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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 2014 to 31 December 2014)

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

(E.F. Arias, A. Harmegnies, Z. Jiang, H. Konaté, W. Lewandowski[1], 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 2013*, volume 8, provides the definitive results for 2013 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[2])

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.

The revision of the algorithm was completed at the start of 2014 with the official introduction of the new clock weighting algorithm in UTC. The new procedure is based on the concept of clock frequency predictability. The weight assigned to a clock reflects its predictability rather than its stability, as was the case in the previous procedure. The result is a more balanced distribution of weights between caesium clocks and hydrogen masers and enhances the influence of the hydrogen masers in the ensemble. An improvement in the short- and long-term stability of EAL is foreseen by applying the new weighting algorithm.

Work started on updating the method to evaluate the uncertainties of [*UTC-UTC*(*k*)] reported in Section 1 of *Circular T*. The current algorithm provides underestimated values for the pivot laboratory (currently PTB) which does not correspond to real physical values. This is due to the fact that some correlations are not taken into account.

2.1 EAL stability

Some 88 % of the clocks used in the calculation of time scales are either commercial atomic clocks with high performance caesium tubes or active hydrogen masers. A weighting procedure was developed to guarantee the long-term stability of EAL. To prevent domination of the scale by a small number of very stable clocks, a maximum relative weight is used each month which depends on the number of participating clocks. On average, about 10 % of the participating clocks were at the maximum weight during 2014; almost all of these were hydrogen masers. The total weight of hydrogen masers and caesium clocks is about 50 % while the number of these clocks in the ensemble is significantly different, about 300 caesium clocks and 100 hydrogen masers. This means that the time scale implicitly relies on the hydrogen masers in the short term and on caesium clocks in the

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

long term, which was an aim of the new weighting procedure. Both the short- and long-term stability of EAL are expected to improve by 20 %. The stability of EAL at the end of 2014, expressed in terms of an Allan deviation, is about three parts in 10^{16} for averaging times of one month. A long-interval estimation of the frequency stability of EAL after the introduction of the new weighting procedure indicates that it will decrease by up to 1.8 parts in 10^{16} over the next few years.

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 2014, individual measurements of the TAI frequency have been provided by twelve primary frequency standards, including ten caesium fountains (LNE-SYRTE FO1, LNE-SYRTE FO2, NIST F1, NIST F2, IT CSF2, SU CSFO, NPL CSF2, PTB CSF1 and PTB CSF2), and by a rubidium secondary frequency standard (LNE-SYRTE FO2Rb). Reports on 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 2014, 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 $+0.70 \times 10^{-15}$ to -0.99×10^{-15}, with a maximum standard uncertainty of 0.28×10^{-15}. No steering corrections have been applied since October 2012, demonstrating the positive impact of the new algorithms 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), known as TT(BIPM13), valid until December 2013, 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(BIPM13) based on the most recent TAI computation. Such an extension is useful for pulsar analysis pending on 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 is under way with the VNIIFTRI, Russian Federation, and the GLONASS authorities on the absolute calibration of a BIPM receiver and the receiver at the AOS, Poland, that provides data for the offset evaluation.

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. In 2014, the WGPSFS reviewed four new Cs fountains that had been submitted by four different laboratories.

The WGFS maintains a list of recommended values of standard frequencies for applications including secondary representations of the second. The latest changes to the list, as recommended by the CCTF in September 2012 as secondary representations of the second have been endorsed by the CIPM in Recommendation 1(CI-2013). Work is under way to prepare the elements necessary for the revision of the list of recommended frequencies at the WGFS meeting in September 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 (FO2Rb). Ten measurement reports of FO2Rb were submitted in 2014 and have been officially used for the accuracy of TAI. For the first time, FO2Rb measurements were used for the computation of TT(BIPM13) in January 2014.

4. **Time links used for UTC** (E.F. Arias, A. Harmegnies, Z. Jiang, H. Konaté, W. Lewandowski, G. Panfilo, G. Petit, L. Tisserand, A. Kanj[3] and W. Wenjun[4])

At the end of 2014, 73 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 are possible using C/A code measurements from GPS single-frequency receivers, or dual-frequency, multi-channel GPS geodetic-type receivers (P3). The older GPS single-channel single-frequency receivers are almost obsolete, having been replaced by either multi-channel single- or dual-frequency receivers.

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*.

Fifteen TWSTFT links are officially submitted for use in the computation of UTC, representing 19 % of the time links. The combination of TWSTFT and PPP (so called TWPPP) is used whenever possible. This generally concerns about a dozen links for which the two techniques are available. This combination takes advantage of the small noise of the GPSPPP and of the accuracy of the TWSTFT links.

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 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 *Observatoire Royal de Belgique* (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 long term (days).

[3] Post-doctoral research under a two-year BIPM-CNES contract starting on 1 January 2013
[4] Chinese Academy of Sciences, NTSC (Xi'an, China), on a one-year secondment starting 3 June 2014

GPS PPP alone or in combination with TWSTFT are in use for UTC clock comparisons in 55 % of the links, where the statistical uncertainty of time transfer is well below the nanosecond, the best value is 0.3 ns for 46 % of the time 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.

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

All GNSS time and frequency transfer data are corrected for satellite positions using IGS and European Space Agency (ESA) precise satellite ephemerides. The measurement data obtained by using single-frequency receivers are corrected for ionospheric delays using IGS maps of the total electron content of the ionosphere.

4.2 Phase and code measurements from geodetic-type receivers

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 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.

4.3. Two-way time transfer

Two meetings of the TWSTFT participating stations were held during 2014. The 22nd annual meeting of the CCTF WG on TWSTFT was held at the VNIIFTRI, Mendeleevo, Russian Federation, on 16-17 September 2014. The outcomes of these meetings that will have an impact on the Time Department's activities are: 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, and the recommendation to elaborate a document with the calibration guidelines for TWSTFT links. The BIPM has been invited to lead the group that is preparing the guidelines.

The TWSTFT technique is currently operational in twelve European, two North American and nine Asia-Pacific time laboratories. Fifteen TWSTFT links are routinely used in the computation of UTC; they are combined with GPS PPP solutions. The TWSTFT technique applied to clock comparisons in UTC is at its maximum potential with sessions scheduled every two hours.

Some of the TWSTFT links involved in the computation of UTC are used for particular experiments such as the Time Transfer by Laser Link (T2L2). The BIPM is interested in developing studies on this technique which could be used to validate less accurate time links and their calibrations.

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 the stability of the TWSTFT links in case of a loss of their direct calibration.

Campaigns with a travelling calibration station that were organized and funded by the participating laboratories in 2014, resulted in the calibration of seven TW UTC links. 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://tai.bipm.org/TimeLink/LkC).

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

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. As part of the process of maintaining UTC, the BIPM organizes and runs campaigns to measure the relative delays of GPS time equipment in participating time laboratories.

The method previously developed by the Time Department to perform absolute calibration of the Ashtech Z12-T hardware delays allows the use of this receiver in differential calibrations of the same type of receivers world-wide; calibration campaigns have continued since January 2001 and have been expanded to include other types of receivers (Septentrio PolaRx2-3-4, Dicom GTR50 and GTR51, Javad JPS E-GGD, PikTime TTS3 and TTS4). New types of receivers are being investigated in collaboration with the laboratories that use the equipment. In all cases, at least two receivers remain at the BIPM to serve as a local reference to which the travelling receivers are compared between calibration trips. 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.

Based on a successful pilot experiment run by the Time Department in 2012-2013, a time transfer system consisting of two or three GNSS receivers, antennas and auxiliary equipment has been developed, together with a calibration procedure, with the aim of performing GPS time link calibrations that can be transferred to any other technique on the same baseline. The system and procedures have been validated, and the process, named METODE (MEasurement of TOtal DElay), has been used regularly in 2014 for direct calibration of GPS links, and for transferring the calibration to links between Asia and Europe.

Following a recommendation by the CCTF, the Time Department has issued the '*BIPM Guidelines for GNSS equipment calibration in UTC contributing laboratories*'. This document is intended for Regional Metrology Organizations (RMOs) and aims to establish a permanent cooperation for sharing the organization of campaigns to determine the relative delays of time transfer equipment in UTC contributing laboratories. The *Guidelines* are being continuously improved and this led to a revised edition of the *Guidelines* being produced in 2014 and the elaboration of standard processing and reporting procedures. Global processing of all measurements using METODE was carried out in 2013 and 2014, completing the measurement campaign being conducted by selected laboratories in APMP and EURAMET. Measurements are continuing in COOMET and SIM, and after the end of the BIPM campaign, regional calibration trips will be implemented in accordance with the *BIPM Guidelines*. By 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 validating the calibration reports and implementing 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 4.3).

The CCTF WG on TWSTFT decided, in September 2014, to establish guidelines for TWSTFT link calibration, and appointed a task group to prepare a draft document, under the leadership of the Department. The first draft of the guidelines has been completed and is being revised before final approval by the WG.

4.5 Advanced time and frequency transfer

One of the Time Department's innovative activities in this field is related to the establishment of optical fibre links between certain laboratories which maintain local representations of UTC. A successful experiment was conducted using the BIPM GPS equipment in parallel with the optical fibre link regularly operated between two institutes that represent UTC in Poland. This experiment demonstrated excellent agreement (at the level of the GPS PPP uncertainty) between the GPS PPP link calculated with the BIPM equipment and the optical fibre link. The optical fibre link can be used to assess the calibration of a UTC link calculated with the current time transfer techniques as a result of the small (hundred picoseconds) and stable calibration uncertainty. This experiment enabled the validation of the new BIPM calibration system with u_B within 1 ns. It also allowed validation of the results of the newly developed IPPP processing technique. Several other fibre links between contributing laboratories are calculated on a regular basis and are anticipated to achieve a potential measurement uncertainty of about 100 ps in the future. In order to benefit from the quality of these links, the Time Department has initiated discussions with the laboratories that already implement time transfer via optical fibres with the aim of establishing standards for data transmission and to validate the compatibility of the different techniques.

In parallel, the Time Department continued its activities in the framework of the CCTF WG on Coordination of the Development of Advanced Time and Frequency Transfer Techniques (WGATFT), and followed the progress in the NMIs and other institutes in this field of activity.

5. **Key comparisons** (E.F. Arias, H. Konaté, Z. Jiang, W. Lewandowski, G. Panfilo, G. Petit, L. Tisserand, 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, are published monthly as BIPM *Circular T*.

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 2014, dialogue with the participants helped towards 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 44 laboratories 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 consistently better than ±3 ns peak to peak with the values published monthly in BIPM *Circular T*.

The results (ftp://62.161.69.5/pub/tai/publication/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.

BIPM delegates have had a critical role during this process at the International Telecommunication Union (ITU), and also in disseminating information and promoting decision making at the level of national representatives. In 2014 the work has focused on the preparation of the relevant documents for the World Radiocommunication Conference to be held in Geneva, Switzerland, from 2-27 November 2015 (WRC15), where a decision is to be taken on the redefinition of UTC without leap second adjustments.

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; the target is to report on the features of the next realization of the International Celestial Reference Frame (ICRF3) to the IAU General Assembly in 2015 and to provide 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. Jiang Z., Total Delay and Total Uncertainty in UTC Time Link Calibration, *Proc. 45th PTTI Meeting,* 2014, 112-125.
2. Jiang Z., Lewandowski W., Evolution of the Uncertainty of [*UTC-UTC(k)*], *Proc. 45th PTTI Meeting,* 2014, 208-216.
3. Jiang Z., Accurate time link calibration for UTC time transfer - Status of the BIPM pilot study on the UTC time link calibration, *Proc. 28th European Frequency and Time Forum*, 2014.
4. Jiang Z., Tisserand L., Stability of the BIPM GNSS travelling calibrator, *Proc. 28th European Frequency and Time Forum*, 2014.
5. Jiang Z., Czubla A., Nawrocki J., Nogaś P., (2014) Calibration comparison between optical fiber and GPS time links, *Proc. ION/PTTI2014*.
6. Jiang Z., Lewandowski W., An Approach to the Uncertainty Estimation of [UTC-UTC(*k*)], *Proc. ION/PTTI2014*.
7. Konaté H., Arias E.F., The BIPM Time Department Database, *Proc. 45th PTTI Meeting,* 2014, 1-13.
8. Panfilo G., Harmegnies A., Tisserand L., A new weighting procedure for UTC, *Metrologia*, 2014, **51**, 285-292.
9. Petit G., Arias E.F., Harmegnies A., Panfilo G., Tisserand L., UTCr: a rapid realization of UTC, *Metrologia*, 2014, **51**, 33-39.
10. Petit G., A timescale based on the world's fountain clocks, *Proc. PTTI meeting*, Bellevue, WA, December 2013.
11. Petit G., Kanj A., Harmegnies A., *et al*., GPS frequency transfer with IPPP, *Proc. 28th European Frequency and Time Forum*, 2014, 451-454,.
12. Petit G., Wolf P., Delva P., Atomic time, clocks and clock comparisons in relativistic space-time: a review, in *Frontiers of Relativistic Celestial Mechanics*, Volume 2, *Applications and Experiments*, Sergei M. Kopeikin Ed., De Gruyter, 2014, 266pp.

BIPM publications

13. *BIPM Annual Report on Time Activities for 2013*, 8, 121 pp., available only at http://www.bipm.org/en/publications/time_activities.html.
14. *Circular T* (monthly), 8 pp.
15. *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).

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 is vice-president of Commission 31 (Time) and co-chaired the working group on the redefinition of UTC. 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 (conferences, lectures and presentations, visits)

E.F. Arias to:

- Delft (The Netherlands), 17-18 March 2014, for a meeting of the EURAMET Time and Frequency Technical Committee;
- Paris (France), 9 April 2014, for a discussion on the IERS Conventions;
- Geneva (Switzerland), 6-14 May 2014, for the meeting of the ITU-R WP7A;
- Neuchâtel (Switzerland), 23-26 June 2014, to the 28th European Frequency and Time Forum and for the meetings of CCTF Working Groups;
- Neuchâtel (Switzerland), 27 June 2014, to the Workshop “frequency standards with trapped ions”;
- Beijing (China), 18-23 August 2014, for the URSI General Assembly, and as convener of a session on UTC;
- Hendaye (France), 17 September 2014, to give a training course on Time Scales at the Chateau d’Abbadia (expenses paid by the Chateau d’Abbadia Foundation);
- Geneva (Switzerland), 30 September to 7 October 2014, for the meeting of the Working Party 7A at the ITU;
- Luxembourg, 14 October 2014, to the meeting of the IAU Working Group on the ICRF3;
- Boston (USA), 1-5 December 2014, for the 46th PTTI Meeting, as convener of a session and for the meeting of TW participating stations.

Z. Jiang to:

- Nanjing and Beijing (China), 21-28 May 2014, for the China Satellite Navigation Conference, organizing a session, for the Interoperability Workshop, for a meeting with BeiDou time experts;
- Neuchâtel (Switzerland) to the 28th European Frequency and Time Forum (giving presentations) and for the meetings of CCTF Working Groups,;
- Mendeleevo (Russian Federation), 15-16 September 2014, for the 22nd Meeting of the CCTF Working Group on TWSTFT;
- Boston (USA), 1-5 December 2014, for the 46th PTTI Meeting (giving presentations) and for the meeting of TW participating stations.

A Kanj to:

- Neuchâtel (Switzerland), 23-26 June 2014, to the 28th European Frequency and Time Forum and for the meetings of CCTF Working Groups (expenses paid by the CNES);
- Boston (USA), 1-5 December 2014 for the 46th PTTI Meeting and for the meeting of TW participating stations.

W. Lewandowski to:

- Krakow (Poland), 6-7 February 2014, for the “Industrial policy of the European Union. The Economic Weimar Triangle”;
- Geneva (Switzerland), 6-14 May 2014, for the meeting of the ITU-R WP7A;
- Namur (Belgium), 19-20 May 2014, for the meeting of the ESA Programme Board on Satellite Navigation (PB-NAV);
- Nanjing and Beijing (China), 21-28 May 2014, for the China Satellite Navigation Conference, for the Interoperability Workshop, and for a meeting with BeiDou time experts.

