0.2639	-0.1763	0.0773	0.3242	0.2177	0.0383	-0.2270
USNO	35 0279	-0.1793	-0.0447	0.0273	0.0793	-0.2115	-0.2336	0.4644	0.8366	1.2053	1.3356	0.7423	-0.1196
USNO	35 0389	0.7576	0.7439	0.6354	0.4636	0.2876	0.3963	0.3591	0.2324	0.2911	0.2678	0.3032	0.3210
USNO	35 0394	0.1040	-0.1062	-0.1210	-0.2533	-0.0764	0.1090	0.2845	0.2760	0.1253	-0.1106	-0.0833	0.0173
USNO	35 0416	-0.9569	-0.8291	-0.4462	-0.4656	-0.2999	-0.3166	-	-	-	-	-	-
USNO	35 0417	0.1411	0.2158	0.0161	-0.0242	-0.2234	-0.2855	0.1917	0.4105	-	-	-	-
USNO	35 0703	-0.2504	-0.3006	-0.2761	-0.4339	-0.2723	-0.2233	0.0567	0.4657	1.0286	1.3895	1.3096	0.6411
USNO	35 0717	0.0617	-0.0669	-0.0644	-0.2557	-0.4144	-0.3161	-0.4853	-0.4340	-0.4470	-0.5809	-0.4784	-0.2939
USNO	35 0762	-0.2042	-0.7424	-0.9290	-0.8100	-0.5060	-0.1471	0.0824	0.0220	-0.1658	-0.1346	0.0770	0.0858
USNO	35 0765	-15.1718	-	-	-	-	-	-	-	-	-	-	-
USNO	35 1096	0.2871	0.2669	0.2264	0.0236	-0.0241	-0.0363	0.0076	0.0087	0.0161	-0.0649	-0.0639	-0.0776
USNO	35 1097	0.1267	0.1985	-	-	-	-	-	-	-	-	-	-
USNO	35 1125	0.2962	0.2191	-0.0279	-0.0686	0.0329	0.0054	0.1411	0.1442	-0.1091	-0.1213	-0.1883	-0.3121
USNO	35 1327	0.2011	0.1479	-0.0493	-0.0010	0.0400	-0.0660	-0.1766	-0.2510	-0.3731	-0.4258	-0.4138	-0.3445
USNO	35 1328	0.0033	-0.0512	0.0223	-0.0607	0.0632	-0.0709	-0.0006	-0.0247	0.0640	-0.0052	0.1985	0.2839
USNO	35 1331	-0.0200	-0.2592	-0.7892	-0.7713	-0.8213	-0.4357	-0.2038	0.0914	0.1397	0.2746	0.2586	0.2007

Table 10. (Cont.)

Lab.	Clock	57049	57079	57109	57139	57169	57199	57234	57264	57294	57324	57354	57384
USNO	35 1459	-0.5237	-0.4613	-0.3669	-0.1448	-0.0353	0.1415	0.0411	-0.0285	-0.1876	-0.1275	-0.1588	0.0316
USNO	35 1462	0.0953	0.0722	-0.0150	-0.1716	-0.2056	-0.0698	0.1277	0.0441	0.0843	0.0804	0.0749	0.0437
USNO	35 1463	0.0763	0.1967	0.2544	0.3571	0.2178	0.0721	-0.0662	-0.1152	-0.0639	-0.0219	0.1150	0.0901
USNO	35 1468	0.0968	-0.1016	-0.1772	0.0681	0.2182	0.3564	0.2111	0.0412	-0.1457	-0.1701	-0.2252	-0.1932
USNO	35 1481	-0.2277	-0.1529	-0.1075	0.0166	-0.0479	-0.0586	-0.1078	-0.1593	-0.2504	-0.1070	-0.1512	-0.0357
USNO	35 1543	-0.0895	0.2810	0.7320	1.1187	1.1472	1.0056	0.4482	0.1297	-0.0398	0.0930	-0.0040	0.1426
USNO	35 1573	0.0904	-0.2141	-0.1956	-0.3065	-0.0268	0.2725	0.7564	0.7657	0.6028	0.2077	0.0071	-0.1838
USNO	35 1575	-0.0762	-0.1836	-0.0971	-0.1624	-0.1395	-0.1969	-0.0441	-0.0440	-0.0389	-0.2297	-0.3395	-0.4590
USNO	35 1580	0.8588	0.6432	0.4791	0.2074	0.2000	0.2174	0.0327	0.0882	0.1073	0.0236	-0.0026	-0.0595
USNO	35 1585	-2.1405	-3.3711	-3.7986	-3.6538	-2.2316	-0.5574	-0.9778	-0.8932	-0.9051	-0.8065	-0.5000	-0.3843
USNO	35 1598	-0.2078	-0.3514	-0.4707	-0.2056	0.1628	0.0230	-1.1844	-1.7467	-2.1145	-1.6476	-0.8451	-0.2533
USNO	35 1655	-0.4522	-0.0493	0.1358	0.2547	0.3198	0.3946	0.3278	0.2105	0.0517	-0.0444	-0.0635	-0.1096
USNO	35 1658	-0.0278	-0.0984	-0.1555	-0.2588	-0.1070	0.0174	0.1063	0.0483	-0.0565	-0.1554	-0.2049	-0.1760
USNO	35 1692	-0.1266	-0.1237	-0.1502	-0.1641	-0.1520	-0.0415	0.0049	0.0051	-0.0356	-0.2586	-0.4522	-0.5697
USNO	35 1694	-0.1329	-0.1436	-0.0924	-0.0638	-0.0430	-0.2022	-0.2169	-0.2894	-0.1813	-0.0266	0.0052	-0.0286
USNO	35 1696	0.1184	-0.1725	-0.5264	-0.5792	-0.4765	-0.1980	0.4868	0.6620	1.0241	1.0804	0.9247	0.6164
USNO	35 1697	0.0429	0.1151	0.1361	0.0682	0.1650	0.1449	0.0599	0.1754	0.1235	0.0463	0.1472	0.0080
USNO	40 0701	-0.2376	0.1862	0.4466	1.2871	4.8182	6.8558	6.9189	5.5328	2.7236	-0.6701	-0.8640	-0.6767
USNO	40 0702	0.0696	0.0455	0.0591	0.0648	0.1620	0.2163	0.2254	0.1989	0.1411	0.0493	0.0441	0.0513
USNO	40 0704	0.1466	0.1214	0.1051	0.1128	0.1054	0.0948	0.0752	0.0920	0.1039	-	-	-
USNO	40 0705	0.1444	0.1276	0.1207	0.1037	0.0746	0.0935	0.1096	0.1387	0.1656	0.1873	0.1421	0.1085
USNO	40 0708	0.2834	0.2758	0.2873	0.2937	0.2954	0.2902	0.2761	0.2737	0.2749	0.2771	0.2728	0.2599
USNO	40 0710	-	-	-	-	-	-	-	0.4474	0.3562	0.3056	0.3047	0.3004
USNO	40 0711	1.4548	1.4315	1.4483	1.4517	1.4764	1.4609	1.4241	1.3917	1.3864	1.3720	1.4006	1.3970
USNO	40 0712	-0.0357	-0.0685	-0.0941	-0.0880	-0.0445	0.0237	0.0521	0.0391	0.0072	-0.0241	-0.0443	-0.0280
USNO	40 0713	1.5324	3.1342	5.1906	7.1805	8.6253	9.0649	9.0438	4.8874	-3.5414	-9.2453	-11.8060	-10.8437
USNO	40 0714	0.3301	0.2677	0.2434	0.2071	0.2130	0.3025	0.3281	0.3290	0.3441	0.3481	0.3069	0.3310
USNO	40 0715	0.4069	0.3587	0.3397	0.3487	0.3869	0.4572	0.4812	0.4749	0.4784	0.4814	0.4805	0.4797
USNO	40 0716	0.1435	0.1281	0.1290	0.1337	0.1241	0.1378	0.1367	0.1409	0.1375	0.1501	0.1404	0.1401
USNO	40 0717	1.6207	1.5452	1.4892	1.4509	1.4940	2.4097	2.0465	1.7671	1.4698	1.1655	0.8453	1.3826

Table 10. (Cont.)