G. Petit to:

- Toulouse (France), 16 January 2014, to visit the CNES time laboratory and for a Workshop “Precise positioning Using Carrier Phase Measurements” ;
- Paris (France), 9 April 2014, for a discussion on the IERS Conventions;
- Vienna (Austria), 27 April 2014, to participate in the IERS Directing Board;
- Paris (France), 13 June 2014, to participate in a PhD jury;
- Neuchâtel (Switzerland) 23-27 June 2014, to attend the EFTF 2014 meeting, to give an oral presentation, a CCTF WG meeting and a CCL-CCTF WG meeting;
- Besançon (France), 1-2 July 2014, to give two lectures at the European Frequency and Time Seminar;
- Luxembourg, 13-14 October 2014, to attend the REFAG 2014 workshop;
- Paris (France), 23 October 2014, to attend a CNES workshop on GRASP;
- Prague (Czech Republic), 12-14 November 2014, for the ninth meeting the International Committee on GNSS (ICG), with presentations.

G. Panfilo to:

- Rome (Italy), 8 October 2014, invited to give a presentation on the BIPM Time Department activities at the Sapienza – Università di Roma, Rome.

L. Robertsson to:

- Toulouse (France), 12 February 2014, for the “Journée peignes de fréquence optique”;
- Neuchâtel (Switzerland), 23-26 June 2014, to the 28th European Frequency and Time Forum and for the meeting of four CCTF Working Groups;

- Neuchâtel (Switzerland), 27 June 2014, to the Workshop “frequency standards with trapped ions”.

W. Wenjun to:

- Neuchâtel (Switzerland), 23-26 June 2014, to the 28th European Frequency and Time Forum (to give presentations) and for the meeting of four CCTF Working Groups (expenses paid by the Chinese Academy of Sciences);
- Mendeleevo (Russian Federation), 15-16 September 2014, for the 22nd Meeting of the CCTF Working Group on TWSTFT (expenses paid by the Chinese Academy of Sciences).

15. Visitors, secondees

- A. Kanj as a post-doctoral researcher under a BIPM-CNES contract for the optimization of GNSS time transfer, 1-15 February and 1 August - 31 December 2014;
- J. Faller (JILA, USA) for a BIPM seminar and discussions on gravity measurements associated with BIPM activities, 20 March 2014;
- P. Fisk (NMIA, Australia) for discussions on the activities of the CCTF WG on TAI, 28 March 2014;
- S. Junqueira (ONRJ, Brazil) and a team from the Observatory for discussions on time transfer at ONRJ, 23 April 2014;
- W. Wu (NICT, Chinese Academy of Sciences) on a one-year secondment starting on 3 June 2014, for activities on time transfer and calibration;
- A. Bauch (PTB, Germany) for discussions on time transfer and calibrations, 12 June 2014;
- C. Lin (TL, Chinese Taipei) for a discussion on GNSS calibrations, 1 July 2014;
- G. Garcia (INMETRO, Brazil) for discussions on the Brazilian contribution to UTC, 26 September 2014;
- F. Parisi from the University of Torino (Italy) to study an independent time scale based on the Kalman Filter, 1 November 2014 – 6 February 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, starting January 2005.
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
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 relevant notes	UTC - lab
[*UTC*(*lab1*) - *UTC*(*lab2*)] obtained by the TWSTFT link	lab1 - lab2.tw
Schedules for common-view observations of GPS (until April 2014)	schgps.XX

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 Product Centre
Dr Daniel GAMBIS
Observatoire de Paris
61, avenue de l'Observatoire
75014 Paris, France

Telephone: + 33 1 40 51 22 26
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 400 atomic clocks kept 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.

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*.

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 introduced 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.

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 Section 6 of BIPM *Circular T* for the techniques and methods of time transfer officially used.

The uncertainty of [$UTC(k_1)$ - $UTC(k_2)$], obtained at the BIPM with these procedures is given in *Circular T*, section 6.
BIPM *Circular T* includes an evaluation of [*UTC - GPS time*] based on GPS data provided by Paris Observatory (LNE-SYRTE), and also an evaluation of [*UTC - GLONASS time*] based on ongoing observations of the GLONASS system at the Astrogeodynamical Observatory (AOS), Poland.

The BIPM also 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.

5. Time scales established in retrospect

For the most demanding applications, such as millisecond pulsar timing, the BIPM issues atomic time scales in retrospect. 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 2014.

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 2014 is extracted from the *Director's Report on the Activity and Management of the BIPM (1 January − 31 December 2014)*. All the publications mentioned in this report are available on request from the BIPM.

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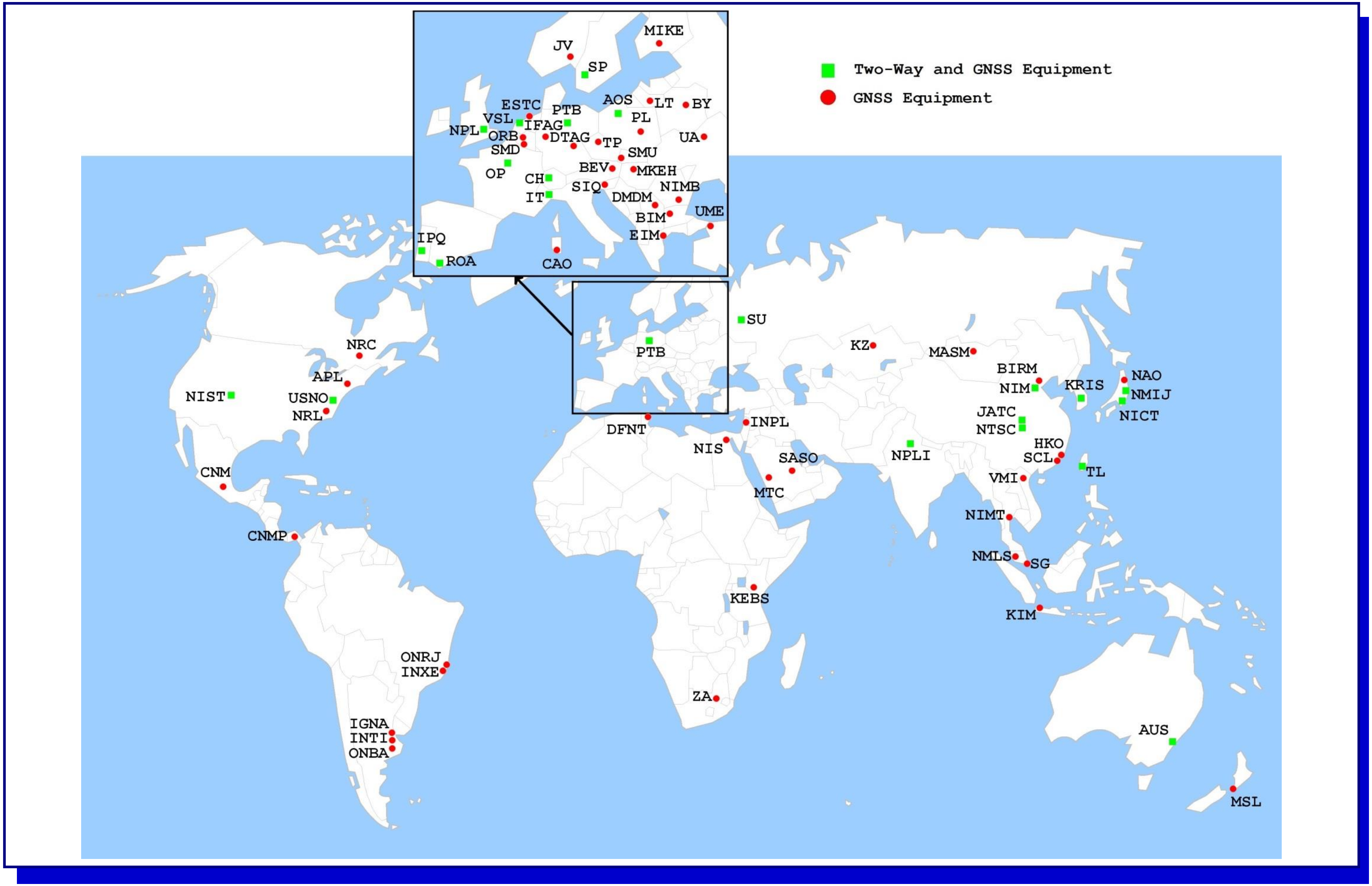

Geographical distribution of the laboratories that contribute to TAI and time transfer equipment (April 2015)

Table 1. Relative frequency offsets and step adjustments of UTC, up to 31 December 2015

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 2015

Limits of validity (at 0 h UTC)	[*TAI* - *UTC*] / s
1961 Jan. 1 - 1961 Aug. 1	1.422 8180 + (MJD - 37300) x 0.001 296
1961 Aug. 1 - 1962 Jan. 1	1.372 8180 + " "
1962 Jan. 1 - 1963 Nov. 1	1.845 8580 + (MJD - 37665) x 0.001 1232
1963 Nov. 1 - 1964 Jan. 1	1.945 8580 + " "
1964 Jan. 1 - 1964 Apr. 1	3.240 1300 + (MJD - 38761) x 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) x 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
DLR	Deutsche Zentrum für Luft- und Raumfahrt (German Aerospace Centre) Oberpfaffenhofen, Germany
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
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
IPQ	Instituto Português da Qualidade, Monte de Caparica, Portugal
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 (KasInMetr), Astana, Kazakhstan
LT	Center for Physical Sciences and Technology (VMT/FTMC), Vilnius, Lithuania
MIKE(1)	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
NIM	National Institute of Metrology, Beijing, P.R. China

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.)

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, Russia
TCC(2)	TIGO Concepción Chile, Chile
TL	Telecommunication Laboratories, Chung-Li, Taiwan
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, Vietnam
VSL	VSL, Dutch Metrology Institute, Delft, the Netherlands
ZA	National Metrology Institute of South Africa (NMISA), Pretoria, South Africa

(1) From 1 January 2015. Formerly, Center for Metrology and Accreditation

(2) End of participation since September 2014. TIGO equipment moved to La Plata (Argentina).

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 2014

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		
AOS	3 Ind. Cs 2 H-masers	1 H-maser (2) + microphase-stepper	* (13)	*	*	*	*	*
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 (a)	6 H-masers	3-4 H-masers + microphase-stepper			*		*	
CAO	2 Ind. Cs	1 Cs		*	*	*	*	
CH	4 Ind. Cs (3) 1 H-maser	all the Cs 1 H-maser	*	*		*		*
CNM	3 Ind. Cs 2 H-maser	3 Ind. Cs 2 H-maser + microphase-stepper	*	*		*	*	
CNMP	3 Ind. Cs	1 Cs + frequency offset generator		*	*			

Table 4. Equipment and source of UTC(*k*) of the laboratories contributing to TAI in 2014 (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		
DLR	3 Ind. Cs 3 H-masers	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	5 Ind. Cs 2 H-masers	1 Cs + microphase-stepper		*		*		
IGNA	2 Ind. Cs	1 Cs		*	*			
INPL	2 Ind. Cs	1 Cs				*	*	
INTI (a)	1 Ind. Cs	1 Cs		*	*			
INXE	3 Ind. Cs 1 Ind. Rb 1 Lab. Cs	1 Cs + microphase-stepper			*	*		

Table 4. Equipment and source of UTC(*k*) of the laboratories contributing to TAI in 2014 (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		
IPQ	3 Ind. Cs	1 Cs + microphase-stepper		*		*	*	*
IT	6 Ind. Cs 4 H-masers 2 Lab. Cs	1 H-maser + microphase-stepper		*	*	*		*
JATC	(4)	1 Cs + microphase-stepper	*					
JV (a)	3 Ind. Cs	1 Cs + microphase-stepper			*			
KEBS	3 Ind. Cs	1 Cs + reference generator				*	*	
KIM	2 Ind. Cs	1 Cs				*	*	
KRIS	5 Ind. Cs 4 H-masers	1 H-maser + microphase-stepper	*	*	*	*	*	*
KZ	5 Ind. Cs (5)	1 Cs + microphase-stepper				*	*	
LT	2 Ind. Cs	1 Cs		*	*			
MASM	1 Ind. Cs	1 Cs + time/frequency steering				*	*	
MIKE	2 Ind. Cs 4 H-masers	1 H-maser + microphase-stepper			*	*		

Table 4. Equipment and source of UTC(*k*) of the laboratories contributing to TAI in 2014 (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		
MKEH	1 Ind. Cs	1 Cs			*			
MSL	2 Ind. Cs	1 Cs + microphase-stepper		*		*		
MTC (a)	5 Ind. Cs	1 Cs (6)			*			
NAO	4 Ind. Cs 1 H-maser	1 Cs + microphase-stepper		*	*			
NICT	33 Ind. Cs 7 H-masers (7) 1 Lab. Cs	18 Cs	*	*	*	*		*
NIM (a)	7 Ind. Cs 6 H-masers	1 H-maser + microphase-stepper		*	*	*		*
NIMB (a)	2 Ind. Cs	1 Cs			*	*		
NIMT	2 Ind. Cs	1 Cs + microphase-stepper		*	*	*		
NIS	3 Ind. Cs	1 Cs		*	*	*	*	
NIST	2 Lab. Cs 11 Ind. Cs 14 H-masers	5 Cs 6 H-masers + microphase-stepper	*	*		*		*
NMIJ	4 Ind. Cs 1 Lab. Cs 4 H-masers	1 H-maser + microphase-stepper		*	*	*		*

Table 4. Equipment and source of UTC(*k*) of the laboratories contributing to TAI in 2014 (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		
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	3 Ind. Cs 2 Lab. Cs 2 H-masers	1 Cs + microphase-stepper	*	*		*		
NRL	29 Ind. Cs 6 H-masers	1 H-maser + frequency synthesizer steered to UTC(NRL)		*		*		
NTSC	24 Ind. Cs 3 H-masers	1 Cs + microphase-stepper	*	*	*	*		*
ONBA	2 Ind. Cs	1 Cs			*			
ONRJ	7 Ind. Cs 2 H-masers	7 Cs 2 H-masers + frequency offset generator	* (8)	*		*	*	
OP	7 Ind. Cs 3 Lab. Cs 1 Lab. Rb 4 H-masers	1 H-maser (9) + microphase-stepper	* (10)	*	*	*	*	*
ORB	4 Ind. Cs 1 H-masers	1 H-maser or 1 Cs (11) + femtostepper		*		*	*	
PL	12 Ind. Cs 3 H-masers	1 Cs (12) + microphase-stepper	* (13)	*	*	*		

Table 4. Equipment and source of UTC(*k*) of the laboratories contributing to TAI in 2014 (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		
PTB	3 Ind. Cs 4 Lab. Cs (14) 4 H-masers	1 H-maser (15) + microphase-stepper	* (16)	*	*	*	*	*
ROA	6 Ind. Cs (17) 1 H-maser	1 H-maser (18) + frequency synthesizer steered to UTC(ROA)		*		*	*	*
SASO (a)	5 Ind. Cs	1 Cs		*		*	*	
SCL	2 Ind. Cs	1 Cs + microphase-stepper		*	*			
SG	3 Ind. Cs 1 H-maser	1 H-maser + microphase-stepper	*	*	*	*	*	
SIQ (a)	1 Ind. Cs	1 Cs			*			
SMD	3 Ind. Cs 1 H-maser	1 Cs + microphase-stepper				*	*	
SMU	1 Ind. Cs	1 Cs + output frequency steering			*	*	*	
SP	19 Ind. Cs (19) 9 H-masers	1 H-maser + microphase-stepper		*		*	*	*
SU	2 Lab. Cs (20) 8-9 H-masers	6-9 H-masers (21)	* (22)	*		* (23)	*	* (24)
TCC (25)	3 Ind. Cs 2 H-masers	1 Cs			*	*		

Table 4. Equipment and source of UTC(*k*) of the laboratories contributing to TAI in 2014 (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		
TL	13 Ind. Cs 3 H-masers	1 H-maser + microphase-stepper	* (26)	*		*		*
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) (27)	* (27)	*	*	*		*
VMI	3 Ind. Cs	1 Cs + microphase-stepper				*		
VSL	4 Ind. Cs	1 Cs + microphase-stepper		*		*		*
ZA	4 Ind. Cs	1 Cs				*	*	

Notes

(a)		Information based on the Annual Report for 2013, 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)	JATC	The standards are located at National Time Service Centre (NTSC). The link between UTC(JATC) and UTC(NTSC) is obtained by internal connection.
(5)	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
(6)	MTC	UTC(MTC) is generated by Symmetricom/Microsemi TSC 2043B Direct Digital Synthesizer, DC to 6.48 MHz
(7)	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
(8)	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.
(9)	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.

Notes (Cont.)

(10) OP The French atomic time scale TA(F) is computed by the LNE-SYRTE with data from 24 industrial caesium clocks located as follows (at the end of 2014) :

* 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
* Agilent Technologies France (Les Ulis)	1 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.

(11) ORB The source of UTC(ORB) has been generated by a Cs clock since July 2013.

(12) PL The Polish official timescale UTC(PL) is maintained by the GUM.

(13) 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 (TPSA, 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.

(14) 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.

(15) PTB UTC(PTB) is based on the output of an active hydrogen maser steered in frequency since MJD 55224 (February 2010).

(16) PTB Starting MJD 56079 0:00 UTC TA(PTB) is 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*) has an initial arbitrary offset from TAI without continuity to the data reported in previous months.
TA(*PTB*)-*UTC*(*PTB*) is published in PTB Time Service Bulletin.

Notes (Cont.)

(17) 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

(18) 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.

(19) SP The standards are located as follows (at the end of 2014):

* 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

(20) SU CsFO1 and CsFO2 are fountain frequency standards using laser cooled caesium atoms. CsFO2 operated as frequency standard almost regularly. Starting March 2014 CsFO2 contributed to TAI.

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

(22) SU Starting UTC 0:00 MJD 56289 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 without continuity to the data reported in previous months.
TA(*SU*)-*UTC*(*SU*) is published in SU Time Service Bulletin.

(23) SU During June-July 2014 because of Two-Way equipment failure GPS/GLONASS Time Link have been used to contribute to TAI.

(24) SU Two-way measurements are referred to MC(SU). Difference UTC(SU) – MC(SU) for the referred period have been regularly evaluated by SU Time Service. Starting December 2014 due to the end of operation of the satellite AM2, Time link has been switched to GPS/GLONASS.

(25) TCC TCC as part of the TIGO observatory had to stop its service due to the end of the TIGO-project in Chile. TIGO will be moved to a new site near La Plata in Argentina. The TIGO components will be used to construct the Argentinean-German Geodetic Observatory (AGGO).

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

(27) 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.

Table 5. Differences between the normalized frequencies of EAL and TAI, up to April 2015

(File containing values since the beginning of the steering is available at ftp://62.161.69.5/pub/tai/scale/ealtai14.ar)

Date	MJD	[*f*(*EAL*) - *f*(*TAI*)] × 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 APR 27	56199 - 57139	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/utai14.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-F2, NPL-CSF2, NPLI-CsF1, PTB-CS1, PTB-CS2, PTB-CSF1, PTB-CSF2, SU-CsFO2, SYRTE-FO1 and SYRTE-FO2 reported on the year 2014.
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 2014.
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 8.

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 2014 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 2014 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 0.25)	0.18	[1]	H maser	15 / 10 d to 30 d
NIM5	Fountain	1.4	1.4	[2]	H maser	6 / 15 d to 30 d
NIST-F2	Fountain	0.15	0.11	[3]	H maser	3 / 25 d to 45 d
NPL-CSF2	Fountain	(0.20 to 0.27)	0.23	[4]	H maser	8 / 10 d to 30 d
NPLI-CsF1	Fountain	(2.36 to 3.01)	2.5	[5]	H maser	7 / 10 d to 20 d
PTB-CS1	Beam/Mag.	8	8.	[6]	TAI	12 / 30 d
PTB-CS2	Beam/Mag.	12	12.	[7]	TAI	12 / 30 d
PTB-CSF1	Fountain	(0.70 to 0.73)	1.4	[8]	H maser	6 / 10 d to 35 d
PTB-CSF2	Fountain	(0.28 to 0.35)	0.41	[9]	H maser	9 / 10 d to 35 d
SU-CsFO2	Fountain	0.50 then 0.25	0.50	[10]	H maser	9 / 20 d to 30 d
SYRTE-FO1	Fountain	(0.36 to 0.41)	0.37	[11]	H maser	10 / 15 d to 35 d
SYRTE-FO2	Fountain	(0.25 to 0.29)	0.23	[11]	H maser	11 / 20 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	(0.29 to 0.36)	0.32	[12]	H maser	10 / 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	56079	56099	2.38	0.32	0.25	0.20	0.28	0.53	
IT-CsF2	56194	56214	-0.11	0.42	0.21	0.20	0.28	0.58	
IT-CsF2	56234	56249	-0.93	0.31	0.18	0.10	0.37	0.52	
IT-CsF2	56394	56424	-0.20	0.34	0.18	0.20	0.20	0.48	
IT-CsF2	56614	56634	-1.31	0.33	0.18	0.20	0.28	0.51	
IT-CsF2	56634	56649	-0.74	0.41	0.18	0.20	0.37	0.61	
IT-CsF2	56724	56749	-1.08	0.33	0.19	0.14	0.23	0.47	
IT-CsF2	56749	56774	-0.98	0.35	0.19	0.14	0.23	0.48	
IT-CsF2	56779	56799	-0.78	0.33	0.19	0.10	0.28	0.48	
IT-CsF2	56814	56829	-1.50	0.31	0.18	0.17	0.37	0.54	
IT-CsF2	56839	56864	-1.14	0.28	0.18	0.18	0.23	0.44	
IT-CsF2	56939	56949	0.89	1.30	0.17	0.36	0.53	1.46	
IT-CsF2	56954	56964	0.78	1.30	0.17	0.32	0.62	1.49	
IT-CsF2	56964	56979	-0.24	1.00	0.17	0.22	0.49	1.15	
IT-CsF2	56994	57014	0.33	0.70	0.18	0.14	0.28	0.79	
NIM5	56669	56684	-1.25	0.60	1.40	0.20	0.85	1.76	
NIM5	56699	56714	-1.66	0.50	1.40	0.20	0.85	1.73	
NIM5	56729	56749	-0.64	0.80	1.40	0.10	0.66	1.74	
NIM5	56759	56779	0.43	0.80	1.40	0.10	0.66	1.74	
NIM5	56779	56809	0.21	0.60	1.40	0.20	0.35	1.58	
NIM5	56809	56824	1.53	0.90	1.40	0.20	0.37	1.72	
NIST-F2	56489	56534	-1.22	0.44	0.15	0.16	0.14	0.51	
NIST-F2	56804	56829	-1.85	0.53	0.15	0.23	0.23	0.64	
NIST-F2	56894	56929	-0.86	0.42	0.15	0.18	0.17	0.51	
NPL-CsF2	56654	56684	0.55	0.22	0.23	0.08	0.20	0.38	
NPL-CsF2	56684	56714	-0.33	0.21	0.21	0.03	0.20	0.36	
NPL-CsF2	56714	56744	-0.09	0.22	0.22	0.09	0.20	0.38	
NPL-CsF2	56744	56774	0.35	0.21	0.20	0.06	0.20	0.36	
NPL-CsF2	56774	56804	-1.34	0.24	0.20	0.13	0.20	0.39	
NPL-CsF2	56899	56929	0.57	0.36	0.27	0.14	0.20	0.51	
NPL-CsF2	56929	56949	0.70	0.37	0.21	0.05	0.28	0.51	
NPL-CsF2	56954	56964	0.61	0.91	0.24	0.42	0.62	1.20	
NPLI-CsF1	56419	56439	-0.27	0.53	2.60	0.13	0.28	2.67	
NPLI-CsF1	56514	56529	3.54	0.47	3.01	0.15	0.37	3.07	
NPLI-CsF1	56589	56599	0.97	0.90	2.65	0.20	0.53	2.85	
NPLI-CsF1	56604	56614	1.35	0.61	2.71	0.19	0.53	2.83	
NPLI-CsF1	56644	56654	-0.85	0.74	2.74	0.18	0.53	2.89	
NPLI-CsF1	56659	56669	1.02	0.75	2.36	0.18	0.53	2.54	
NPLI-CsF1	56679	56689	-0.27	0.93	2.36	0.19	0.53	2.60	
PTB-CS1	56654	56684	-7.69	6.00	8.00	0.00	0.07	10.00	(1)
PTB-CS1	56684	56714	-11.51	6.00	8.00	0.00	0.07	10.00	
PTB-CS1	56714	56744	-9.24	6.00	8.00	0.00	0.07	10.00	
PTB-CS1	56744	56774	-6.50	6.00	8.00	0.00	0.07	10.00	
PTB-CS1	56774	56804	-4.41	6.00	8.00	0.00	0.07	10.00	
PTB-CS1	56804	56834	-8.20	6.00	8.00	0.00	0.07	10.00	
PTB-CS1	56834	56869	-8.97	6.00	8.00	0.00	0.06	10.00	
PTB-CS1	56869	56899	-12.55	6.00	8.00	0.00	0.07	10.00	
PTB-CS1	56899	56929	-10.16	6.00	8.00	0.00	0.07	10.00	
PTB-CS1	56929	56959	-11.24	6.00	8.00	0.00	0.07	10.00	
PTB-CS1	56959	56989	-12.28	6.00	8.00	0.00	0.10	10.00	
PTB-CS1	56989	57019	-8.12	6.00	8.00	0.00	0.13	10.00	

Table 6A. (Cont.)

Standard	Period of estimation		$d/10^{-15}$	$u_A/10^{-15}$	$u_B/10^{-15}$	$u_{link/lab}$ $/10^{-15}$	$u_{link/TAI}$ $/10^{-15}$	$u/10^{-15}$	
PTB-CS2	56654	56684	0.02	3.00	12.00	0.00	0.07	12.37	(1)
PTB-CS2	56684	56714	3.38	3.00	12.00	0.00	0.07	12.37	
PTB-CS2	56714	56744	-0.83	3.00	12.00	0.00	0.07	12.37	
PTB-CS2	56744	56774	-1.37	3.00	12.00	0.00	0.07	12.37	
PTB-CS2	56774	56804	-7.08	3.00	12.00	0.00	0.07	12.37	
PTB-CS2	56804	56834	-7.85	3.00	12.00	0.00	0.07	12.37	
PTB-CS2	56834	56869	-5.27	3.00	12.00	0.00	0.06	12.37	
PTB-CS2	56869	56899	-5.07	3.00	12.00	0.00	0.07	12.37	

PTB-CS2	56899	56929	-3.41	3.00	12.00	0.00	0.07	12.37
PTB-CS2	56929	56959	-3.10	3.00	12.00	0.00	0.07	12.37
PTB-CS2	56959	56989	-5.07	3.00	12.00	0.00	0.10	12.37
PTB-CS2	56989	57019	-2.02	3.00	12.00	0.00	0.13	12.37
PTB-CSF1	56729	56739	-0.12	0.13	0.73	0.02	0.18	0.76
PTB-CSF1	56794	56809	-1.00	0.14	0.73	0.02	0.12	0.75
PTB-CSF1	56814	56834	-0.88	0.12	0.71	0.02	0.09	0.73
PTB-CSF1	56834	56869	-0.27	0.09	0.71	0.02	0.06	0.72
PTB-CSF1	56869	56884	0.70	0.13	0.70	0.02	0.12	0.72
PTB-CSF1	56889	56899	0.50	0.16	0.70	0.02	0.18	0.74
PTB-CSF2	56649	56679	0.45	0.13	0.33	0.01	0.07	0.36
PTB-CSF2	56689	56709	0.54	0.15	0.31	0.01	0.09	0.36
PTB-CSF2	56729	56739	0.02	0.16	0.35	0.02	0.18	0.42
PTB-CSF2	56739	56754	-0.25	0.17	0.33	0.02	0.12	0.39
PTB-CSF2	56859	56879	0.52	0.16	0.30	0.02	0.09	0.35
PTB-CSF2	56879	56899	0.69	0.17	0.28	0.02	0.09	0.34
PTB-CSF2	56904	56924	0.59	0.16	0.29	0.03	0.09	0.35
PTB-CSF2	56929	56949	0.36	0.16	0.32	0.02	0.09	0.37
PTB-CSF2	56999	57019	0.94	0.17	0.31	0.04	0.19	0.40
SU-CsFO2	56379	56409	-0.06	0.36	0.50	0.11	0.65	0.90
SU-CsFO2	56409	56439	0.49	0.28	0.50	0.10	0.65	0.87
SU-CsFO2	56439	56469	0.79	0.26	0.50	0.10	0.65	0.87
SU-CsFO2	56484	56504	0.41	0.33	0.50	0.11	0.94	1.12
SU-CsFO2	56504	56534	-0.73	0.30	0.50	0.11	0.65	0.88
SU-CsFO2	56684	56714	-0.50	0.29	0.50	0.10	0.33	0.67
SU-CsFO2	56899	56929	0.85	0.24	0.25	0.10	0.33	0.49
SU-CsFO2	56929	56959	0.13	0.22	0.25	0.11	0.33	0.48
SU-CsFO2	56959	56989	0.53	0.23	0.25	0.11	0.33	0.48
SYRTE-FO1	56694	56714	-0.49	0.42	0.41	0.10	0.28	0.66
SYRTE-FO1	56714	56744	-0.84	0.25	0.40	0.11	0.20	0.52
SYRTE-FO1	56744	56774	-1.00	0.20	0.36	0.11	0.20	0.47
SYRTE-FO1	56774	56804	-0.74	0.20	0.39	0.11	0.20	0.49
SYRTE-FO1	56804	56834	-0.90	0.30	0.37	0.10	0.20	0.52
SYRTE-FO1	56834	56869	-0.45	0.25	0.39	0.10	0.17	0.50
SYRTE-FO1	56869	56899	-0.02	0.20	0.38	0.10	0.20	0.48
SYRTE-FO1	56899	56924	-0.39	0.30	0.38	0.11	0.23	0.55
SYRTE-FO1	56944	56959	-0.03	0.32	0.39	0.10	0.37	0.63
SYRTE-FO1	56999	57019	0.67	0.20	0.37	0.10	0.28	0.52
SYRTE-FO2	56689	56714	-0.88	0.20	0.29	0.10	0.23	0.43
SYRTE-FO2	56719	56744	-1.63	0.20	0.27	0.11	0.23	0.42
SYRTE-FO2	56744	56774	-0.97	0.26	0.25	0.11	0.20	0.42
SYRTE-FO2	56774	56794	-0.56	0.20	0.26	0.13	0.28	0.45
SYRTE-FO2	56804	56834	-0.57	0.30	0.27	0.10	0.20	0.46

Table 6A. (Cont.)