Lab.	Clock	57049	57079	57109	57139	57169	57199	57234	57264	57294	57324	57354	57384
USNO	40 0718	3.7530	3.7985	3.4668	2.4053	0.2352	-0.1356	0.4443	0.7733	1.2712	1.6669	0.9932	0.9018
USNO	40 0719	1.0157	0.9814	0.9729	0.9681	0.9823	0.9894	0.9905	-	-	-	-	-
USNO	40 0720	2.3467	2.3476	2.4133	2.4016	2.3906	2.3190	2.2469	2.2367	2.2605	2.2704	2.2869	2.3009
USNO	40 0721	3.8678	3.8712	3.9021	3.9206	3.9626	3.9741	3.9644	3.9043	3.7846	3.6533	3.5996	3.5669
USNO	40 0722	-	-	-	-	-	3.8521	3.8517	3.6482	3.5983	3.6027	3.5815	3.4779
USNO	40 0723	0.1800	0.1474	0.1364	0.1618	0.1661	0.1463	0.1319	0.1363	0.1472	0.1782	0.2032	0.2211
USNO	40 0724	0.2595	0.1119	-0.0310	-0.1125	0.0526	0.3716	0.5646	0.4767	0.2458	-0.0306	-0.0481	-0.0466
USNO	40 0725	0.1198	0.1068	0.1156	0.1127	0.1137	0.1170	0.1293	0.1577	0.1500	0.1354	0.1100	0.0890
USNO	40 0726	3.5241	3.5050	3.5004	3.4970	3.5143	3.5339	3.5265	3.5232	3.4963	3.4728	3.4551	3.4351
USNO	40 0727	1.5412	1.7172	1.9240	2.1274	2.3919	2.6927	2.9000	3.0334	3.1518	3.2024	3.2386	3.2615
USNO	40 0728	2.9426	2.9145	2.9026	2.6199	1.1878	0.4370	0.3603	0.9130	1.9028	3.0804	3.0280	2.9479
USNO	40 0729	4.5916	4.5627	4.5213	4.5005	4.4828	4.4450	4.4170	4.4386	4.4255	4.4281	4.4025	4.3479
USNO	40 0730	3.2956	3.2676	3.2419	3.2396	3.2581	3.2773	3.2824	3.2933	3.2852	3.2794	3.2581	3.2216
USNO	40 0731	-0.0487	-0.0881	-0.1019	-0.1365	-0.1577	-0.1547	-0.1335	-0.1350	-0.1265	-0.0874	-0.0575	-0.0429
USNO	40 0732	2.9812	2.9524	2.9339	2.7517	1.6618	1.0345	0.9416	1.2627	1.9918	2.9676	2.9628	2.9463
USNO	40 0734	-5.3203	-5.2628	-5.1759	-5.1269	-4.9223	-4.6684	-4.4251	-4.2254	-4.2576	-4.3637	-4.4087	-4.3441
USNO	40 0735	4.4660	4.4710	4.4754	4.6363	4.7368	4.7300	4.8227	4.9327	4.8066	4.6924	4.4612	4.1847
USNO	40 0736	4.5539	4.6275	4.6449	4.6244	4.6273	4.6495	4.6714	4.6867	4.6857	4.6723	4.6621	4.6435
USNO	40 0737	9.2282	9.2261	9.2973	9.3494	9.3768	9.3717	9.2846	9.1880	9.0781	8.9333	8.7906	8.7051
USNO	93 0002	0.0272	0.0113	0.0006	-0.0069	-0.0029	0.0017	-0.0019	0.0008	-0.0078	-0.0019	0.0042	0.0116
USNO	93 0003	0.0080	-0.0079	-0.0043	-0.0023	0.0072	0.0102	-0.0002	0.0021	-0.0013	0.0083	0.0148	0.0127
USNO	93 0004	0.0057	-0.0061	-0.0007	-0.0065	0.0005	0.0000	-0.0186	-0.0147	-0.0066	0.0017	0.0140	0.0158
USNO	93 0005	0.0180	0.0087	0.0117	0.0048	0.0059	0.0055	-0.0115	-0.0103	-0.0069	-0.0008	0.0061	0.0157
VMI	35 2230	0.4533	0.1439	-0.2706	-	-	10.6476	4.6686	1.9642	0.8640	0.9379	0.3542	-0.4025
VMI	36 1233	0.2923	-0.2606	-0.4520	-	-	10.4967	7.8018	2.9168	1.1337	0.8722	0.4749	-0.6788
VMI	36 2314	0.3875	0.1860	-0.2594	-	-	11.2304	3.7396	1.4217	0.3022	0.5493	0.1710	-0.4969
VSL	35 0179	-	-	-0.1709	-0.4768	-0.0069	0.0847	0.0449	0.2234	0.3888	0.3808	0.4648	0.4057
VSL	35 0456	-0.5047	-0.3428	-0.0284	0.1318	0.1955	0.3176	0.3705	0.3356	0.2952	0.2150	0.0193	-0.1876
VSL	35 0548	-0.2749	-0.4947	-0.1280	-0.0362	0.2828	0.4973	0.6062	0.5132	0.5183	0.3093	0.1392	0.0741
VSL	35 0731	-0.4133	-0.2545	0.0247	0.0714	-0.0129	0.0323	-0.0990	-0.0788	-0.1219	-0.0047	-0.0295	0.0905
ZA	36 1821	-0.1511	-0.0784	-0.2536	-0.2032	0.0284	-0.1490	-0.3025	-0.0768	-0.1909	0.0680	0.3589	0.3155

TIME SIGNALS

The time signal emissions reported here follow the UTC system, in accordance with the Recommendation 460-4 of the Radiocommunication Bureau (RB) of the International Telecommunication Union (ITU) unless otherwise stated.

Their maximum departure from the Universal Time UT1 is thus 0.9 seconds.

The following tables are based on information received at the BIPM in April 2016.

AUTHORITIES RESPONSIBLE FOR TIME SIGNAL EMISSIONS

Signal	Authority
BPC, BPL, BPM	National Time Service Center, NTSC Chinese Academy of Sciences 3 East Shuyuan Rd, Lintong District, Xi’an Shaanxi 710600, China
CHU	National Research Council of Canada Measurement Science and Standards Frequency and Time Standards Bldg M-36, 1200 Montreal Road Ottawa, Ontario, K1A 0R6, Canada
DCF77	Physikalisch-Technische Bundesanstalt Time and Frequency Department, WG 4.42 Bundesallee 100 D-38116 Braunschweig Germany
EBC	Real Instituto y Observatorio de la Armada Cecilio Pujazón s/n 11.110 San Fernando Cádiz, Spain
HLA	Center for Time and Frequency Division of Physical Metrology Korea Research Institute of Standards and Science 267 Gajeong-Ro, Yuseong, Daejeon 34113 Republic of Korea
JJY	Space-Time Standards Laboratory National Institute of Information and Communications Technology 4 -2- 1, Nukui-kitamachi Koganei, Tokyo 184-8795 Japan
LOL	Servicio de Hidrografía Naval Observatorio Naval Buenos Aires Av. España 2099 C1107AMA – Buenos Aires, Argentina
MIKES	VTT Technical Research Centre of Finland Ltd Centre for Metrology MIKES P.O. Box 1000, FI-02044 VTT, Finland

Signal	Authority
MSF	National Physical Laboratory Time Quantum and Electromagnetics Division Hampton Road Teddington, Middlesex TW11 0LW United Kingdom
RAB-99, RBU, RJH-63, RJH-69, RJH-77, RJH-86, RJH-90,RTZ,RWM	All-Russian Scientific Research Institute for Physical Technical and Radiotechnical Measurements FGUP “VNIIFTRI” Meendeleevo, Moscow Region 141570 Russia
TDF	CFHM Chambre française de l’horlogerie et des microtechniques 22 avenue Franklin Roosevelt 75008 Paris, France and LNE Laboratoire national de métrologie et d’essais 1 rue Gaston Boissier 75724 Paris Cedex 15, France
WWV, WWVB, WWVH	Time and Frequency Division, 688.00 National Institute of Standards and Technology - 325 Broadway Boulder, Colorado 80305, U.S.A.