Standard	Period of estimation		$d/10^{-15}$	$u_A/10^{-15}$	$u_B/10^{-15}$	$u_{link/lab}/10^{-15}$	$u_{link/TAI}/10^{-15}$	$u/10^{-15}$
SYRTE-FO2	56834	56869	0.23	0.25	0.28	0.10	0.17	0.42
SYRTE-FO2	56869	56899	0.49	0.20	0.27	0.10	0.20	0.40
SYRTE-FO2	56899	56929	-0.04	0.20	0.27	0.10	0.20	0.40
SYRTE-FO2	56929	56959	0.57	0.20	0.27	0.10	0.20	0.40
SYRTE-FO2	56959	56989	1.04	0.20	0.27	0.10	0.23	0.42
SYRTE-FO2	56989	57019	0.27	0.25	0.27	0.10	0.20	0.43

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	56689	56704	-0.57	0.20	0.29	0.10	0.37	0.52	1.30	[13]
SYRTE-FORb	56789	56804	0.18	0.60	0.36	0.12	0.37	0.80	1.30	[13]
SYRTE-FORb	56804	56829	-0.17	0.40	0.32	0.11	0.23	0.57	1.30	[13]
SYRTE-FORb	56854	56869	0.68	0.40	0.29	0.11	0.37	0.62	1.30	[13]
SYRTE-FORb	56869	56899	0.47	0.33	0.32	0.10	0.20	0.51	1.30	[13]
SYRTE-FORb	56899	56929	0.15	0.20	0.30	0.10	0.20	0.42	1.30	[13]
SYRTE-FORb	56929	56959	0.67	0.20	0.29	0.10	0.20	0.42	1.30	[13]
SYRTE-FORb	56959	56974	1.17	0.20	0.29	0.11	0.43	0.57	1.30	[13]
SYRTE-FORb	56979	56989	0.97	0.30	0.29	0.11	0.70	0.82	1.30	[13]
SYRTE-FORb	56989	57019	0.25	0.20	0.30	0.10	0.20	0.42	1.30	[13]

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Operation of IT-CsF2 in 2014

IT-CsF2 is the primary atomic frequency standard under operation at INRIM. The frequency standard is based on a laser cooled Cs fountain apparatus at cryogenic temperature (88.5K) in order to reduce the blackbody radiation shift. The formal evaluation of the frequency standard was presented in [1] and the first results are reported to BIPM since the end of 2013 for publication in the Circular T. The normal procedure of the standard evaluation involves the periodical check and validation of the whole set of parameters affecting the standard accuracy (Zeeman shift, spectral purity of the microwave excitation signal, drift tube temperature, atomic density shift, laser light leaks). Because of some changes in the laser setup in August and September months, the atoms density shift data collected in the past were no more usable for the end year months evaluation. Because of that in October we started a new type-A uncertainty evaluation for the atomic density shift precluding the possibility, during fall period (circ T 323 and 324), to reach the accuracy budget in the low 10^{-16} value.

During 2014 we reported continuously formal evaluation of the standard. The nine measurements have a mean duration of 20 days each with a dead time of the order of 10-15% over the evaluation period. The total operating time during the 2014 year was 165 days.

Circ T	Period	days	ITCsF2-d	uA	uB	Ul/Lab	Ul/Tai	u
316	56724 56749	25	-0.46	0.33	0.19	0.14	0.23	0.47
316	56749 56774	25	-0.98	0.35	0.19	0.14	0.23	0.48
317	56779 56799	20	0.10	0.33	0.19	0.10	0.28	0.48
318	56814 56829	15	-0.51	0.31	0.17	0.17	0.37	0.54
319	56839 56864	25	-0.74	0.28	0.18	0.18	0.23	0.44
322	56939 56949	10	0.54	1.30	0.17	0.36	0.53	1.46
323	56954 56964	10	0.08	1.30	0.17	0.32	0.62	1.49
324	56964 56979	15	-0.94	1.00	0.17	0.22	0.49	1.15
324	56994 57014	20	-0.20	0.70	0.18	0.14	0.28	0.79

[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

Operation of the NIM5 primary frequency standard in 2014

The NIM5 Cs fountain primary frequency standard at NIM was characterized in 2014. Six average frequencies of the hydrogen maser H271 against NIM5 were measured and the results, including all relevant biases and uncertainties, were reported to the BIPM and published in Circular T 319 and 320, as shown in the following table.

MJD periods	$d/10^{-15}$	$u_A/10^{-15}$	$u_B/10^{-15}$	$U_{l/lab}/10^{-15}$	$U_{l/TAI}/10^{-15}$	$u/10^{-15}$
56669.0-56684.0	-1.25	0.60	1.40	0.20	0.85	1.76
56699.0-56714.0	-1.66	0.50	1.40	0.20	0.85	1.73
56729.0-56749.0	-0.64	0.80	1.40	0.10	0.66	1.74
56759.0-56779.0	0.43	0.80	1.40	0.10	0.66	1.74
56779.0-56809.0	0.21	0.60	1.40	0.20	0.35	1.58
56809.0-56824.0	1.53	0.90	1.40	0.20	0.37	1.72

During a formal evaluation, NIM5 operated alternatively in the high and low densities with a ratio about 2 to determine frequencies at zero density. Each evaluation also included mapping the C-field and measuring the possible biases due to microwave power by running at π/2 and 3π/2 Ramsey pulses alternatively. The type B uncertainties in NIM5 for the six runs in 2014 were remained the same. Details of the evaluation are in the references [1, 2], and the evaluation budget is shown in the table below.

Physical Effect	Bias (10^{-15})	Uncertainty (10^{-15})
2nd order Zeeman	73.4	0.2
Collisional shift	-1.1	0.2
Microwave interferometric switch	0.0	1.2
Microwave leakage	0.0	<0.1
DCP	0.0	0.5
Microwave spectral impurities	0.0	<0.1
Blackbody radiation	-16.2	0.1
Gravitational red shift	11.8	0.1
Majorana transition	0.0	<0.1
Light shift	0.0	<0.1
Rabi and Ramsey pulling	0.0	<0.1
Cavity pulling	0.0	<0.1
Collision with background gases	0.0	<0.1
Total	67.9*	1.4

* The collisional shift was calculated at low density.

The Type B uncertainty is dominated by the interferometric switch, which is under further studys now. One of the two 1x3 fiber-couplers used for molasses beams was found getting off normal and replaced with a new one in Sep. 2014. The atom numbers are increased by a factor of 2 relative to the atom numbers before the replacement.

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[2] Y. Zhang, K. Liu, F. Fang, N. Liu, T. Li, *Proc. IFCS*, (Taiwan), 376-8, 2014

Operation of NIST-F1 and NIST-F2 in 2014

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 $4x10^{-16}$ to $8x10^{-16}$ 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.

No formal NIST-F1 evaluations were carried out in 2014. NIST-F1 was partially disassembled for much needed repairs and also to enable it to be moved to the new building. It has now been reassembled and is undergoing preliminary testing. We hope to have it back in full operation early in 2015.

There were only two formal evaluations of NIST-F2 in 2014. Operation of NIST-F2 was halted in September of 2014 due to pending nearby heavy construction that has been imminent for four months The Type B uncertainty for both NIST-F2 runs was $1.5x10^{-16}$. 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 uncertainties ranged from $4.2x10^{-16}$ to $5.3x10^{-16}$ for the two runs. The uncertainties due to the spin exchange shift ranged from $2.3x10^{-16}$ to $2.6x10^{-16}$. Total uncertainties, including frequency transfer and dead time uncertainties, ranged from $5.1x10^{-16}$ to $6.4x10^{-16}$.

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Operation of the NPL primary frequency standards in 2014

At National Physical Laboratory in UK one caesium fountain, NPL-CsF2, has been fully evaluated and is operated as primary frequency standard. A second one, NPL-CsF3 built for redundancy and comparisons, has been made operational and is currently being evaluated.

NPL-CsF2 was made operational and characterised for the first time in 2009. Later its accuracy was reassessed in 2011 and 2013. The table below summarises the current uncertainty budget

Type B uncertainty evaluation	Uncertainty / 10^{-16}
Second order Zeeman	0.8
Blackbody radiation	1.1
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 were 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 2014, the NPL-CsF2 primary frequency standard was used 8 times to evaluate the TAI step interval. The measurement procedure 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. In October 2014 the standard was run during a comparison campaign arranged by the EMRP-ITOC programme [1].

The new fountain NPL-CsF3 has been made fully operational in 2014 and undergone preliminary evaluation. The evaluation process is expected to be completed in 2015.

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[1] http://projects.npl.co.uk/itoc/

Operation of the NPLI-CsF1 primary frequency standard in 2014

NPLI-CsF1, the first Cs fountain primary frequency standard at CSIR – National Physical Laboratory India, has been put in operation since 2011. The preliminary results of fountain's frequency evaluation were first published in 2013 [1]. During 2013-2014, seven formal evaluations of the NPLI-CsF1 were conducted and reported to BIPM. During the first formal evaluation in May 2013, NPLI-CsF1 was operated for 20 days and compared with five other fountains in Germany, Russia and China, namely PTB-CsF1, PTB-CsF2, SU-CsF1, SU-CsF2 and NIM-CsF. The fountain pairs were compared by using Two-way Satellite Time and Frequency Transfer (TWSTFT) and GPS Carrier Phase (GPS CP) techniques. The results showed that all the frequency difference between the fountains agreed within the 1-sigma uncertainty in the low 10^{-15} level [2]. The results of all seven evaluations appeared in the BIPM Circular-T December 2014 issue. Before each evaluation, the fountain is run for about 2-4 days for measuring the collision shift. During this run, the atom density is altered between high and low density every 100 shots. The collision shift is estimated at zero density by extrapolating the frequencies at high and low density. The C-field magnitude is also checked before and after each evaluation run. The room temperature, humidity, laser powers are recorded regularly during the run. During the evaluation, the fountain is operated at fixed atom density and the frequency offset between the fountain and H-Maser frequency is recorded every shot to shot. The average fountain frequency offset is obtained by averaging for each day and then averaging over the whole evaluation period. A detailed description of the measurement procedure, evaluation of uncertainties and records of frequency evaluation are given in reference [1, 3]. During 2014, only two formal evaluations were carried out on NPLI-CSF1. Typical uncertainty budget of NPLI-CsF1 is shown in Table 1. The budget is dominated by the collision frequency shift. The fountain is evolving at the moment in terms of reliability, run-time and more careful examination of the major frequency shifts.

Table 1: Typical systematic uncertainty budget for NPLI-CsF1

Effect	Bias $(\times \mathbf{10^{-15}})$	Uncertainty $(\times \mathbf{10^{-15}})$
2^{nd} Order Zeeman Shift	50.46	0.06
Black Body Radiation	-17.27	0.23
Gravitational Red Shift	19.6	0.11
Cold Collisional Shift	-12.0	2.4
Light shift	0.0	0.2
Background gas collisions	0.0	0.1
Cavity pulling	0.0	0.01
Rabi, Ramsey Pulling	0.0	0.1
Majorana transitions	0.0	0.1
Spectral impurity	0.0	0.2
Microwave leakage	0.0	0.1
DCP	0.0	0.2
Total(U_B)	**39.8**	**2.45**

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Operation of the PTB primary clocks in 2014

PTB's primary clocks with a thermal beam

During 2014 PTB's primary clocks CS1 and CS2 [1] were operated continuously. Time differences UTC(PTB) - clock in the standard ALGOS format were reported to BIPM, so that $u_{l/lab}$ is zero. The mean relative frequency offset y(CS1 – CS2) amounted to about -5.9×10^{-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. The 5 MHz output signals of both clocks have been continuously compared to the signal of an active hydrogen maser using a high-resolution phase comparator. Data analysis has been made based on several 5-day batches distributed during 2014.

CS1

The CS1 relative frequency instability $\sigma_y(\tau = 1$ hour) was found to vary between 82×10^{-15} and 102×10^{-15} during 2014, 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) was well within the value $u_A(\tau = 30$ d, CS1) = 6×10^{-15} stated in Circular T. During the year, two reversals of the beam direction were performed on CS1. 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 $\sigma_y(\tau = 1$ hour) was measured between 60×10^{-15} and 76×10^{-15} during 2014. This range of values justifies the estimate of the uncertainty contributions u_A as $u_A(\tau = 30$ d, CS2) = 3×10^{-15}. The standard deviation of the 12 *d*-values reported in Circular T of 2014 amounted, however, to 3.5×10^{-15} which is slightly higher. The *d*(CS2)-value for the month of February 2014 is somewhat offset from the other 11 values, but no root-cause could be identified for that. During the year, four 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}.

PTB's primary caesium fountain clocks

In 2014 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 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.

In March 2014, for the first time a TAI scale unit measurement was reported to the BIPM where the quartz oscillator based microwave synthesis was replaced by a synthesis which makes use of an optically stabilized microwave oscillator [4, 5]. In the new 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 the fountain frequency measurement 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.

Frequency shifts due to Rabi and Ramsey pulling were re-evaluated by taking into account the specific properties of fountain clocks and the effect of initial coherent atomic states [6]. As a result the corresponding uncertainty estimates of CSF1 and CSF2 are now based on a more sound, experimentally confirmed theory.

CSF1

A detailed description of the PTB fountain CSF1 is given in Refs. [7] and [8]. In 2014 CSF1 provided steering data for the hydrogen maser during 304 days of the year. Six measurements of the TAI scale unit of 10 (2×),15 (2×), 20 (1×) and 35 (1×) days duration were performed in 2014 and reported to the BIPM. Due to the performance and reliability of the laser systems, dead times are routinely kept below 3% of the nominal measurement duration. The resulting clock link uncertainty $u_{l/lab}$ was 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 six TAI contributions in 2014 statistical uncertainties $u_A < 0.2\times10^{-15}$ were achieved.

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

Physical effect	Bias / 10^{-15}	Type B uncertainty / 10^{-15}
Quadratic Zeeman shift	107.82	0.10
Black body radiation shift	- 16.53	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 2014.

CSF2

A detailed description of the PTB fountain CSF2 is given in Refs. [9] and [10]. In 2014 CSF2 provided steering data for the hydrogen maser during 303 days of the year. Nine measurements of the TAI scale unit of 10 (1×), 15 (1×), 20 (6×) and 30 (1×) days duration were performed and reported to the BIPM. The dead times of these measurements were in most cases below 3% (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 method of “rapid adiabatic passage” was routinely utilized for controlling the collisional shift during the measurement periods. The statistical uncertainty of CSF2 measurements was calculated with the assumption of white frequency noise for the total measurement intervals. For the nine TAI contributions in 2014 we arrived at statistical uncertainties $u_A < 0.2\times10^{-15}$.

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

Physical effect	Bias / 10^{-15}	Type B uncertainty / 10^{-15}
Quadratic Zeeman shift	99.969	0.010
Black body radiation shift	- 16.561	0.057
Cold collisions	- 0.57	0.23
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		0.31

Table 2: Typical frequency biases and type B uncertainties of PTB-CSF2 in 2014.

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Evaluation of SU-CsFO2 for BIPM Annual Report 2014

Five session of Russian fountain SU-CsFO2 operation were reported to Time Section of BIPM in the year 2014

Accuracy

Initially the frequency was corrected from the quadratic Zeeman, the Black Body radiation, the cold collisions and cavity pulling, microwave power dependence, and gravity [1].

The table shows the change of budget of systematic effects during the year. The changes were made due to application fountain formulae [2] in measurement data processing

	The beginning of the year 2014		The end of the year 2014	
Physical Effect	**Correct (10^{-16})**	**Uncertaint (10^{-16})**	**Correction (10^{-16})**	**Uncertainty (10^{-16})**
Cold collisions	5.2	2.3		
Microwave shiftt	0.39	3.8		
Tilting(DCP)			0.37	0.75
Total	**1148.1**	**4.6**	**1132**	**2.5**

According to [2] the formulae is $\alpha^2\overline{\mathrm{F}}^2 + \alpha^2\overline{\Phi}^2 + \overline{\mathrm{H}}^2 + \dfrac{\overline{\mathrm{C}}^2}{\alpha} + \dfrac{\overline{\mathrm{S}}^2}{\alpha^2} = \sigma_\alpha^2$

α =1 means that in the fountain use a full (maximum) of atoms. So α shows how many times decreased the number of atoms. σ^2_α is a dispersion at the given number of atoms. In the formulae F refers to detector noise, Φ- refers to number of atoms, H – is thermal noise, C is the probing signal influence and S is spin exchange influence. All squares either positive or negative. From the solutions we may find shifts from detector noise, quantum projection noise, atomic cloud temperature noise, probing signal noise and spin exchange noise for a given session of measurements. All of them are not included in uncertainty U_b. From the formulae it follows that for fountain SU-CsFO2 typical atomic cloud temperature is 0.4μK, typical number of atoms is 550 000 and the typical influence of probing signal is 7.10^{-14} for 1 s.

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Operation of the SYRTE fountain clocks in 2014

FO1, FO2Cs and FOM primary frequency standards

In 2014 we have sent 10 and 11 calibrations to BIPM performed by the SYRTE cesium fountains FO1 and FO2-Cs, respectively. The mobile fountain FOM, in operation at CNES Toulouse until July 2014 for tests of the PHARAO space clock flight model, was not connected to the reference maser at Observatoire de Paris.

The nominal operation of FO1 and FO2-Cs was the same as in 2013. The microwave synthesizers 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 three SYRTE caesium fountain clocks in 2014. The values and the uncertainties of the frequency shifts which depend on the operating parameters are updated for each TAI contribution.

Fountain	FO1		FO2-Cs		FOM	
Physical origin	Correction	Uncertainty	Correction	Uncertainty	Correction	Uncertainty
2nd order Zeeman	-1220.0	0.4	-1916.9	0.3	-305.6	1.2
Blackbody Radiation	172.6	0.6	168.4	0.6	165.6	0.6
Cold Collisions + cavity pulling	75.6	1.3	87.8	1.4	28.6	5.0
Distributed cavity phase shift	-1.0	2.7	-0.9	1	-0.7	1.6
Microwave Leaks, spectral purity	0	<1	0	0.5	0	1.8
Ramsey & Rabi pulling	0	<1	0	<0.1	0	<0.1
Microwave lensing	-0.7	<0.7	-0.7	0.7	-0.9	<0.9
Second order Doppler	0	<0.1	0	<0.1	0	<0.1
Background gas collisions	0	<0.3	0	<1	0	<1
Red shift	-69.3	1	-65.4	1	-68.7	1
Total (1σ) uncertainty u_B		**3.6**		**2.5**		**6.0**

Table 1: Typical accuracy budgets for the 3 SYRTE caesium fountains similar to the one given in [1]. (Values given in units of 10^{-16})

FO2-Rb secondary frequency standard

FO2-Rb calibration reports were regularly sent to BIPM in 2014 and included in Circular T: 10 calibration values were transmitted. Initially, in 2012 and 2013, the FO2-Rb data published in Circular T had no weight in the steering of TAI. The participation to the steering of TAI started in July 2013.

The operation of FO2-Rb is similar to that of the Cs fountains. The Rb part of FO2 operates simultaneously to the Cs part but with a slightly different launching velocity. The microwave synthesis is also based on the low noise signal provided by the CSO phase locked on the reference 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 x 10^{-16}), the type B uncertainty (typically 3 - 4 x 10^{-16}), and the uncertainty due to the link between the reference maser and the standard (typically 1 - 2 x 10^{-16}), the uncertainty of the secondary representation of the second (1.3 x 10^{-15} with the current recommended value [3, 4]) is accounted for. Table 2 gives the typical accuracy budget of FO2-Rb.

Fountain	FO2-Rb	
Physical origin	Correction	Uncertainty
2nd order Zeeman	-3470.4	0.7
Blackbody Radiation	125.3	1.4
Cold Collisions + cavity pulling	6.8	1.5
First order Doppler	-0.4	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 accuracy budget for the SYRTE FO2Rb fountain similar to the one given in [2]. (Values given in units of 10^{-16})

The maser frequency calibrations by the 4 SYRTE fountains are also used to produce a daily steering of the reference maser output signal for the generation of the French timescale UTC(OP).

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[4] 2013 International Committee for Weights and Measures 2013 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/sitai14.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 × 10^{-15}/ √(τ)**, a flicker frequency noise **0.35 × 10^{-15}** and a random walk frequency noise **0.55 × 10^{-16}x√(τ) in 2012, 0.4 × 10^{-16}x√(τ) in 2013 and 0.2 × 10^{-16}x√(τ) in 2014,** with τ in days. The relation between EAL and TAI is given in Table 5.

Month	Interval	d/ 10^{-15}	uncertainty/ 10^{-15}
Jan. 2012	55924-55954	+3.45	0.24
Feb. 2012	55954-55984	+3.17	0.23
Mar. 2012	55984-56014	+3.80	0.28
Apr. 2012	56014-56044	+2.63	0.19
May 2012	56044-56074	+2.50	0.23
Jun. 2012	56074-56104	+2.46	0.20
Jul. 2012	56104-56139	+1.56	0.25
Aug. 2012	56139-56169	+0.60	0.21
Sep. 2012	56169-56199	+0.32	0.29
Oct. 2012	56199-56229	-0.22	0.24
Nov. 2012	56229-56259	-0.33	0.23
Dec. 2012	56259-56289	-0.32	0.25
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	-0.19	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	-0.85	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	+0.38	0.20
Nov. 2014	56959-56989	+0.66	0.26
Dec. 2014	56989-57019	+0.51	0.25

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.

International GPS Tracking Schedules

(Files available at ftp://62.161.69.5/pub/tai/publication/schgps/)

GPS Schedule no 62 File SCHGPS.62	implemented on MJD = 56776 (2014 April 29) at 0 h UTC	Reference date MJD = 50722 (1997 October 1)

The GPS schedule publication has been interrupted from May 2014 since there are no more single-channel GPS receivers in UTC.

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/utcgpsglo14.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 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 2012 July 1, 0 h UTC, until 2015 June 30, [*UTC* - *GPS time*] = -16 s + C_0,
From 2015 July 1, 0 h UTC, until further notice, [*UTC* - *GPS time*] = -17 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 2012 July 1, 0 h UTC, until 2015 June 30, [*TAI – UTC(USNO)_GPS*] = 35 s + C_0'
From 2015 July 1, 0 h UTC, until further notice, [*TAI – UTC(USNO)_GPS*] = 36 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 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/utcgpsglo14.ar

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

The GLONASS satellites disseminate a common time scale designated 'GLONASS time'. The relation 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 1997 July 1), which varies with time.

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

From 2012 July 1, 0 h UTC, until 2015 June 30, [*TAI* - *GLONASS time*] = 35 s + C_1
From 2015 July 1, 0 h UTC, until further notice, [*TAI* - *GLONASS time*] = 36 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 1997 January 1 (MJD 50449) to 1999 March 22 (MJD 51259)
+107 ns for 1999 March 23 and March 24 (MJD 51260 and MJD 51261)
0 ns since 1999, March 25 (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 2012 July 1, 0 h UTC, until 2015 June 30, [*TAI – UTC(SU)_GLONASS*] = 35 s + C_1'
From 2015 July 1, 0 h UTC, until further notice, [*TAI – UTC(SU)_GLONASS*] = 36 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 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 2014

(File available on ftp://62.161.69.5/pub/tai/scale/RTAI/rtai14.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 data prior to this adjustment are corrected, so that Table 8 gives homogeneous rates for the whole year 2014. 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	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	56684	56714	56744	56774	56804	56834	56869	56899	56929	56959	56989	57019
APL	35 904	-	-	-	-	29.86	29.56	29.77	30.27	-	34.35	35.42	38.01
APL	35 1264	-	-	-	-	22.37	22.23	22.45	21.43	-	19.13	18.57	19.57
APL	35 1791	-	-	-	-	0.51	-0.25	0.02	0.19	-	0.41	-0.12	0.13
APL	40 3107	-	-	-	-	32.20	32.39	32.61	32.75	33.02	33.16	33.35	33.69
APL	40 3108	-	-	-	-	465.34	468.29	471.50	474.71	477.65	480.55	483.37	486.20
APL	40 3109	-	-	-	-	35.17	34.71	34.21	33.68	33.27	32.84	32.30	31.80
AUS	35 2269	-1.65	-1.00	-0.30	-0.82	-0.53	-1.41	-2.37	-1.84	-1.79	-1.78	-2.04	-1.99
AUS	36 299	13.78	14.13	14.46	14.11	14.84	13.79	15.83	15.06	15.48	15.08	15.46	15.51
AUS	36 340	3.55	2.23	2.03	3.38	2.17	2.92	1.31	0.46	1.68	1.18	0.12	3.04
AUS	36 654	-12.85	-11.34	-12.94	-14.22	-14.83	-14.64	-15.09	-14.71	-14.82	-14.92	-15.94	-15.76

Table 8. (Cont.)

Lab.	Clock	56684	56714	56744	56774	56804	56834	56869	56899	56929	56959	56989	57019
AUS	36 1141	13.68	10.60	11.90	13.41	13.67	12.79	10.31	13.79	12.28	10.18	9.72	12.71
BEV	35 1065	-0.57*	1.72	3.33	-11.49	-	-	-	-	-	-	-	-
BEV	35 1793	0.47*	1.26*	1.11*	1.68*	0.32*	0.49*	-0.59*	-0.51*	-0.93*	-0.74*	0.00*	-1.08
BEV	35 3009	-	-	-	-	-	-	-2.87	-2.36	-2.15	-1.76	-1.67	-1.91
BEV	40 3452	-	-	-	-38.69*	-33.62*	-27.56	-19.59	-13.64	-7.91	-2.28	3.18	8.81
BIM	18 8058	2.77	2.66	5.01	3.51	3.90	3.53	4.11	5.92	3.15	1.94	2.55	2.76
BY	40 4222	5.01*	-6.66	-11.78	-13.99	-13.13	-12.36	-14.41	-16.24	-10.23	-7.34	-7.17	6.08
BY	40 4227	5.46*	3.44*	8.12*	6.43*	2.07*	3.13*	6.28*	12.27*	3.20	3.99	4.35	5.86
BY	40 4229	18.21	15.79	17.56	18.20	18.24	18.39	19.28	19.97	21.15	26.98	28.08	31.19
CH	22 112	61.88	66.69	74.49	79.38	83.22	76.85	68.30	64.57	55.88	-	-	-
CH	24 105	-	-	-	-	-	-	-	-	-	-	5.64	5.51
CH	35 2117	3.33	2.71	0.63	2.35	2.10	3.45	1.77	2.40	2.80	2.77	1.10	3.04
CH	35 2743	-2.76	-2.00	-2.45	-4.19	-3.06	-3.25	-3.03	-2.26	-1.82	-3.15	-2.42	-4.20
CH	40 5701	-25.44	-25.67	-25.93	-26.18	-26.73	-27.02	-	-	0.05	1.14	1.24	0.90
CNM	35 2708	-0.11	0.85	-	-	-7.59	-6.81	-7.87	-7.33	-	-7.40	-7.65	-
CNM	35 2709	5.17	6.50	-	-	-2.38	-2.30	-1.86	-0.33	-	-1.13	-1.71	-
CNM	35 2885	-	-	-	-	-21.70	-21.17	-21.29	-20.92	-	-20.80	-21.22	-
CNM	40 7301	-9.53	-8.26	-	-	-18.79	-18.81	-18.98	-19.27	-	-2.22	-3.78	-
CNM	40 7302	-	-	-	-	62.93	74.13	86.19	98.33	-	26.72	37.35	-
CNMP	36 1752	5.73	5.67	5.50	8.29	7.40	8.50	-	8.68	5.63	7.62	9.19	-
CNMP	36 1806	-0.13	-0.76	2.06	-0.14	-0.29	-1.56	-	1.19	-1.61	-1.87	-0.94	-
CNMP	36 2873	0.39	0.98	0.98	1.35	1.03	2.32	-	0.92	2.75	1.23	1.23	-
DMDM	35 2191	20.65	19.67	19.37	19.59	19.58	20.26	-	-	20.17	20.48	19.56	18.70
DMDM	36 2033	8.16	8.67	8.68	8.87	7.57	8.42	-	-	9.82	8.01	8.47	9.71
DTAG	35 2805	2.66	2.83	3.24	3.03	3.21	0.86	-0.11	-	0.04	0.47	0.78	0.75
DTAG	35 2941	0.22*	-0.43	-0.64	-0.60	-0.39	-0.30	0.32	-	0.04	0.68	0.77	0.33
DTAG	35 2966	-	-	-	-	-	-	0.26	-	0.62	0.85	0.73	0.98
DTAG	36 2794	1.53	-0.60	-1.33	-0.71	0.07	-	-	-	-	-	-	-
EIM	35 716	19.13	18.86	16.86	16.71	-	19.45	-	-	-	-	-	-
EIM	35 2060	0.31	0.22	0.11	-0.25	-	-	-	-	-	-0.02	0.19	0.00
ESTC	22 132	-103.33	-111.08	-119.01	-123.86	-126.93	-128.13	-143.07	-149.42	-154.06	-157.27	-	-
ESTC	35 1615	-31.87*	-32.46*	-32.61*	-32.39*	-33.09*	-33.54*	-33.08*	-33.26*	-32.65*	-31.91*	-	-
ESTC	35 2025	-	-	1.89*	1.54*	2.04*	1.77*	2.18*	2.21*	2.33*	2.66*	-	-
ESTC	35 2353	-0.42	-0.39	-0.57	-0.16	-1.33	-	-	-	-	-	-	-
ESTC	40 2551	-21.15	-23.38	-25.60	-27.84	-29.85	-32.34	-34.44	-36.51	-38.05	-40.05	-	-

Table 8. (Cont.)

Lab.	Clock		56684	56714	56744	56774	56804	56834	56869	56899	56929	56959	56989	57019
F	35	124	7.37	7.89	7.24	7.40	6.87	7.05	6.54	6.89	6.80	7.04	7.29	6.48
F	35	157	13.18	-	-	13.46	13.49	13.11	12.96	13.08	12.99	13.61	12.34	12.99
F	35	158	11.42	11.84	12.17	12.00	12.67	12.97	13.70	13.73	14.03	13.07	13.93	15.23
F	35	355	-0.60	0.54	0.47	-0.58	0.89	1.47	1.60	0.67	0.67	3.07	4.01	3.55
F	35	385	21.54	20.70	20.97	23.21	22.41	22.44	21.97	21.81	22.34	21.40	22.00	21.22
F	35	396	1.30	0.60	0.33	1.01	1.29	1.19	0.77	0.92	1.77	1.27	1.71	1.14
F	35	469	-	-	-	-4.55	-5.52	-5.66	-4.95	-5.14	-4.25	-2.92	-1.78	-2.46
F	35	489	-	-	-	17.08	16.78	17.16	17.79	17.14	16.91	16.82	17.92	18.10
F	35	609	-26.49	-26.84	-27.33	-29.02	-29.39	-29.85	-30.22	-30.28	-30.25	-30.91	-31.82	-32.48
F	35	700	-12.83	-11.95	-11.70	-12.28	-11.95	-12.30	-11.75	-13.02	-11.78	-	-	-
F	35	770	-7.98	-7.77	-8.09	-7.56	-7.66	-10.15	-9.63	-9.61	-9.49	-9.79	-10.47	-9.98
F	35	774	26.70	26.34	26.40	26.44	26.30	26.63	26.89	26.02	26.36	25.69	25.91	25.94
F	35	781	8.02	7.73	7.95	8.16	8.07	8.11	8.70	7.40	6.79	7.47	7.76	7.73
F	35	859	3.18	2.14	3.60	4.41	4.00	3.49	2.40	1.65	3.48	4.96	1.70	4.38
F	35	1177	-2.73	-3.42	-3.21	-3.79	-4.23	-3.49	-3.80	-3.48	-5.23	-4.20	-5.36	-2.39
F	35	1222	1.13	1.19	1.80	1.70	1.74	1.85	1.89	1.90	2.16	2.32	1.23	1.53
F	35	1321	5.13	3.45	5.06	2.83	1.75	1.34	2.21	1.26	3.12	2.37	2.49	1.39
F	35	1556	-3.33	-2.80	-1.72	-2.13	-3.44	-2.68	-2.47	-2.19	-2.16	-1.57	-2.89	-3.89
F	35	1644	10.67	-	-	9.26	8.86	9.45	9.12	9.12	9.05	8.64	7.86	8.66
F	35	2388	0.02	2.03	1.24	1.11	1.87	2.69	2.72	3.26	2.79	2.40	3.61	4.31
F	35	2609	6.24	5.97	6.72	5.92	5.88	5.83	5.83	5.38	5.45	4.99	5.08	5.27
F	35	2647	-	17.28	24.55	26.32	25.49	26.05	25.25	25.89	25.19	26.69	24.43	26.30
F	35	2804	2.60	3.63	2.94	3.35	3.13	3.83	3.91	3.33	3.91	4.34	4.17	4.63
F	40	809	19.97	20.82	21.38	-	-	-	1.19	2.01	2.81	3.51	4.21	5.03
F	40	810	24.34	25.24	25.96	26.64	27.33	28.13	28.88	29.60	30.26	30.87	-	-
F	40	889	18.79	19.21	19.57	19.91	20.26	20.59	20.87	21.22	21.59	21.91	22.17	22.52
F	40	890	14.77	14.99	15.20	15.32	15.47	15.61	15.77	15.91	16.12	16.19	16.28	16.47
HKO	35	2425	-1.30	-1.62	-1.85	-2.09	-1.74	-2.51	-2.70	-1.92	-2.01	-2.46	-2.28	-3.28
HKO	35	2884	1.17	1.39	1.39	1.98	3.09	1.94	2.10	2.35	3.16	3.00	2.93	4.24
IFAG	36	1167	-3.02	-1.98	-3.22	-0.83	-1.11	2.27	-0.35	0.84	0.46	-1.83	-2.40	-2.58
IFAG	36	1173	13.50	12.08	13.44	14.64	16.14	16.89	15.93	-	-	-	-	-
IFAG	36	1629	10.63	10.41	9.83	10.40	9.86	11.12	11.81	11.99	11.11	10.02	9.44	8.90
IFAG	36	1732	14.38*	14.13*	13.89*	14.42*	14.22*	13.97*	12.38	13.30	13.78	13.41	14.53	13.28
IFAG	36	1798	-2.80	-2.24	-2.68	-2.48	-2.36	-1.84	-1.81	-2.32	-2.63	-3.26	-2.99	-2.81
IFAG	40	4418	5.12	5.28	5.60	5.87	5.70	5.96	6.02	6.31	6.29	6.57	7.14	7.20

Table 8. (Cont.)