TIME SIGNALS EMITTED IN THE UTC SYSTEM

Station	Location Latitude Longitude	Frequency (kHz)	Schedule (UTC)	Form of the signal
BPC	Shangqiu China 34° 27'N 115° 50'E	68.5	00 h 00 m to 21 h 00 m	UTC second pulse modulation of the phase shift keying of the carrier. The additional pulse width modulation includes calendar and local time information.
BPL	Pucheng China 34° 56'N 109° 32'E	100	Continuous	The BPL time signals are generated by NTSC and are in accordance with the legal time of China which is UTC(NTSC)+8 . The BPL system is the same as the Loran-C system, utilizing the multi-pulse phase coding scheme. Carrier Frequency of 100KHz. The information that BPL broadcasts contains minutes, seconds, year, month, day and other information. Using pulse shift modulation.
BPM	Pucheng China 35° 0'N 109° 31'E	2 500 5 000 10 000 15 000	7 h 30 m to 1 h Continuous Continuous 1 h to 9 h	The BPM time signals are generated by NTSC and are in accordance with UTC(NTSC)+8 h. Signals emitted in advance on UTC by 20 ms. Second pulses of 10 ms duration with 1 kHz modulation. Minute pulses of 300 ms duration with 1 kHz modulation. UTC time signals are emitted from minute 0 to 10, 15 to 25, 30 to 40, 45 to 55. UT1 time signals are emitted from minute 25 to 29, 55 to 59.
CHU	Ottawa Canada 45° 18'N 75° 45'W	3 330 7 850 14 670	Continuous	Second pulses of 300 cycles of a 1 kHz modulation, with 29th and 51st to 59th pulses of each minute omitted. Minute pulses are 0.5 s long. Hour pulses are 1.0 s long, with the following 1st to 9th pulses omitted. A bilingual (Fr. Eng.) announcement of time (UTC) is made each minute following the 50th second pulse. FSK code (300 bps, Bell 103) after 10 cycles of 1 kHz on seconds 31 to 39. Year, DUT1, leap second information, TAI-UTC and Canadian daylight saving time format on 31, and time code on 32-39. Broadcast is single sideband; upper sideband with carrier reinsert. DUT1 : ITU-R code by double pulse.
DCF77	Mainflingen Germany 50° 1'N 9° 0'E	77.5	Continuous	The DCF77 time signals are generated by PTB and are in accordance with the legal time of Germany which is UTC(PTB)+1 h or UTC(PTB)+2 h. At the beginning of each second (except in the last second of each minute) the carrier amplitude is reduced to about 15 % for a duration of 0.1 or 0.2 s corresponding to “binary 0” or “binary 1”, respectively, referred to as second marks 0 to 59 in the following. The number of the minute, hour, day of the month, day of the week, month and year are transmitted in BCD code using second marks 20 to the 58, including overhead. Information emitted during minute n is valid for minute n+1. The information transmitted during the second marks 1 to the 14 is provided by third parties. Information on that additional service can be obtained from PTB. To achieve a more accurate time transfer and a better use of the frequency spectrum available an additional pseudo-random phase shift keying of the carrier is superimposed on the AM second markers. No transmission of DUT1.

Station	Location Latitude Longitude	Frequency (kHz)	Schedule (UTC)	Form of the signal
EBC	San Fernando Spain 36° 28'N 6° 12'W	15 006 4 998	10 h 00 m to 10 h 25 m 10 h 30 m to 10 h 55 m except Saturday, Sunday and national holidays.	Second pulses of 0.1 s duration of a 1 kHz modulation. Minute pulses of 0.5 s duration of 1 250 Hz modulation. DUT1: ITU-R code by double pulse.
HLA	Daejeon Rep. of Korea 36° 23'N 127° 22'E	5 000	Continuous	Second pulses of 9 cycles of 1 800 Hz tones. 29th and 59th second pulses omitted. Hour identified by 0.8 s long 1 500 Hz tones. Beginning of each minute identified by 0.8 s long 1 800 Hz tones. BCD time code given on 100 Hz subcarrier.
JJY	Tamura-shi Fukushima Japan 37° 22'N 140° 51'E	40	Continuous	A1B type 0.2 s, 0.5 s and 0.8 s second pulses, spacings are given by the reduction of the amplitude of the carrier. Coded announcement of hour, minute, day of the year, year, day of the week and leap second. Transmitted time refers to UTC(NICT) + 9 h.
JJY	Saga-shi Saga Japan 33° 28'N 130° 11'E	60	Continuous	A1B type 0.2 s, 0.5 s and 0.8 s second pulses, spacings are given by the reduction of the amplitude of the carrier. Coded announcement of hour, minute, day of the year, year, day of the week and leap second same as JJY(40). Transmitted time refers to UTC(NICT) + 9 h.
LOL	Buenos Aires Argentina 34° 37'S 58° 21'W	10 000	11 h to 12 h except Saturday, Sunday and national holidays.	Second pulses of 5 cycles of 1000 Hz modulation. Second 59 is omitted. Announcement of hours and minutes every 5 minutes, followed by 3 minutes of 1000 Hz or 440 Hz modulation. DUT1: ITU-R code by lengthening.
MIKES	Espoo Finland 60° 11'N 24° 50'E	25 000	Continuous	Modulation as in DCF77, but with 1 kHz amplitude modulation added and without pseudo-random phase shift keying of the carrier. Time code in UTC.
MSF	Anthorn United Kingdom 54° 54'N 3° 16'W	60	Continuous, except for interruptions for maintenance from 10 h 0 m to 14 h 0 m on the second Thursday of December and March, and from 09 h 0 m to 13 h 0 m on the second Thursday of June and September. A longer period of maintenance during the summer is announced annually.	The carrier is interrupted for 0.1 s at the start of each second, except during the first second of each minute (second 0) when the interruption is 0.5 s. Two data bits are transmitted each second (except second 0): data bit “A” between 0.1 and 0.2 s after the start of the second and data bit “B” between 0.2 and 0.3 s after the start of the second. Presence of the carrier represents “binary 0” and an interruption represents “binary 1”. The values of data bit “A” provide year, month, day of the month, day of the week, hour and minute in BCD code. The time represented is UTC(NPL) in winter and UTC(NPL)+1h when DST is in effect. The values of data bit “B” provide DUT1 and an indication whether DST is in effect. The information transmitted applies to the following minute. DUT1: ITU-R code by double pulse.