Lab.	Clock	56684	56714	56744	56774	56804	56834	56869	56899	56929	56959	56989	57019
IFAG	40 4439	-9.72	-10.39	-11.02	-11.57	-12.35	-13.49	-	-	5.30	4.51	4.05	3.43
IGNA	35 1196	19.16	-	-	16.90	17.61	15.50	-	-	17.72	17.71	17.38	-
INPL	35 2480	-0.39	-1.65	-0.86	-0.02	-1.10	0.17	-0.59	-0.18	-0.36	0.14	1.09	0.75
INPL	35 2481	-0.78	-0.44	-0.82	-0.30	0.16	-0.95	-0.97	-1.35	-1.99	-2.75	-3.63	-3.64
INTI	35 2377	-1.02	-2.32	0.83	0.80	-0.86	-0.44	0.02	0.14	-0.43	1.06	0.72	1.25
INXE	35 2393	-	-0.18	0.01	0.35	-1.11	0.28	1.13	-1.13	0.16	-0.83	0.19	0.59
IPQ	35 2012	7.15	-	7.75	7.45	8.01	-	-	-	-	-	-	-
IPQ	35 2890	0.62	-	0.49	1.11	1.99	1.90	2.03	2.73	1.68	1.72	1.16	-
IT	35 219	1.52	1.23	1.62	1.21	2.02	1.55	2.35	1.90	2.99	1.33	0.64	1.28
IT	35 505	-24.87	-24.17	-25.11	-25.36	-24.16	-24.94	-25.02	-25.18	-24.64	-23.66	-23.84	-24.20
IT	35 1115	-6.50	-6.65	-6.46	-6.42	-6.12	-5.71	-5.29	-2.42	-4.84	-5.98	-6.61	-5.45
IT	35 1373	-6.88	-6.70	-6.16	-6.15	-5.79	-5.50	-5.83	-6.24	-6.06	-6.17	-5.74	-6.64
IT	35 2118	15.50	14.87	15.00	14.72	13.91	14.28	14.00	13.39	13.35	13.52	13.38	12.80
IT	35 2487	-7.60	-6.95	-7.06	-6.87	-7.32	-7.17	-7.41	-6.63	-7.20	-6.25	-6.21	-5.75
IT	40 1101	-5.36	0.11	5.10	9.88	14.71	19.46	24.85	30.09	35.18	39.92	44.67	49.39
IT	40 1102	-3.65	1.58	6.78	11.89	17.19	22.10	27.51	32.48	37.43	42.01	46.41	51.17
IT	40 1103	33.27	34.29	35.32	35.91	36.83	37.77	38.90	39.75	40.80	41.64	42.57	43.55
IT	40 1104	-	-	-	-	-	-	-	8.38	-0.79	-12.93	-28.35	-36.38
JV	21 216	90.37	92.91	93.02	95.87	97.41	-	105.22	107.19	111.29	111.31	108.90	116.03
JV	36 1277	-16.07	-14.58	-15.88	-14.59	-16.16	-	-13.93	-14.56	-15.17	-15.62	-15.11	-14.25
JV	36 2617	14.24	12.89	12.35	13.76	13.39	-	13.01	13.88	12.96	14.17	13.03	14.35
JV	36 2629	-4.45	-4.39	-6.99	-3.98	-5.29	-	-4.25	-4.08	-4.51	-5.70	-4.97	-4.66
JV	40 8713	-	28.40	29.39	31.02	28.60	-	22.83	19.93	16.27	13.96	11.29	10.10
KEBS	35 2518	-	24.93	23.91	-	-	-	-57.56	-	-58.11	-57.41	-56.62	-
KIM	36 618	2.44	1.56	4.35	3.24	2.64	-	-	-	-	-	-	-
KRIS	35 321	11.67	11.33	11.06	11.08	10.16	10.80	9.32	9.11	8.17	-	-	8.10
KRIS	35 739	0.85	0.87	0.11	-0.19	0.30	-0.27	0.52	0.46	0.15	0.90	-	-1.25
KRIS	35 1135	28.11	28.10	27.88	27.70	28.00	27.43	26.09	27.97	27.31	-	-	13.89
KRIS	35 1693	8.47	8.93	9.47	8.95	8.42	8.87	8.67	8.62	8.99	-	-	8.97
KRIS	35 1783	21.19	21.64	21.40	21.08	21.57	20.86	21.05	21.02	20.42	-	-	22.71
KRIS	40 5625	1.41	1.57	1.88	1.97	3.19	2.41	2.88	3.15	3.20	-	-	13.62
KRIS	40 5626	-5.64	-5.40	-5.31	-5.01	-4.75	-4.48	-4.23	-4.04	-3.80	-3.77	-	3.11
KZ	35 2202	-10.76	-10.57	-10.18	-10.72	-10.99	-9.26	-3.47	-3.65	0.63	-	-	2.43
KZ	35 2665	5.61	5.25	6.33	5.44	6.09	5.41	6.59	6.69	5.61	-	-	6.00
KZ	35 2667	4.98	4.44	5.37	5.03	4.60	5.08	6.11	5.19	5.52	-	-	5.80

Table 8. (Cont.)

Lab.	Clock	56684	56714	56744	56774	56804	56834	56869	56899	56929	56959	56989	57019
LT	35 1362	0.88	2.76	-0.10	0.40	0.73	0.23	1.70	-0.21	0.23	1.53	2.61	1.56
LT	35 1868	-0.36	-0.71	0.32	0.36	1.08	1.49	0.86	-0.32	0.01	0.17	0.75	1.02
MASM	35 2900	-	-	-	-	-	-	-	-	-	-	-5.94	-6.91
MIKE	36 986	-	2.17	2.33	1.24	3.81	2.95	2.53	2.10	1.86	3.18	1.66	0.93
MIKE	40 4108	-	-	-	-	0.88	-	0.92	1.29	1.62	2.09	2.42	2.80
MIKE	40 4113	-	-0.79	-0.57	0.35	0.40	0.68	1.28	2.91	6.60	6.16	6.88	7.65
MIKE	40 4180	-	-4.69*	-4.46*	-3.58*	-3.45*	-3.02*	-2.47	-1.99	-1.85	-1.34	-0.90	-0.39
MKEH	36 849	-40.50	-41.45	-41.16	-41.89	-40.17	-40.97	-41.02	-42.16	-41.06	-39.21	-41.40	-40.92
MSL	36 274	-	-24.82	-25.77	-15.19	-11.38	-6.25	-2.15	-2.09	-3.52	1.20	-0.97	-
MSL	36 2869	-	-17.12	-17.84	-7.44	-4.47	2.63	4.75	7.46	2.16	6.57	6.67	-
MTC	35 3002	-	-	-	-	-	-	-	-	-	-	-	1.31
MTC	35 3003	-	-	-	-	-	-	-	-	-	-	-	-0.91
MTC	35 3004	-	-	-	-	-	-	-	-	-	-	-	-1.24
MTC	35 3005	-	-	-	-	-	-	-	-	-	-	-	-0.33
NAO	35 779	-	4.63	4.54	5.14	5.08	5.53	5.92	6.14	6.59	4.27	-0.46	1.59
NAO	35 1206	-	0.41	0.17	0.35	0.17	-1.46	-0.20	-0.90	-0.72	-0.24	2.39	1.67
NAO	35 1214	-	1.07	0.00	0.21	0.43	0.50	-0.08	0.66	-0.62	0.56	-0.24	-0.10
NAO	35 1689	-	2.13	1.93	2.44	2.69	2.32	2.75	3.05	2.97	1.94	-0.26	-0.50
NAO	40 1301	-	3.70	0.73	-1.41	-2.03	-7.45	-2.97	0.07	-4.83	-8.70	-7.69	-14.44
NICT	35 112	-8.90	-9.25	-11.01	-8.45	-6.98	-7.31	-7.18	-7.83	-7.35	-	-	-
NICT	35 332	6.49	5.47	6.38	6.59	5.47	5.67	5.79	5.63	5.01	5.49	4.15	4.03
NICT	35 343	9.01	8.22	7.85	8.67	7.86	8.37	7.91	7.43	7.49	7.14	7.98	6.94
NICT	35 715	9.66	10.04	10.20	9.24	9.79	9.83	9.49	9.26	9.40	8.92	9.22	9.39
NICT	35 732	-6.61	-6.78	-7.03	-7.61	-7.34	-7.35	-7.55	-7.93	-7.64	-7.45	-8.23	-8.23
NICT	35 907	20.12	20.31	20.14	20.01	19.00	19.23	18.27	18.10	17.80	17.31	16.87	17.46
NICT	35 913	-13.31	-13.16	-12.80	-13.10	-14.74	-15.01	-14.85	-15.27	-15.88	-15.68	-14.89	-14.53
NICT	35 916	-2.01	-	-	-	-	-	-	2.37	1.91	1.72	2.00	1.75
NICT	35 1225	5.13	-	-	18.90	18.74	18.85	19.37	19.88	19.67	20.00	18.99	19.95
NICT	35 1226	7.99	8.97	9.72	8.22	8.88	8.14	7.90	8.38	7.42	6.61	6.77	6.07
NICT	35 1611	6.29	-0.32	9.04	6.03	5.38	6.29	5.71	5.87	4.54	4.55	3.40	3.67
NICT	35 1778	-24.39	-24.73	-24.58	-25.23	-25.51	-24.49	-24.75	-24.54	-24.94	-24.33	-24.76	-23.98
NICT	35 1789	-8.09	-7.96	-7.93	-8.07	-8.43	-8.10	-8.01	-8.17	-8.53	-8.19	-8.51	-9.57
NICT	35 1790	9.75	7.82	8.58	7.59	8.49	8.35	7.38	8.46	8.24	8.69	8.23	8.54
NICT	35 1866	3.29	3.29	2.28	3.19	3.29	3.35	2.98	3.37	3.02	2.55	2.59	2.88
NICT	35 1882	-1.18	-1.61	-1.60	-1.41	-1.66	-2.39	-1.12	-1.62	-0.59	-1.42	-1.19	-1.26

Table 8. (Cont.)

Lab.	Clock	56684	56714	56744	56774	56804	56834	56869	56899	56929	56959	56989	57019
NICT	35 1887	-41.87	-29.21	-30.03	-34.70	-33.01	-16.37	-1.23	-3.72	-9.58	-14.87	-15.66	-16.27
NICT	35 1944	6.16	6.72	6.66	8.29	7.44	7.90	8.91	10.98	11.35	11.25	11.32	10.89
NICT	35 2010	-1.15	-1.35	-0.14	-0.49	-0.66	-0.51	-1.47	-0.94	-1.03	-0.75	-1.31	-1.09
NICT	35 2011	1.91	2.40	1.48	2.14	2.12	2.76	2.51	1.72	1.92	2.03	2.67	2.36
NICT	35 2056	-20.89	-21.07	-20.23	-20.75	-20.42	-20.30	-20.12	-19.42	-19.90	-19.79	-19.67	-20.04
NICT	35 2113	2.72	2.58	2.26	2.23	2.45	3.42	3.66	3.99	4.44	5.34	5.96	5.14
NICT	35 2116	-	-	-	-	-	-	-	-	-	-	-9.31	-10.00
NICT	35 2570	10.47	9.76	10.00	10.77	11.20	10.67	10.04	9.98	9.56	9.96	9.59	10.02
NICT	35 2574	-0.13	0.92	0.54	1.13	0.57	1.71	2.09	2.57	2.50	2.60	2.37	2.21
NICT	35 2627	1.71	2.29	1.77	1.66	2.14	2.51	1.98	3.38	3.46	1.46	1.23	2.39
NICT	35 2628	2.56	2.39	2.60	2.42	0.72	1.82	1.74	1.89	2.28	1.92	2.21	1.50
NICT	35 2784	5.99	5.47	6.29	7.21	7.01	6.74	7.16	7.08	7.41	6.87	6.70	7.36
NICT	35 2876	-	-	-	-	-	-	-	-	-9.05	-9.03	-8.93	-9.03
NICT	35 2903	-8.98	-9.10	-9.23	-8.84	-8.86	-8.47	-7.86	-8.03	-8.54	-7.93	-7.30	-6.73
NICT	36 1217	4.82	3.88	7.35	6.60	4.16	4.36	2.66	4.74	3.16	4.30	5.00	3.36
NICT	40 2003	-34.00	-34.15	-34.23	-34.61	-34.92	-35.06	-34.96	-35.01	-34.94	-34.89	-34.79	-34.59
NICT	40 2004	26.56	28.49	30.38	32.24	33.92	35.77	37.70	39.58	41.43	43.34	45.44	47.34
NICT	40 2005	97.35*	98.81*	100.24*	101.69*	103.07*	104.56*	105.94*	107.09*	108.67*	110.18*	111.40*	113.38
NICT	40 2006	33.12	34.95	36.88	39.03	40.89	42.75	44.75	46.86	48.52	50.26	51.88	53.57
NIM	35 1235	16.25	16.00	15.95	15.16	14.76	16.11	18.13	16.10	16.95	16.45	17.94	16.64
NIM	35 2239	1.95	1.48	1.94	1.28	1.09	2.25	1.99	2.13	-	-	-	1.84
NIM	35 2256	12.13	13.85	12.76	13.66	13.16	13.19	13.03	13.51	13.34	13.34	12.71	12.63
NIM	35 2483	2.66	3.46	4.02	3.41	3.31	3.39	3.25	2.82	2.78	3.28	-	3.02
NIM	35 2643	-5.66	-5.73	-5.26	-5.51	-5.06	-5.00	-4.89	-4.78	-4.91	-4.80	-5.20	-5.01
NIM	35 2744	-3.82	-3.59	-2.90	-2.70	-2.72	-2.49	-2.61	-2.18	-2.19	-1.85	-2.45	-2.38
NIM	35 2767	-29.18	-30.14	-29.73	-29.02	-29.60	-29.70	-28.20	-28.78	-28.56	-28.64	-28.85	-28.65
NIM	35 2769	-	-	-	-	-	-	-	-	-	16.03	16.01	16.70
NIM	40 4832	138.67	141.45	144.34	147.82	151.19	154.73	158.16	161.37	164.19	166.52	169.31	172.10
NIM	40 4835	214.34	213.86	214.34	214.42	218.33	-	-	-	-	-	-	-
NIM	40 4871	185.38	189.61	193.93	198.18	202.00	206.15	210.68	215.28	219.36	223.09	227.42	231.61
NIM	40 4878	75.09	79.11	83.37	88.05	93.40	98.34	103.39	108.59	112.97	117.32	121.73	125.30
NIM	40 4879	131.38	136.31	142.86	148.22	152.94	157.01	161.83	161.95	164.90	169.86	171.04	173.95
NIM	40 4880	125.00	132.34	139.36	146.37	153.11	159.57	166.10	171.97	177.07	181.97	187.20	192.11
NIMB	35 600	4.01	2.74	1.51	-0.17	1.28	0.48	-0.27	-0.22	0.02	2.18	1.81	2.10
NIMT	35 2246	6.21	6.84	6.34	-	-	5.09	4.88	6.05	6.29	5.87	5.89	5.75

Table 8. (Cont.)

Lab.	Clock	56684	56714	56744	56774	56804	56834	56869	56899	56929	56959	56989	57019
NIMT	35 2247	-0.10	0.25	-1.00	-1.14	-1.18	2.93	-0.30	-0.35	-0.28	2.84	-1.10	-0.55
NIS	35 1126	-	-	-	-	-	-	27.23	22.81	24.53	17.13	1.20	1.41
NIST	35 282	-	-	-	-12.16	-11.59	-12.51	-11.85	-12.36	-12.15	-12.32	-12.54	-13.04
NIST	35 408	-20.19	-20.42	-20.09	-20.66	-20.46	-21.16	-20.51	-20.17	-20.84	-20.38	-21.36	-20.80
NIST	35 1074	-22.88	-22.05	-	-7.65	-7.31	-7.19	-7.52	-7.70	-8.06	-8.15	-7.73	-7.57
NIST	35 1519	-6.52	-5.38	-4.49	-5.09	-3.40	-4.48	-2.85	-2.82	-2.65	-1.53	-0.99	-1.52
NIST	35 2031	-8.75	-10.38	-8.00	-	-	-	-	-	-	-13.95	-13.56	-12.94
NIST	35 2032	-2.86	-2.95	-2.98	-2.37	-2.96	-3.45	-2.24	-2.56	-2.73	-2.00	-2.19	-2.34
NIST	35 2034	-10.57	-10.71	-10.77	-10.91	-11.03	-11.89	-10.84	-11.22	-11.14	-11.54	-11.74	-11.27
NIST	35 2579	-3.43	-4.03	-3.34	-1.27	-2.31	-2.20	-2.88	-2.95	-2.65	-2.44	-1.40	-1.56
NIST	35 2672	2.15	3.32	2.56	2.47	2.48	3.15	2.37	2.68	3.36	3.20	3.64	3.75
NIST	35 2935	-	-	-	-	-	-	-	-	-16.04	-15.85	-15.87	-16.70
NIST	40 204	39.57	39.87	40.20	40.44	40.71	40.97	-	-	-	-	-	-
NIST	40 205	-25.04	-24.98	-24.94	-24.93	-24.84	-24.87	-24.87	-24.89	-24.79	-24.63	-24.64	-24.56
NIST	40 206	-40.89	-40.21	-39.62	-39.17	-38.60	-37.96	-37.11	-36.08	-35.04	-34.22	-33.13	-32.41
NIST	40 212	-	-	-	-	-	-	-	-	192.20	199.17	206.34	213.67
NIST	40 222	33.45	33.59	33.71	33.85	34.04	34.00	34.15	34.23	34.35	34.53	34.63	34.82
NMIJ	35 224	-14.51	-14.64	-14.77	-14.91	-15.14	-14.59	-14.31	-15.60	-15.45	-15.54	-15.29	-15.61
NMIJ	35 523	16.14	15.77	15.57	15.47	15.93	15.89	15.16	15.59	16.42	15.31	15.28	14.45
NMIJ	40 5002	-	-	-	-	-	-	-	-	-0.34	-1.48	-3.61	-5.27
NMIJ	40 5003	0.48	0.53	0.51	0.56	0.64	0.48	0.49	0.64	-	-	0.77	0.80
NMIJ	40 5015	101.82	105.07	108.19	111.09	114.51	116.93	-	-	-	-	-	-
NMLS	35 328	-17.70	-15.99	-14.84	-13.89	-13.81	21.79	21.56	19.35	-0.13	-0.13	1.36	-0.45
NPL	35 1275	3.46	3.92	3.66	4.87	4.77	5.47	4.53	3.89	4.44	4.57	5.05	5.06
NPL	40 1701	20.78	20.88	21.44	21.47	18.59	21.83	21.92	22.14	22.40	22.79	23.22	23.54
NPL	40 1708	-0.63*	-1.66*	-1.30*	-1.24*	-1.11*	-1.18*	-0.16*	-1.01*	-0.73*	-0.87*	-0.37*	-0.12
NPLI	35 57	92.00	91.90	92.03	92.96	92.46	93.95	94.58	93.28	91.85	92.24	95.24	96.28
NPLI	35 140	17.18	14.66	14.02	17.17	16.69	18.61	19.22	18.82	15.06	18.01	16.68	12.85
NPLI	35 1324	-2.57	-2.60	-2.79	-3.89	-2.75	-1.77	-2.37	-2.62	-2.59	-3.72	-3.29	-2.52
NPLI	35 2245	-1.31	-0.89	-1.58	-1.56	-1.35	-0.39	-1.08	-0.14	-0.12	-0.19	-0.30	0.09
NPLI	35 2796	-24.78	-25.05	-24.78	-24.92	-24.64	-24.76	-24.53	-24.82	-23.93	-24.53	-23.68	-23.39
NPLI	40 5201	9.30	5.89	-13.64	-9.76	-6.47	-3.93	-0.73	2.40	5.70	8.63	-0.71	1.82
NRC	35 2150	0.62*	1.17	0.78	1.49	0.30	0.85	1.31	0.66	0.80	1.69	0.56	0.71
NRC	35 2152	-3.51*	-3.07*	-3.90*	-3.80*	-4.22*	-3.84*	-4.79*	-3.72*	-3.91*	-5.11*	-3.97	-3.72
NRC	36 2219	2.73	3.69	4.14	4.22	3.33	3.15	3.62	4.47	4.52	2.86	3.94	5.06

Table 8. (Cont.)

Lab.	Clock	56684	56714	56744	56774	56804	56834	56869	56899	56929	56959	56989	57019
NRC	40 304	8.07	8.04	5.06	4.79	-	-	-	-	-	-	-	-
NRC	40 306	77.56	84.61	91.89	99.35	107.15	114.44	123.91	132.65	141.04	149.58	157.95	166.20
NRL	35 714	-	-	6.38	6.89	7.59	6.95	-	-	-	-	-	-
NRL	35 719	-	-	-6.97	-7.58	-7.33	-7.40	-	-	-	-	-	-
NRL	35 1245	-	-	-8.86	-9.42	-8.05	-8.90	-	-	-	-	-	-
NRL	35 2460	-	-	-	-10.44	-	-	-	-	-	-	-	-
NRL	35 2464	-	-	-	14.05	-	-	-	-	-	-	-	-
NRL	35 2580	-	-	-	29.49	-	-	-	-	-	-	-	-
NRL	36 387	-	-	-1.05	-1.53	-1.67	-0.41	-	-	-	-	-	-
NRL	40 1001	-	-	-0.94	-2.09	-0.83	-0.23	-	-	-	-	-	-
NRL	40 1003	-	-	0.92	0.08	-0.36	-0.74	-	-	-	-	-	-
NRL	40 1009	-	-	2.04	0.31	-1.13	-3.36	-	-	-	-	-	-
NRL	40 1010	-	-	8.52	10.71	3.96	-4.64	-	-	-	-	-	-
NTSC	35 1007	-	-	-	-	-	-	-	-	-	-3.64	-3.66	-
NTSC	35 1011	11.24	11.64	11.14	11.55	11.82	13.11	12.28	11.89	10.47	12.77	13.96	14.41
NTSC	35 1016	10.84	10.19	9.63	9.54	9.72	9.75	10.84	11.34	10.84	11.22	10.71	11.91
NTSC	35 1018	-8.19	-8.68	-8.35	-9.29	-8.88	-7.67	-9.30	-8.55	-8.72	-8.45	-8.15	-8.37
NTSC	35 1818	-21.96	-21.23	-22.35	-21.79	-22.02	-22.94	-22.84	-23.03	-23.96	-22.98	-23.70	-23.19
NTSC	35 1820	16.97	17.11	17.22	17.46	17.32	17.26	17.66	17.09	18.04	17.01	17.14	17.92
NTSC	35 1823	17.00	16.67	16.85	16.88	17.22	16.60	17.45	17.17	16.49	17.32	17.36	17.34
NTSC	35 2096	-6.09	-4.81	-5.30	-5.26	-5.50	-5.03	-5.37	-7.17	-6.64	-	-	-
NTSC	35 2098	6.26	6.63	6.61	6.24	6.63	6.84	6.46	6.07	5.62	5.90	5.16	6.00
NTSC	35 2131	10.39	10.79	10.34	10.62	10.55	10.94	11.56	10.25	11.22	10.33	10.12	9.68
NTSC	35 2141	-2.66	6.94	6.49	11.59	16.94	19.36	7.07	11.35	13.98	7.73	9.48	4.31
NTSC	35 2142	-13.53	-13.85	-13.41	-14.13	-13.18	-14.12	-13.53	-13.75	-13.84	-13.78	-14.30	-14.27
NTSC	35 2143	10.75	10.82	10.20	10.16	11.18	10.52	10.59	11.43	11.00	10.52	8.86	9.87
NTSC	35 2144	-4.66	-5.16	-3.89	-3.74	-3.30	-2.45	-3.35	-4.07	-3.16	-	-	-
NTSC	35 2145	-2.30	-3.32	-3.44	-3.58	-3.62	-3.38	-3.83	-3.72	-5.46	-7.23	-7.29	-7.82
NTSC	35 2147	7.12	7.29	7.79	7.54	6.81	6.89	6.82	-	-	-	-	-
NTSC	35 2573	6.09	5.38	5.54	6.03	5.86	5.25	5.08	5.78	5.41	5.48	5.02	4.67
NTSC	35 2831	9.99	10.24	11.07	10.94	11.80	12.51	12.27	-	-	-	-	-
NTSC	35 2852	18.60	18.72	18.63	18.98	19.98	18.77	19.74	19.48	19.56	19.28	19.34	19.79
NTSC	35 2855	16.58	17.21	16.87	17.27	18.47	17.78	18.63	17.96	18.43	-	-	-
NTSC	35 2921	2.92	1.65	1.83	2.21	2.35	1.20	1.50	2.15	1.61	1.52	1.57	0.89
NTSC	35 2922	-0.23	0.66	0.58	0.47	0.03	1.03	1.11	1.91	1.32	1.24	2.04	1.56

Table 8. (Cont.)

Lab.	Clock	56684	56714	56744	56774	56804	56834	56869	56899	56929	56959	56989	57019
NTSC	35 2924	0.88	1.15	1.01	0.96	1.05	0.84	1.33	1.06	1.72	0.76	-	-
NTSC	35 2926	-2.73	-2.82	-2.56	-2.34	-1.75	-2.78	-1.68	-1.98	-1.38	-0.82	-0.90	-0.50
NTSC	35 2928	1.28	1.21	0.99	1.65	1.59	1.15	0.87	2.09	1.95	2.26	2.24	2.50
NTSC	35 2933	-3.95	-3.21	-4.60	-3.87	-3.58	-3.69	-3.89	-3.97	-3.58	-4.11	-4.64	-4.10
NTSC	35 2959	-	-	-	-	-	6.96	7.96	8.40	8.17	8.51	7.89	8.55
NTSC	35 2962	-	-	-	-	-	-3.71	-3.87	-3.77	-3.59	-3.84	-4.09	-4.06
NTSC	35 2964	-	-	-	-	-	17.36	17.52	17.37	16.92	17.48	17.85	18.11
NTSC	35 2965	-	-	-	-	-	13.63	13.93	13.48	14.02	13.79	13.71	12.90
NTSC	35 2976	-	-	-	-	-	20.66	21.78	22.46	22.67	23.24	25.76	26.19
NTSC	35 2978	-	-	-	-	-	-6.03	-5.98	-5.68	-5.94	-5.24	-5.19	-6.36
NTSC	35 2980	-	-	-	-	-	-9.46	-9.00	-8.74	-8.65	-9.06	-8.17	-8.28
NTSC	35 2981	-	-	-	-	-	-2.97	-2.70	-2.81	-3.24	-2.04	-2.17	-1.81
NTSC	40 296	-	-	-	-	-	-	-	16.12	18.52	21.19	23.68	26.24
NTSC	40 297	-	-	-	-	-	-	-	-2.60	-0.07	2.83	5.65	8.24
NTSC	40 4926	636.23	642.74	649.97	657.55	664.68	671.08	678.04	684.39	690.44	697.01	-	-
NTSC	40 4927	565.88	567.04	566.31	563.76	558.50	554.25	554.83	553.26	552.62	554.37	-	-
NTSC	40 4943	0.37	-0.10	0.25	-0.21	0.75	0.11	0.31	0.04	-0.06	0.01	0.05	0.10
NTSC	40 4945	609.63	609.46	606.73	610.27	610.45	610.24	609.94	609.22	609.52	609.55	-	-
NTSC	40 4946	554.33	554.57	552.18	552.62	552.88	552.57	-	-	-	-	-	-
ONBA	36 2228	-	-	-1.84	-2.99	-2.64	-2.47	-1.61	-2.38	-1.85	-	-	-1.89
ONRJ	35 102	-2.02	-2.05	-3.01	-2.86	-2.33	-3.30	-2.24	-1.45	-2.89	-1.48	-	-2.71
ONRJ	35 103	2.55	1.55	2.11	2.92	2.55	0.61	0.49	1.52	0.64	1.31	2.36	1.69
ONRJ	35 123	34.58	34.00	34.13	34.30	34.27	34.30	34.63	34.54	33.69	35.17	34.94	35.28
ONRJ	35 129	9.59	8.80	9.45	8.81	9.45	9.47	9.46	10.10	10.44	10.50	10.87	11.10
ONRJ	35 147	6.08	6.25	5.84	6.39	6.50	6.45	7.31	6.89	6.84	6.72	6.73	7.15
ONRJ	35 1153	3.62	3.31	2.10	1.81	2.68	2.33	1.88	2.12	1.93	2.27	2.68	3.54
ONRJ	35 1942	6.61	6.74	6.20	6.07	5.05	5.34	5.07	4.57	4.12	4.04	2.91	3.98
ONRJ	40 1950	-69.07	-66.44	-64.22	-60.56	-52.94	-40.24	-24.11	-12.86	-10.65	-7.14	-3.07	1.71
ONRJ	40 1958	37.75	40.30	43.16	46.11	47.27	46.82	46.06	45.35	45.11	44.62	44.11	43.61
ORB	35 2722	1.06	1.26	1.25	1.66	1.83	1.57	1.56	1.96	1.37	1.19	2.17	0.67
ORB	35 2723	6.48	5.86	6.31	7.25	6.73	7.33	7.02	6.32	6.26	6.12	6.55	6.14
ORB	35 2724	1.64	1.57	1.84	1.54	1.64	1.64	1.63	1.77	1.82	1.76	2.03	2.45
ORB	36 593	79.14	80.62	77.93	79.83	79.08	77.58	79.76	76.33	77.45	77.08	77.70	76.62
PL	25 124	-9.10	-8.81	-12.10	-8.09	-14.88	-15.40	-17.05	-16.26	-17.15	-11.27	-7.73	-11.64
PL	25 125	-12.31	-13.81	-13.67	-14.87	-17.31	-19.44	-20.10	-22.69	-21.52	-23.06	-23.20	-30.04

Table 8. (Cont.)