Station	Location Latitude Longitude	Frequency (kHz)	Schedule (UTC)	Form of the signal
RAB-99	Khabarovsk Russia 48° 30'N 134° 50'E	25.0 25.1 25.5 23.0 20.5	02 h 06 m to 02 h 36 m 06 h 06 m to 06 h 36 m	A1N type signals are transmitted between minutes 9 and 20 : 0.025 second pulses of 12.5 ms duration are transmitted between minutes 9 and 11; second pulses of 0.1 s duration, 10 second pulses of 1 s duration, 0.1 second pulses of 25 ms and minute pulses of 10 s duration are transmitted between minutes 11 and 20.
RBU	Moscow Russia 56° 44'N 37° 40'E	200/3	Continuous	DXXXW type 0.1 s signals. The numbers of the minute, hour, day of the month, day of the week, month, year of the century, difference between the universal time and the local time, TJD and DUT1+dUT1 are transmitted each minute from the 1st to the 59th second. DUT1+dUT1 : by double pulse.
RJH-63	Krasnodar Russia 44° 46'N 39° 34'E	25.0 25.1 25.5 23.0 20.5	11 h 06 m to 11 h 40 m	A1N type signals are transmitted between minutes 9 and 20 : 0.025 second pulses of 12.5 ms duration are transmitted between minutes 9 and 11 ; 0.1 second pulses of 25 ms duration, 10 second pulses of 1 s duration and minute pulses of 10 s duration are transmitted between minutes 11 and 20.
RJH-69	Molodechno Belarus 54° 28'N 26° 47'E	25.0 25.1 25.5 23.0 20.5	07 h 06 m to 07 h 47 m	A1N type signals are transmitted between minutes 10 and 22 : 0.025 second pulses of 12.5 ms duration are transmitted between minutes 10 and 13; second pulses of 0.1 s duration, 10 second pulses of 1 s duration, 0.1 second pulses of 25 ms and minute pulses of 10 s duration are transmitted between minutes 13 and 22.
RJH-77	Arkhangelsk Russia 64° 22'N 41° 35'E	25.0 25.1 25.5 23.0 20.5	09 h 06 m to 09 h 47 m	A1N type signals are transmitted between minutes 10 and 22 : 0.025 second pulses of 12.5 ms duration are transmitted between minutes 10 and 13; second pulses of 0.1 s duration, 10 second pulses of 1 s duration, 0.1 second pulses of 25 ms and minute pulses of 10 s duration are transmitted between minutes 13 and 22.
RJH-86	Bishkek Kirgizstan 43° 03'N 73° 37'E	25.0 25.1 25.5 23.0 20.5	04 h 06 m to 04 h 47 m 10 h 06 m to 10 h 47 m	A1N type signals are transmitted between minutes 10 and 22 : 0.025 second pulses of 12.5 ms duration are transmitted between minutes 10 and 13; second pulses of 0.1 s duration, 10 second pulses of 1 s duration, 0.1 second pulses of 25 ms and minute pulses of 10 s duration are transmitted between minutes 13 and 22.
RJH-90	Nizhni Novgorod Russia 56° 11'N 43° 57'E	25.0 25.1 25.5 23.0 20.5	08 h 06 m to 08 h 47 m	A1N type signals are transmitted between minutes 10 and 22 : 0.025 second pulses of 12.5 ms duration are transmitted between minutes 10 and 13; second pulses of 0.1 s duration, 10 second pulses of 1 s duration, 0.1 second pulses of 25 ms and minute pulses of 10 s duration are transmitted between minutes 13 and 22.
RTZ	Irkutsk Russia 52° 26'N 103° 41'E	50	00 h 00 m to 19 h 00 m 20 h 00 m to 24 h 00 m	DXXXW type 0.1 s signals. The numbers of the minute, hour, day of the month, day of the week, month, year of the century, difference between the universal time and the local time, TJD and DUT1+dUT1 are transmitted each minute from the 1st to the 59th second. DUT1+dUT1: by double pulse.

Station	Location Latitude Longitude	Frequency (kHz)	Schedule (UTC)	Form of the signal
RWM (1)	Moscow Russia 56° 44'N 37° 38'E	4 996 9 996 14 996	The station operates simultaneously on the three frequencies.	A1X type second pulses of 0.1 s duration are transmitted between minutes 10 and 20, 40 and 50. The pulses at the beginning of the minute are prolonged to 0.5 s. A1N type 0.1 s second pulses of 0.02 s duration are transmitted between minutes 20 and 30. The pulses at the beginning of the second are prolonged to 40 ms and of the minute to 0.5 ms. DUT1+dUT1: by double pulse.
TDF	Allouis France 47° 10'N 2° 12'E	162	Continuous, except every Tuesday from 1 h to 5 h	Phase modulation of the carrier by +1 and -1 rd in 0.1 s every second except the 59th second of each minute. This modulation is doubled to indicate binary 1. The numbers of the minute, hour, day of the month, day of the week, month and year are transmitted each minute from the 21st to the 58th second, in accordance with the French legal time scale. In addition, a binary 1 at the 17th second indicates that the local time is 2 hours ahead of UTC (summer time); a binary 1 at the 18th second indicates that the local time is 1 hour ahead of UTC (winter time); a binary 1 at the 14th second indicates that the current day is a public holiday (Christmas, 14 July, etc...); a binary 1 at the 13th second indicates that the current day is a day before a public holiday.
WWV	Fort-Collins CO, USA 40° 41'N 105° 3'W	2 500 5 000 10 000 15 000 20 000	Continuous	Second pulses are 1 000 Hz tones, 5 ms in duration. 29th and 59th second pulses omitted. Hour is identified by 0.8 second long 1 500 Hz tone. Beginning of each minute identified by 0.8 second long 1 000 Hz tones. DUT1: ITU-R code by double pulse. BCD time code given on 100 Hz subcarrier, includes DUT1 correction.
WWVB	Fort-Collins CO, USA 40° 41'N 105° 3'W	60	Continuous	Second pulses given by reduction of the amplitude, reversal of phase, and by binary phase shift keying of the carrier, AM, PM and BPSK coded announcement of the date, time, DUT1 correction, daylight saving time in effect, leap year and leap second.
WWVH	Kauai HI, USA 21° 59'N 159° 46'W	2 500 5 000 10 000 15 000	Continuous	Second pulses are 1 200 Hz tones, 5 ms in duration. 29th and 59th second pulses omitted. Hour is identified by 0.8 second long 1 500 Hz tone. Beginning of each minute identified by 0.8 second long 1 200 Hz tones. DUT1: ITU-R code by double pulse. BCD time code given on 100 Hz subcarrier, includes DUT1 correction.

(1) RWM is the radiostation emitting DUT1 information in accordance with the ITU-R code and also giving an additional information, dUT1, which specifies more precisely the difference UT1-UTC down to multiples of 0.02 s, the total value of the correction being DUT1+dUT1.
Positive values of dUT1 are transmitted by the marking of *p* second markers within the range between the 21st and 24th second so that dUT1 = $+p \times 0.02$ s.
Negative values of dUT1 are transmitted by the marking of *q* second markers within the range between the 31st and 34th second, so that dUT1 = $-q \times 0.02$ s.

ACCURACY OF THE CARRIER FREQUENCY

Station	Relative uncertainty of the carrier frequency in 10^{-10}
BPM	0.01
CHU	0.05
DCF77	0.02
EBC	0.1
HLA	0.02
JJY	0.01
LOL	0.1
MIKES	0.01
MSF	0.02
RAB-99,RJH-63	0.05
RBU,RTZ	0.02
RJH-69, RJH-77	0.05
RJH-86, RJH-90	0.05
RWM	0.05
TDF	0.02
WWV	0.01
WWVB	0.01
WWVH	0.01

TIME DISSEMINATION SERVICES

The following tables are based on information received at the BIPM between February and April 2016.

AUTHORITIES RESPONSIBLE FOR THE TIME DISSEMINATION SERVICES

AOS	Astrogeodynamical Observatory Borowiec near Poznan Space Research Centre P.A.S. PL 62-035 Kórnik - Poland
AUS	Electricity Section National Measurement Institute PO Box 264 Lindfield NSW 2070 - Australia
BelGIM	Belarussian State Institute of Metrology National Standard for Time, Frequency and Time-scale of the Republic of Belarus Minsk, Minsk Region – 220053 Belarus
BEV	Bundesamt für Eich- und Vermessungswesen Arltgasse 35 A-1160 Wien, Vienna - Austria
CENAM	Centro Nacional de Metrología km. 4.5 Carretera a Los Cués El Marqués, Querétaro, C.P. 76246 - Mexico
CENAMEP	Centro Nacional de Metrología de Panamá AIP CENAMEP AIP Ciudad del Saber Edif. 215 Panama
DMDM	Directorate of Measures and Precious Metals Group for Time, Frequency and Time Dissemination. Mike Alasa 14 11000 Belgrade Serbia
EIM	Hellenic Institute of Metrology Electrical Measurements Department Block 45, Industrial Area of Thessaloniki PO 57022, Sindos Thessaloniki, Greece
GUM	Time and Frequency Laboratory Electricity Department Główny Urząd Miar – Central Office of Measures ul. Elektoralna 2 PL 00 – 950 Warszawa P–10, Poland
HKO	Hong Kong Observatory 134A, Nathan Road Kowloon, Hong Kong, China
IGNA	Instituto Geográfico Nacional Argentino Servicio Internacional de la Hora General Manuel N. Savio 1898 B1650KLP – Villa Maipú, Provincia de Buenos Aires, Argentina

IMBH	Institute of Metrology of Bosnia and Herzegovina (IMBH) Laboratory for time and frequency Augusta Brauna 2 71000 Sarajevo, Bosnia and Herzegovina
INPL	National Physical Laboratory Danciger A bldg Givat - Ram, The Hebrew university 91904 Jerusalem, Israel
INRIM	Istituto Nazionale di Ricerca Metrologica Strada delle Cacce, 91 I – 10135 Torino, Italy
IPQ	Instituto Português da Qualidade Rua António Gião, 2 2829-513 Caparica – Portugal
JV	Justervesenet Norwegian Metrology and Accreditation Service Fetveien 99 2007 Kjeller, Norway
KIM	Puslit Kalibrasi, Instrumentasi dan Metrologi -- Lembaga Ilmu Pengetahuan Indonesia Research Centre for Calibration, Instrumentation and Metrology -- Indonesian Institute of Sciences (Puslit KIM – LIPI) Kawasan PUSPIPTEK Serpong Tangerang 15314 Banten - Indonesia
KRISS	Center for Time and Frequency Division of Physical Metrology Korea Research Institute of Standards and Science 267 Gajeong-Ro, Yuseong Daejeon 34113 Republic of Korea
KZ	Kazakhstan Institute of Metrology Orynbor str., 11 Astana, Republic of Kazakhstan
LNE-SYRTE	Laboratoire National de Métrologie et d'Essais Systèmes de Référence Temps-Espace Observatoire de Paris 61, avenue de l'Observatoire, 75014 Paris – France
LT	Time and Frequency Standard Laboratory Center for Physical Sciences and Technology A. Goštauto 11 Vilnius LT01108, Lithuania
MASM	Time and Frequency Standard Laboratory Mongolian Agency for Standardization and Metrology Peace avenue 46A, Bayanzurkh district, Ulaanbaatar 13343 Mongolia
METAS	Federal Institute of Metrology Sector Length, Optics and Time Lindenweg 50 CH-3003 Bern-Wabern Switzerland

MIKES	VTT Technical Research Centre of Finland Ltd Centre for Metrology MIKES P.O. Box 1000, FI-02044 VTT, Finland
MSL	Measurement Standards Laboratory Callaghan Innovation 69 Gracefield Road PO Box 31-310 Lower Hutt – New Zealand
NAO	Time Keeping Office Mizusawa VLBI Observatory National Astronomical Observatory of Japan 2-12, Hoshigaoka, Mizusawa, Oshu, Iwate 023-0861 Japan
NICT	Space-Time Standards Laboratory National Institute of Information and Communications Technology 4 -2 -1, Nukui-kitamachi Koganei, Tokyo 184-8795 - Japan
NIM	Time & Frequency Laboratory National Institute of Metrology No. 18, Bei San Huan Dong Lu Beijing 100029 - People's Republic of China
NIMB	Time and Frequency Laboratory National Institute of Metrology Sos. Vitan - Barzesti, 11 042122 Bucharest, Romania
NIMT	Time and Frequency Laboratory National Institute of Metrology (Thailand) 3/5 Moo 3, Klong 5, Klong Luang, Pathumthani 12120, Thailand
NIST	National Institute of Standards and Technology Time and Frequency Division, 688.00 325 Broadway Boulder, Colorado 80305, USA
NMIJ	Time Standards Group National Metrology Institute of Japan (NMIJ), AIST Umezono 1-1-1, Tsukuba, Ibaraki 305-8563, Japan
NMISA	Time and Frequency Laboratory National Metrology Institute of South Africa Private Bag X34 Lynnwood Ridge 0040, Pretoria - South Africa
NMLS	Time and Frequency Laboratory National Metrology Institute of Malaysia Lot PT 4803, Bandar Baru Salak Tinggi, 43900 Sepang - Malaysia

NPL	National Physical Laboratory Time Quantum and Electromagnetics Division Hampton Road Teddington, Middlesex TW11 0LW United Kingdom
NPLI	Time and Frequency Section National Physical Laboratory Dr.K.S.Krishnan Road New Delhi 110012 - India
NRC	National Research Council of Canada Measurement Science and Standards Frequency and Time Standards Bldg M-36, 1200 Montreal Road Ottawa, Ontario, K1A 0R6, Canada
NSC IM	Time and Frequency Section National Scientific Center "Institute of Metrology" Kharkov - Ukraine Region – 61002 Ukraine
NTSC	National Time Service Center Chinese Academy of Sciences 3 East Shuyuan Rd, Lintong District, Xi'an Shaanxi 710600, China
ONBA	Servicio de Hidrografía Naval Observatorio Naval Buenos Aires Servicio de Hora Av. España 2099 C1107AMA – Buenos Aires, Argentina
ONRJ	Observatorio Nacional (MCTI) Divisão Serviço da Hora Rua General José Cristino, 77 São Cristovão 20921-400 Rio de Janeiro, Brazil
ORB	Royal Observatory of Belgium Avenue Circulaire, 3 B-1180 Brussels, Belgium
PTB	Physikalisch-Technische Bundesanstalt Time and Frequency Department, WG 4. 42 Bundesallee 100 D-38116 Braunschweig, Germany
ROA	Real Instituto y Observatorio de la Armada Plaza de las Tres Marinas s/n 11.100 San Fernando Cádiz, Spain

SG	National Metrology Centre Agency for Science, Technology and Research (A*STAR) 1 Science Park Drive 118221 Singapore
SIQ	SIQ Ljubljana Metrology department Trzaska ul. 2 1000 Ljubljana Slovenia
SP	SP Technical Research Institute of Sweden Box 857 S-501 15 Borås Sweden
TL	National Standard Time and Frequency Laboratory Telecommunication Laboratories Chunghwa Telecom. Co., Ltd. No. 99, Dianyan Road Yang-Mei, Taoyuan, 32661 Taiwan Republic of China
TP	Institute of Photonics and Electronics Academy of Sciences of the Czech Republic Chaberská 57, 182 51 Praha 8 Czech Republic
UME	Ulusal Metroloji Enstitüsü Baris Mah. Dr. Zeki Acar Cad. No: 1 41470 Gebze - Kocaeli Turkey
USNO	U.S. Naval Observatory 3450 Massachusetts Ave., N.W. Washington, D.C. 20392-5420 USA
VMI	Laboratory of Time and Frequency (TFL) Vietnam Metrology Institute (VMI) No 8, Hoang Quoc Viet Rd, Cau Giay Dist., Hanoi Vietnam.
VNIIFTRI	All-Russian Scientific Research Institute for Physical Technical and Radiotechnical Measurements, Moscow Region 141570 Russian Federation
VSL	VSL Dutch Metrology Institute Postbus 654 2600 AR Delft The Netherlands

TIME DISSEMINATION SERVICES

AOS	AOS Computer Time Service: vega.cbk.poznan.pl (150.254.183.15) Synchronization: NTP V3 primary (Caesium clock), PC Pentium, RedHat Linux Service Area: Poland/Europe Access Policy: open access Contact: Jerzy Nawrocki (nawrocki@cbk.poznan.pl) Robert Diak (kondor@cbk.poznan.pl) Full list of time dissemination services is available on: http://www.eecis.udel.edu/~mills/ntp/
AUS	Network Time Service Computers connected to the Internet can be synchronized to UTC(AUS) using the NTP protocol. The NTP servers are referenced to UTC(AUS) either directly or via a GPS common view link. Please see http://www.measurement.gov.au/Services/Pages/TimeandFrequencyDisseminationService.aspx for information on access or contact time@measurement.gov.au Dial-up Computer Time Service Computers can also obtain time via a modem connection to our dial-up timeserver. For further information, please see our web pages as above.
BelGIM (1)	Internet Time Service: BelGIM operates one time server Stratum 1 using the “Network Time Protocol” (NTP). The server host name is: http://www.belgim.by (Stratum 1)
BEV	3 NTP servers are available; addresses: bevtime1.metrologie.at bevtime2.metrologie.at time.metrologie.at more information on http://www.metrologie.at Provides a time dissemination service via phone and modem to synchronize PC clocks. Uses the Time Distribution System from TUG. It has a baud rate of 1200 and everyone can use it with no cost. Access phone number is +43 (0) 1 211106381 The system will be updated periodically (DUT1, Leap Second…).
CENAM	CENAM operates a voice automatic system that provides the local time for four different time zones for Mexico; Southeast Time, Central Time, Pacific Time and Northwest Time as well the UTC(CNM). The access numbers are: +52 442 211 0505: Southeast Time +52 442 211 0506: Central Time +52 442 211 0507: Pacific Time +52 442 211 0508: Northwest Time +52 442 215 3902: UTC(CNM) Telephone Code CENAM provides a telephone code for setting time in computers. More information about this service please contact Eduardo De Carlos López at edlopez@cenam.mx

(1) Information based on the Annual Report 2014, not confirmed by the Laboratory.

	Network Time Protocol Operates two time server using the "Network Time Protocol", it is located at the Centro Nacional de Metrología, Querétaro, México. Further information at http://www.cenam.mx/hora_oficial/ Web-based time-of-day clock that displays local time for México time zones. Referenced to CENAM Internet Time Service. Available at http://www.cenam.mx/hora_oficial/
CENAMEP (1)	Network Time Server A Stratum 1 time server is used to synchronize computer networks of the government institutions and companies in the private sector using the NTP protocol. To access the Network time service, send an email to servicios@cenamep.org.pa Web Clock A web clock is used to display the time of day in real time. To access the Web Clock, enter the link http://horaexacta.cenamep.org.pa/ Voice Time Server An assembly of computers provides the local time. To access the voice time service, call the telephone numbers (507) 5173201, (507) 5173202 and (507) 5173203
DMDM	Internet Time Service (ITS) DMDM operates two Stratum 1 time servers using the “Network Time Protocol” (NTP v.4.), synchronized to UTC(DMDM). Access policy: restricted. DMDM also operates two Stratum 2 NTP servers: vreme1.dmdm.rs or vreme1.dmdm.gov.rs vreme2.dmdm.rs or vreme2.dmdm.gov.rs Access policy: free. More information on: http://www.dmdm.rs/en/GrupaZaVremeFrekfencijuIDistribucijuVremena.php#TacnoVreme Web-based time-of-day clock that displays local time for Serbia referenced to the DMDM ITS. Available at the web page: http://www.dmdm.rs/en/index.php
EIM	Internet Time Service EIM operates a time server using the “Network Time Protocol” (NTP). The address hercules.eim.gr is also accessible through IP address 83.212.233.6. This route is offered under a restricted access policy. The server uses the 10 MHz signal from our primary standard as reference and is synchronized to UTC(EIM).
GUM	Telephone Time Service providing the European time code by telephone modem for setting time in computers. Includes provision for compensation of propagation time delay. Access phone number : +48 22 654 88 72 Network Time Service Two NTP servers are available: tempus1.gum.gov.pl tempus2.gum.gov.pl with an open access policy. It provides synchronization to UTC(PL). Contact: timegum@gum.gov.pl

(1) Information based on the Annual Report 2014, not confirmed by the Laboratory.

HKO

Internet Clock Services
HKO operates time-of-day clocks that display Hong Kong Standard Time (=UTC(HKO) + 8 h)
Available as:

1. Web Clock (Flash): http://www.hko.gov.hk/gts/time/HKSTime.htm
2. Web Clock (HTML): http://www.hko.gov.hk/gts/time/clock_e.html
3. Palm Clock (Flash): http://pda.weather.gov.hk/clocke.htm
4. Palm Clock (HTML5): http://www.hko.gov.hk/m/clock.htm

Speaking Clock Service
HKO operates an automatic “Dial-a-weather System” that provides a voice announcement of Hong Kong Standard Time.
Access phone number: +852 1878200
(when connected, press “3”, “6”, “1” in sequence)

Network Time Service
HKO operates network time service using Network Time Protocol (NTP). Host names of the NTP servers: stdtime.gov.hk; time.hko.hk (for IPv6 users)
Further information at http://www.hko.gov.hk/nts/ntime.htm

IGNA (1)

GPS common-view data
GPS common-view data using CGGTTS format referred to UTC(IGNA) is available through our website at
http://www.ign.gob.ar/NuestrasActividades/Geodesia/ServicioInternacionalHora/TransferenciaDeTiempo

IMBH

Internet Time Service
Time information is accessible through Network Time Protocol (NTP)
We operate 2 NTP servers. One server is referenced to UTC(IMBH) - Stratum1 level and another is Stratum 2 server.
IP addresses for the mentioned servers are: 192.168.1.66 and 192.168.1.67.

INPL

Time dissemination service is performed in Israel by telecommunication companies, whose time and frequency standards are traceable to local UTC(INPL) time and are calibrated regularly once a year against the Israeli Time and Frequency National Standard kept by INPL.

INRIM

CTD Telephone Time Code
Time signals dissemination, according to the European Time code format, available via modem on regular dial-up connection.
Access phone numbers : 0039 011 3919 263 and 0039 011 3919 264.
Provides a synchronization to UTC(IT) for computer clocks without compensation for the propagation time.
Software for the synchronization of computer clocks is available on the INRIM home page (www.inrim.it).

Internet Time Service
INRIM operates two time servers using the "Network Time Protocol" (NTP); host names of the servers are ntp1.inrim.it and ntp2.inrim.it.
More information on this service can be found on the web pages:
www.inrim.it/ntp/index_i.shtml.

SRC (Segnale RAI Codificato) coded time signal broadcast 20 – 30 times per day by “Radio Uno” and “Radio Tre” FM radio stations of the national broadcasting company RAI.

Web-based time-of-day clock that displays UTC or local time for Italy (Central Europe Time), referenced to INRIM Internet Time Service. Provides a snapshot of time with any web browser. A continuous time display requires a web browser with Java plug-in installed. Service available at
www.inrim.it/ntp/webclock_i.shtml.

(1) Information based on the Annual Report 2014, not confirmed by the Laboratory.

IPQ (1)	GPS common-view data GPS common-view data using CGGTTS format referred to UTC(IPQ) are available through the IPQ's web site for the remote frequency calibration service.
JV	Network Time Protocol JV operates an open access stratum 1 server referenced to UTC(JV) ntp.justervesenet.no Other stratum 1 servers over a separate network are available by special agreement. Contact: hha@justervesenet.no
KIM (1)	Network Time Protocol (NTP) Service The NTP time information referenced to UTC(KIM) is generated by Stratum-1 NTP server at URL: ntp.kim.lipi.go.id or IP: 203.160.128.178 The server also provides time services using Daytime Protocol, and Time Protocol.
KRISS	Telephone Time Service Provides digital time code to synchronize computer clocks to Korea Standard Time (=UTC(KRIS) + 9 h) via modem. Access phone number: + 82 42 868 5116 Network Time Service KRISS operates three time servers using the NTP to synchronize computer clocks to Korea Standard Time via the Internet. Host name of the server: time.kriss.re.kr (210.98.16.100). Software for the synchronization of computer clocks is available at http://www.kriss.re.kr
KZ (1)	Network Time Service Stratum-1 time server using the "Network Time Protocol" (NTP). Restricted access and free access ip 89.218.41.170 Stratum-2 time server using the "Network Time Protocol" (NTP). Free access. Stratum-2 is available: ip 88.204.171.178 Web-based Time Services: A real-time clock aligned to UTC(KZ) and corrected for internet transmission delay. "Six-pip time signals" are broadcast by FM radio stations hourly every day.
LNE-SYRTE	LNE-SYRTE operates several time servers using the "Network Time Protocol" (NTP) : Stratum-1 time server: ntp-p1.obspm.fr (restricted access) Stratum-2 time server: ntp.obspm.fr (free access) Futher information at: http://syrte.obspm.fr/informatique/ntp_infos.php
LT	Network Time Service via NTP protocol NTP v3 DNS: laikas.pfi.lt Port 123 Synchronization from caesium clock (1 pps) System: Datum TymeServe 2100 NTP server Access policy: free Contact: Rimantas Miškinis Mail: Laikas@pfi.lt http://www.pfi.lt/metrology/

(1) Information based on the Annual Report 2014, not confirmed by the Laboratory.

MASM (1)

Network Time Protocol
MASM operates public NTP server referenced to UTC(MASM) in free access.Host name: ...time.icttime.mn/

More information at http://www.masm.gov.mn

METAS

Telephone Time Service
The coded time string (compliant to the European Time Code format) is referenced to UTC(CH) and generated by a TUG type time code generator.
Service discontinued in 2014

Internet Time Service
METAS operates stratum-1 public NTP servers in free access.
Host names:
ntp.metas.ch
metasntp11.admin.ch
metasntp12.admin.ch
metasntp13.admin.ch

More information available at http://www.metas.ch/metas/en/home/fabe/zeit-und-frequenz/time-dissemination.html

MIKES

MIKES provides an official stratum-1 level service to paying organizations and institutions. Stratum-2 level service is freely available to everyone and the servers providing the public service are synchronized to the stratum-1 level servers of MIKES.

Stratum-1 NTP servers (official service, synchronized to UTC(MIKE))

Ntp1.mikes.fi	194.100.49.131
ntp2.mikes.fi	194.100.49.132
ntp3.mikes.fi	194.100.49.133
ntp4.mikes.fi	194.100.49.134
ntp1.mikes.funet.fi	193.166.4.49
ntp2.mikes.funet.fi	193.166.4.50
ntp3.mikes.funet.fi	193.166.4.51
ntp4.mikes.funet.fi	193.166.4.52

Stratum-2 NTP servers (public service)

time.mikes.fi	194.100.49.139
time1.mikes.fi	194.100.49.151
time2.mikes.fi	194.100.49.152

Further information can be found at http://www.mikes.fi/ntp-palvelu/

MSL

Network Time Service
Computers connected to the Internet can be synchonized to UTC(MSL) using the NTP protocol. Access is available for users within New Zealand. Two servers are available at
msltime1.irl.cri.nz and msltime2.irl.cri.nz

Speaking Clock
A speaking clock gives New Zealand time. Because it is a pay service, access is restricted to callers within New Zealand.
Further information about these services can be found at
http://msl.irl.cri.nz/services/time-and-frequency

NAO

Network Time Service
Three stratum 2 NTP servers are available. The NTP servers internally refer stratum 1 NTP server that is linked to UTC(NAO).
One of the three stratum 2 NTP servers are selected automatically by a round-robin DNS server to reply for an NTP access.
The server host name is s2csntp.miz.nao.ac.jp.

(1) Information based on the Annual Report 2014, not confirmed by the Laboratory

NICT	Telephone Time Service (TTS) NICT provides digital time code accessible by computer at 300/1200/2400 bps, 8 bits, no parity. Access number to the lines: + 81 42 327 7592. Network Time Service (NTS) NICT operates four Stratum 1 NTP time servers linked to UTC(NICT) through the Internet. Internet Time Service (ITS) NICT operates four Stratum 1 NTP time servers linked to UTC(NICT) through the Internet. Host name of the servers: ntp.nict.jp (Round robin). GPS common view data NICT provides the GPS common view data based on UTC(NICT) to the time business service in Japan.
NIM	Telephone Time Service The coded time information generated by NIM time code generator, referenced to UTC(NIM). Telephone Code provides digital time code at 1200 to 9600 bauds, 8 bits, no parity, 1 stop bit. Access phone number: 8610 6422 9086. Network Time Service Provides digital time code across the Internet using NTP. Further information at: http://en.nim.ac.cn/page/976
NIMB	1 NTP server is available: Address: ntp.inm.ro (STRATUM 1) with an open access policy Server is referenced to UTC(NIMB).
NIMT	Internet Time Service NIMT operates 3 NTP servers at: time1.nimt.or.th time2.nimt.or.th time3.nimt.or.th The NTP servers are referenced to UTC(NIMT) Telephone Time Service The time code is generated and disseminated through the telephone lines. Computers and displayed clocks are able to access UTC(NIMT) by dialling +66 (0) 2 551 0332. FM/RDS Radio Transmission The time code is applied to the sub-carrier frequency of 57 kHz using the Radio Data System protocol. The accuracy of time transmission is around 1 s of UTC(NIMT). The time code is broadcast via 40 radio stations across the country.
NIST	Automated Computer Time Service (ACTS) Provides digital time code by telephone modem for setting time in computers. Free software and source code available for download from NIST. Includes provision for calibration of telephone time delay. Access phone numbers : +1 303 494 4774 (12 phone lines) and +1 808 335 4721 (2 phone lines). Further information at http://www.nist.gov/pml/div688/grp40/acts.cfm Internet Time Service (ITS) Provides digital time code across the Internet using three different protocols: Network Time Protocol (NTP), Daytime Protocol, and Time Protocol. (Time Protocol is not supported by all servers)

Geographically distributed set of multiple time servers at multiple locations within the United States of America. For most current listing of time servers and locations, see: http://tf.nist.gov/tf-cgi/servers.cgi
Free software and source code available for download from NIST. Further information at http://www.nist.gov/pml/div688/grp40/its.cfm

Telephone voice announcement: Audio portions of radio broadcasts from time and frequency stations WWV and WWVH can be heard by telephone: +1 303 499 7111 for WWV and +1 808 335 4363 for WWVH

NMIJ	GPS common-view data GPS common-view data using CGGTTS format referred to UTC(NMIJ) are available through the NMIJ's web site for the remote frequency calibration service.
NMISA	Network Time Service One open access NTP server is available at address time.nmisa.org. More information is available at http://time.nmisa.org/
NMLS	Web-based time-of-day clock A web clock is used to display the local time for Malaysia. The service is available at http://mst.sirim.my Network Time Service The NTP time information is referenced to UTC(NMLS) and is currently generated by Stratum-1 NTP servers, made available for public freely. The NTP server host names are ntp1.sirim.my and ntp2.sirim.my.
NPL	Telephone Time Service A TUG time code generator provides the European Telephone Time Code, referenced to UTC(NPL), by telephone modem. Software for synchronising computers is available from the NPL web site at www.npl.co.uk/time. The service telephone number is 0906 851 6333 until June 2015 (this is a premium rate number and can only be accessed from within the UK), then will be replaced by 020 8943 6333. Internet Time Service Two servers referenced to UTC(NPL) provide Network Time Protocol (NTP) time code across the internet. More information is available from the NPL web site at www.npl.co.uk/time. The server host names are: ntp1.npl.co.uk ntp2.npl.co.uk
NPLI	Telephone Time Service The coded time information generated by time code generator of NPLI, referenced to UTC(NPLI). Telephone Code provides digital time code (for the current time of Indian standard Time) at 1200 bauds, 8 bits, no parity, 1 stop bit. This service is known as TELECLOCK Service. Accessible by : a. an NPLI-developed Teleclock Receiver already available in the market. b. a Computer through Telephone Modem and NPLI-developed software.

NRC	Telephone Code Provides digital time code by telephone modem for setting time in computers. Access phone number: +1 613 745 3900. http://www.nrc-cnrc.gc.ca/eng/services/time/time_date.html Talking Clock Service Voice announcements of Eastern Time are at ten-second intervals followed by a tone to indicate the exact time. The service is available to the public in English at +1 613 745 1576 and in French at +1 613 745 9426. For more information see: http://www.nrc-cnrc.gc.ca/eng/services/time/talking_clock.html Web Clock Service The Web Clock shows dynamic clocks in each Canadian Time zone, for both Standard time and daylight saving time. The web page is at: http://www.nrc-cnrc.gc.ca/eng/services/time/web_clock.html. Short Wave Radio CHU radio station broadcasts the time of day with voice announcements in English and French and time code at three different frequencies: 3.330 MHz, 7.850 MHz and 14.670 MHz. Further information at: http://www.nrc-cnrc.gc.ca/eng/services/time/short_wave.html Network Time Protocol Operates multiple time servers using the " Network Time Protocol " at different locations and on two networks. Host names: time.nrc.ca and time.chu.nrc.ca. Further information at: http://www.nrc-cnrc.gc.ca/eng/services/time/network_time.html The official website for the Frequency and Time group is: http://www.nrc-cnrc.gc.ca/eng/services/time/index.html The contact email is: MSS-SMETime@nrc-cnrc.gc.ca
NSC IM	Network Time Service. National Science Center Institute of Metrology (Kharkiv, Ukraine) operates one time server Stratum 1 using the “Network Time Protocol” (NTP). The server host name is: http://www.metrology.kharkov.ua/
NTSC	Network Time Service (NTS) NTSC operates a time server directly referenced to UTC(NTSC) + 8 h. Software for the synchronization of computer clocks is available on the NTSC Time and Frequency web page: http://time.ntsc.ac.cn Access Policy: free Contact: Shaowu DONG (sdong@ntsc.ac.cn).
ONBA	Speaking clock access phone number 113 (only accessible in Argentina). Hourly and half hourly radio-broadcast time signal. Internet time service at web site http://www.hidro.gov.ar/observatorio/lahora.asp

ONRJ

Telephone Voice Announcer (55) 21 25806037.
Telephone Code (55) 21 25800677 provides digital time code at 300 bauds, 8 bits, no parity, 1 stop bit (Leitch CSD5300)

Internet Time Service at the address : 200.20.186.75 and 200.20.186.94
SNTP at port 123
Time/UDP at port 37
Time/TCP at port 37
Daytime/TCP at port 13

WEB-based Time Services:
1) A real-time clock aligned to UTC(ONRJ) and corrected for internet transmission delay.
Further information at: http://200.20.186.71/asp/relogio/horainicial.asp
2) Voice Announcer, in Portuguese, each ten seconds, after download of the Web page at: http://200.20.186.71.

Broadcast Brazilian legal time (UTC – 3 hours) announced by a voice starting with "Observatório Nacional" followed by the current time (hh:mm:ss) each ten seconds with a beep for each second with a 1KHz modulation during 5ms and a long beep with 1KHz modulation during 200ms at the 58 , 59 and 00 seconds. The signal is transmitted every day of the year by the radio station PPE, whose signal is at 10 MHz with kind of modulation A3H and HF transmission power of 1 kW.

ORB

Network Time Service via NTP protocol
Hostname : ntp1.oma.be and ntp2.oma.be
Access policy : free
Synchronization to UTC(ORB)
Contact : f.roosbeek@oma.be
Information on the web pages
http://www.astro.oma.be/en/scientific-research/reference-systems-and-planetology/time-lab/

ORB provides a time dissemination via phone and modem to synchronize PC clocks on UTC(ORB). The system used is the Time Distribution System from TUG, which produces the telephone time code mostly used in Europe.
The baud rate used is 1200. The access phone number is 32 (0) 2 373 03 20. The system is updated periodically with DUT1 and leap seconds

PTB

Telephone Time Service
The coded time information is referenced to UTC(PTB) and generated by a TUG type time code generator using an ASCII-character code.
The time protocols are sent in a common format, the "European Telephone Time Code". Access phone number : +49 531 51 20 38 .

Internet Time Service
The PTB operates three time servers using the " Network Time Protocol " (NTP), see http://www.ptb.de/cms/en/ptb/fachabteilungen/abtq/fb-q4/ag-q42.html for details and explanations.

Host names of the servers:
ptbtime1.ptb.de
ptbtime2.ptb.de
ptbtime3.ptb.de

ROA

Telephone Code
The coded time information is referenced to UTC(ROA) and generated by a TUG type time code generator using an ASCII-character code. The time protocols are sent in a common format, the "European Telephone Time Code". Access phone number : +34 956 599 429

Network Time Protocol
Server : hora.roa.es
Synchonized to UTC(ROA) better than 10 microseconds
Service policy : free

Server : minuto.roa.es
Synchonized to UTC(ROA) better than 10 microseconds
Service policy : free

SG

Website: http://www.a-star.edu.sg/nmc/metrology-TFM-td.htm.

Network Time Service (NeTS)
Transmit digital time code via the Internet using three protocols - Time Protocol, Daytime Protocol and Network Time Protocol.
Operate one time server at name: nets.org.sg

Automated Computer Time Service (ACTS)
Transmit digital time code (NIST format) via telephone modem for setting time in computers. The coded time information is referenced to UTC(SG). Include provision for correcting telephone time delay.
Access phone number: +65 67799978.

SIQ

Internet Time Service (Network Time Protocol)
One server referenced to UTC(SIQ) provides Network Time Protocol (NTP) time code across the internet.
There is a free access to the server for all users.
The server host names are: ntp.siq.si or time.siq.si
(two URL's for the same server; IP: 194.249.234.70)

SP

Telephone Time Service
The coded time information is referenced to UTC(SP) and generated by two TUG type time code generators using an ASCII-character code.
The time protocols are sent in a common format, the "European Telephone Time Code".
Access phone number: +46 33 41 57 83

Internet Time Service
The coded time information is referenced to UTC(SP) and generated by several NTP servers using the Network Time Protocol (NTP) for both IPv4 and IPv6.
Access host names: ntp1.sptime.se, ntp2.sptime.se, ntp3.sptime.se and ntp4.sptime.se

Speaking Clock
The speaking clock service is operated by Telia AB in Sweden.
The time announcement is referenced to UTC(SP) and disseminated from a computer based system operated and maintained at SP.
Access phone number : 90510 (only accessible in Sweden).
Access phone number : +4633 90510 (from outside Sweden).

More information about these services are found on the web site www.sp.se

TL	Speaking Clock Service Traceable to UTC(TL). Broadcast through PSTN (Public Switching Telephone Network) automatically and provides an accurate voice time signal to public users. Local access phone number: 117. The Computer Time Service Provides ASCII time code by telephone modem for setting time in computers. Access phone number: +886 3 4245117. NTP Service TL operates the network time service using the "Network Time Protocol" (NTP). Host name of the server: time.stdtime.gov.tw, further information in http://www.stdtime.gov.tw/english/e-home.aspx
TP	Internet Time Service UFE operates time servers directly referenced to UTC(TP). Time information is accessible through Network Time Protocol (NTP). Server host name: ntp2.ufe.cz More information at http://www.ufe.cz/
UME	Telephone Time Service Providing the European time code that is referenced to UTC(UME) by telephone modem for setting computer time. Includes compensation of propagation time delay. More information for this service please contact:ume.zamanfrekans@tubitak.gov.tr. Access phone number: +90 262 679 50 24 Network Time Service UME operates an NTP server referenced to UTC(UME). Server Host Name: time.ume.tubitak.gov.tr
USNO (1)	Telephone Voice Announcer +1 202 762-1401 Backup voice announcer: +1 719 567-6742 Telephone Code +1 202 762-1594 provides digital time code at 1200 baud, 8 bits, no parity GPS via subframe 4 page 18 of the GPS broadcast navigation message Web site for time and for data files: http://tycho.usno.navy.mil/ Network Time Protocol (NTP) see http://www.usno.navy.mil/USNO/time/ntp for software and site closest to you.
VMI	Network Time Service VMI operates one time server Stratum 1 using the Network Time Protocol (NTP). For information on access to the website, please contact phuongtv@vmi.gov.vn. The server host name is: http://standardtime.vmi.gov.vn/ or IP: 113.160.59.166 port 123

(1) Information based on the Annual Report 2014, not confirmed by the Laboratory

VNIIFTRI

Internet Time Service
VNIIFTRI operates eight time servers Stratum 1 and one time server Stratum 2 using the “Network Time Protocol” (NTP).

The server host names are:
ntp1.vniiftri.ru (Stratum 1)
ntp2.vniiftri.ru (Stratum 1)
ntp3.vniiftri.ru (Stratum 1)
ntp4.vniiftri.ru (Stratum 1)
ntp1. niiftri.irkutsk.ru (Stratum 1)
ntp2. niiftri.irkutsk.ru (Stratum 1)
vniiftri.khv.ru (Stratum 1)
vniiftri2.khv.ru (Stratum 1)
ntp21.vniiftri.ru (Stratum 2).

VSL

Internet Time Service
VSL operates a time server directly referenced to UTC(VSL).
Time information is accessible through Network Time Protocol (NTP).
The URL for the NTP server is: ntp.vsl.nl