Lab.	Clock	56684	56714	56744	56774	56804	56834	56869	56899	56929	56959	56989	57019
PL	35 441	2.33	2.04	-	-	14.42	14.95	15.54	15.54	15.21	15.78	16.27	15.98
PL	35 502	4.89	3.86	2.94	3.08	2.81	-	-	24.35	26.53	-	-	-
PL	35 745	-6.11	-2.39	0.58	-0.32	0.21	-0.04	-0.82	-1.55	-0.74	-0.82	0.42	-1.01
PL	35 761	1.54	2.47	1.32	2.55	0.92	0.45	0.57	-0.16	0.15	1.67	3.89	2.57
PL	35 1120	-1.63	-1.55	-1.77	-0.46	-1.53	-1.39	-0.04	-0.80	-1.14	-1.08	-2.03	-3.87
PL	35 1746	-5.71	-2.07	4.03	3.88	18.13	32.16	31.04	32.57	25.29	22.79	19.55	16.42
PL	35 1934	2.08	2.87	2.55	2.32	3.04	2.95	2.44	2.90	3.34	3.34	3.77	3.47
PL	35 2175	-6.99	-6.77	-7.99	-7.78	-7.48	-6.53	-7.98	-7.50	-7.13	-6.91	-6.96	-
PL	35 2394	6.45	5.41	5.81	6.44	5.10	6.05	6.09	6.04	6.29	6.22	7.84	7.57
PL	35 2891	-	-	-	-	4.56	4.55	3.84	4.18	4.12	4.40	4.97	4.53
PL	40 4004	-19.93	-41.79	-81.81	-109.41	-140.29	-161.65	-184.88	-205.64	-234.31	-263.50	-284.85	-309.27
PL	40 4601	17.87	17.96	18.93	19.77	20.56	21.23	21.85	22.66	23.32	24.05	24.89	25.38
PL	40 4602	608.25	618.39	623.08	630.13	638.14	646.43	655.75	663.66	671.51	676.98	682.70	687.12
PTB	35 128	7.08	7.47	6.98	5.67	6.70	7.42	7.01	5.59	5.98	5.82	6.27	8.38
PTB	35 415	-5.77	-5.40	-5.59	-7.57	-7.83	-8.19	-8.33	-7.62	-6.69	-7.50	-8.31	-8.22
PTB	35 1072	9.90	10.81	10.44	10.64	11.94	12.99	11.98	11.12	12.11	11.92	12.82	12.18
PTB	35 2987	-	-	-	-	-	-	-	-	-	-	-	-8.43
PTB	40 506	-13.78*	-12.30*	-10.68*	-9.05*	-3.94	-2.17	-0.42	1.13	2.69	4.23	5.74	7.34
PTB	40 508	-38.62*	-35.28*	-31.72*	-28.67*	-25.54*	-22.56*	-19.87*	-16.09*	-13.24*	-9.46*	-5.95	-3.34
PTB	40 509	-0.05	0.47	0.82	0.95	1.35	1.73	2.16	2.45	2.84	3.25	3.66	5.10
PTB	40 590	-3.21	-2.78	-2.38	-2.37	-1.95	-1.30	-0.66	-0.22	0.02	0.41	-	-
PTB	92 1	2.13	2.46	2.27	2.03	1.85	2.18	2.24	2.55	2.35	2.44	2.53	2.17
PTB	92 2	1.47	1.18	1.54	1.58	2.08	2.15	1.92	1.91	1.76	1.74	1.91	1.64
ROA	35 583	6.57	6.60	6.76	6.42	6.23	6.87	7.46	7.52	7.46	7.73	7.62	6.75
ROA	35 718	6.31	6.74	6.81	6.14	5.90	5.89	5.71	6.21	5.19	5.39	5.83	5.50
ROA	35 1699	9.14	9.24	8.63	8.60	9.10	8.52	7.77	7.10	7.96	8.06	8.73	8.68
ROA	35 2270	-6.02	-5.73	-7.02	-8.23	-6.61	-6.27	-6.91	-7.10	-8.20	-7.41	-9.25	-8.66
ROA	36 1488	9.15	10.52	10.34	10.68	10.21	11.51	11.07	9.49	10.46	10.45	11.11	10.32
ROA	36 1490	12.27	9.57	7.84	13.70	9.91	10.89	12.61	11.47	9.60	12.11	12.81	11.40
ROA	40 1436	206.82	210.43	213.35	217.14	220.11	222.68	225.25	227.78	230.16	232.55	235.29	237.77
SASO	35 221	-4.16	-0.69	-0.40	-1.28	-1.75	-2.77	-	-0.85	-2.93	-1.46	-1.96	-2.09
SASO	35 1628	-0.99	-1.29	1.17	1.58	-0.16	0.12	-	-0.62	0.20	1.12	0.28	-0.28
SASO	35 2923	0.24	0.63	0.60	0.41	0.93	1.76	-	2.06	2.47	2.22	3.08	3.47
SASO	35 2932	1.10	1.23	0.98	0.99	0.55	1.64	-	1.16	1.42	1.91	1.81	1.41
SCL	35 2178	3.45	3.42	3.92	3.65	4.74	4.02	-	2.97	3.79	3.61	3.70	-

Table 8. (Cont.)

Lab.	Clock	56684	56714	56744	56774	56804	56834	56869	56899	56929	56959	56989	57019
SCL	35 2525	1.28	1.42	1.21	0.84	0.46	-0.20	-	-3.64	-2.97	-1.92	-2.42	-
SG	35 188	-	-	-	-	-	-	-	13.14	13.00	13.21	13.15	13.32
SG	35 475	-1.39	-0.89	-1.82	-1.17	-1.19	-1.37	-1.32	-1.60	-2.25	-1.52	-1.05	-1.67
SG	35 1889	19.71	19.83	-	-	-	-	-	-	-	-	-	-
SG	36 522	4.31	3.81	3.42	4.11	5.22	4.01	2.97	4.45	2.91	3.59	3.82	2.57
SG	40 7701	34.68	40.87	46.80	53.78	60.34	67.05	74.11	73.93	86.61	92.71	98.18	104.05
SIQ	36 1268	-1.35	0.18	-1.53	-4.27	-0.76	-0.11	-0.21	-0.60	0.27	0.83	-1.24	-1.53
SMD	35 1766	10.15	9.93	10.82	10.85	10.39	10.53	10.38	10.60	10.66	11.00	10.72	10.15
SMD	35 2003	6.91	6.84	6.04	6.07	4.64	5.11	4.89	5.21	4.79	3.97	3.83	4.61
SMD	35 2543	9.50	9.81	9.50	9.63	9.89	9.69	9.16	9.39	11.00	14.96	15.75	16.89
SMD	40 7909	19.45*	15.49*	10.71*	6.96*	5.72*	-0.61*	-8.03*	-11.58*	2.41	-0.06	-1.61	-8.83
SMU	36 1193	2.33	3.74	-	-	-1.13	-1.05	-0.95	-1.08	-	-	-0.68	-0.46
SP	35 572	18.36	17.31	18.07	18.51	18.54	17.86	17.44	18.15	17.52	17.29	17.26	18.00
SP	35 641	1.47	1.52	1.47	1.61	1.01	1.61	0.96	0.49	1.22	1.80	1.98	1.75
SP	35 767	15.41	14.84	14.49	14.81	15.14	15.01	14.91	15.03	15.44	15.01	14.35	14.96
SP	35 1188	-	-	-4.55	-4.64	-4.41	-5.40	-4.88	-5.37	-4.66	-4.20	-4.72	-3.67
SP	35 1642	-0.80	-0.82	-0.26	0.23	0.68	-0.31	0.03	-0.53	-0.26	-0.22	0.04	0.43
SP	35 2166	6.56	7.51	7.49	6.82	7.00	7.18	7.87	7.86	8.14	9.07	8.54	8.59
SP	35 2745	-1.07	-1.20	-1.21	-1.54	-2.29	-1.43	-2.14	-1.51	-2.09	-1.45	-2.86	-1.96
SP	35 2746	25.61	26.33	26.26	25.61	25.18	25.42	25.71	25.08	25.00	24.96	26.10	25.04
SP	35 2749	6.55	6.36	6.32	5.80	6.28	5.13	6.97	5.94	5.40	5.83	5.00	5.19
SP	35 2750	-23.81	-23.26	-22.73	-22.86	-22.71	-21.80	-22.14	-20.93	-21.58	-21.79	-21.35	-21.05
SP	35 2758	18.71	18.98	18.81	18.97	18.94	18.69	18.74	19.06	18.67	19.13	18.76	18.85
SP	36 223	9.54	8.18	10.09	8.37	8.24	10.36	8.86	8.61	9.06	8.55	8.95	8.71
SP	36 1175	1.42	3.14	2.12	2.32	3.01	3.84	4.27	3.95	2.00	2.53	2.59	3.49
SP	36 1187	-52.98	-49.77	-50.38	-51.48	-53.57	-52.26	-53.61	-53.26	-50.80	-51.32	-50.17	-48.81
SP	36 1531	76.07	76.46	77.58	77.72	77.49	77.40	78.16	77.49	78.16	77.56	79.29	78.50
SP	36 2068	3.56	-	5.85	5.07	5.26	4.56	3.77	2.98	5.84	6.21	4.87	4.82
SP	36 2218	24.02	25.08	24.26	24.09	24.79	23.66	23.58	23.86	24.60	25.16	24.48	24.63
SP	36 2295	11.76	11.16	12.85	11.73	11.93	11.18	12.07	13.17	12.81	14.06	14.74	12.92
SP	36 2297	-6.07	-4.48	-6.51	-5.03	-5.57	-6.29	-5.73	-6.40	-5.51	-4.81	-5.64	-4.58
SP	40 7201	208.57	212.00	214.59	217.16	220.02	223.00	226.73	230.30	233.46	236.48	239.90	243.53
SP	40 7203	41.33	42.12	42.93	43.73	44.47	45.25	-	-	-	-	47.09	48.03
SP	40 7210	216.90	217.95	220.72	223.29	226.80	229.77	231.40	234.30	236.56	238.64	238.62	-
SP	40 7211	75.24	76.94	78.66	80.37	82.13	83.40	84.88	86.51	88.19	89.43	90.85	92.49

Table 8. (Cont.)

Lab.	Clock	56684	56714	56744	56774	56804	56834	56869	56899	56929	56959	56989	57019
SP	40 7212	28.79	29.07	29.58	30.02	30.44	30.85	31.21	31.56	32.03	32.33	32.67	33.05
SP	40 7221	-38.32	-38.09	-37.90	-37.75	-37.57	-37.38	-37.18	-37.01	-36.77	-36.59	-36.45	-36.21
SP	40 7223	-	-	-18.18	-17.25	-16.36	-15.48	-14.48	-13.50	-12.50	-11.32	-10.25	-9.18
SP	40 7231	-	-	-	-	-	-	23.18	30.31	37.33	44.28	51.40	58.81
SP	40 7232	-	-	-	-	-	-	20.55	22.81	23.05	21.50	18.32	14.77
SU	40 3809	-6.46	-6.11	-5.95	-5.70	-5.44	-5.27	-4.95	-4.70	-4.42	-3.94	-3.52	-3.19
SU	40 3810	2.56	2.85	3.01	3.24	3.49	3.69	3.93	4.10	4.29	4.57	4.74	5.00
SU	40 3811	-	-	-	-	-	-49.64	-48.91	-48.14	-47.30	-46.41	-45.62	-44.77
SU	40 3812	7.90	8.27	8.43	8.67	8.97	9.15	9.48	9.63	9.88	10.20	10.40	10.62
SU	40 3814	37.46	38.38	39.11	39.92	40.75	41.48	42.38	43.14	43.92	44.76	-	-
SU	40 3815	-36.29	-35.65	-35.21	-34.70	-34.15	-33.71	-33.13	-32.69	-32.18	-31.65	-31.19	-30.74
SU	40 3816	49.67	50.36	50.80	51.36	52.01	52.59	53.28	53.84	54.59	55.27	-	-
SU	40 3817	54.68	55.80	55.93	56.24	57.45	57.88	58.41	58.81	59.28	59.80	61.08	62.00
SU	40 3818	-0.81	-0.73	-0.73	-0.65	-0.41	-0.24	0.05	0.26	0.50	0.85	1.10	1.38
TCC	35 768	11.17	7.91	8.36	9.47	9.14	8.95	8.89	7.08	-	-	-	-
TCC	35 1881	4.27	2.77	4.55	3.66	3.33	4.31	3.25	3.05	-	-	-	-
TCC	40 8620	14.96	15.06	15.25	14.79	14.69	16.57	14.03	14.15	-	-	-	-
TCC	40 8624	-12.81	-13.10	-12.82	-13.20	-13.28	-13.68	-12.07	-11.07	-	-	-	-
TL	35 1012	3.09	2.07	2.67	2.64	2.03	2.08	2.91	1.05	2.28	2.22	1.50	1.63
TL	35 1498	2.60	2.18	1.25	2.94	2.36	2.55	3.20	3.25	3.11	2.74	3.43	3.73
TL	35 1500	14.20	14.04	14.26	14.06	14.35	14.31	14.18	14.19	13.74	13.36	12.94	12.43
TL	35 1712	-16.76	-17.51	-17.00	-16.58	-16.80	-17.52	-16.45	-16.20	-16.60	-17.60	-16.22	-17.11
TL	35 2365	4.74	4.06	3.90	5.51	4.14	3.47	3.82	3.79	4.21	3.95	4.16	3.47
TL	35 2366	-8.68	-8.85	-8.98	-8.55	-9.40	-9.40	-8.69	-8.97	-9.78	-9.65	-10.04	-9.48
TL	35 2367	11.03	9.66	11.11	11.41	11.61	11.01	11.67	11.15	11.59	11.06	9.82	11.34
TL	35 2368	2.54	2.18	1.13	1.38	1.00	1.80	1.75	1.28	1.11	1.33	1.32	1.28
TL	35 2630	-14.59	-14.46	-14.50	-14.02	-14.08	-13.38	-13.39	-13.86	-13.14	-13.35	-13.63	-13.35
TL	35 2634	11.65	14.40	8.82	8.52	6.89	7.54	7.92	9.54	11.30	9.92	10.11	12.95
TL	35 2636	12.76	13.34	13.20	13.61	13.80	14.26	14.59	15.60	16.56	16.11	15.32	16.16
TL	35 2853	-2.50	-2.32	-2.24	-2.07	-2.09	-2.14	-2.15	-1.24	-1.89	-1.44	-1.27	-1.42
TL	35 2910	1.44	1.76	2.30	2.45	2.19	2.58	2.77	3.11	3.51	2.05	2.67	3.60
TL	40 57	-54.50	-58.03	-60.22	-63.73	-67.50	-70.00	-72.33	-74.10	-77.02	-79.87	-81.78	-81.03
TL	40 3011	-	-	-	-	-	-	-	-	-18.23	-17.69	-16.57	-14.97
TL	40 3052	-5.91	-7.58	-8.80	-11.18	-12.11	-13.31	-14.37	-15.19	-16.39	-16.90	-17.71	-18.60
TP	35 163	9.42	10.14	10.08	11.07	11.11	10.62	12.54	11.68	12.08	12.29	11.31	12.70

Table 8. (Cont.)

Lab.	Clock	56684	56714	56744	56774	56804	56834	56869	56899	56929	56959	56989	57019
TP	35 1227	14.06	-	-	7.53	8.36	7.87	7.86	7.73	7.52	7.30	7.56	6.89
TP	35 2476	7.10	7.38	7.56	9.42	11.11	11.30	11.79	11.12	11.75	11.11	9.99	9.98
TP	35 2970	-	-	-	19.56	20.00	20.04	20.91	20.71	20.47	21.51	21.03	21.38
UA	35 2465	-5.63	-6.91	-8.01	-8.02	-7.62	-11.86	-7.43	-10.28	-12.53	-11.17	-10.65	-12.96
UA	40 7854	-0.25	-0.18	-0.22	0.03	-0.05	-0.41	-0.02	-0.81	0.11	-0.29	-1.25	-0.42
UA	40 7881	2.90	2.02	1.66	1.90	1.89	2.25	2.77	2.44	3.07	3.40	1.71	0.44
UA	40 7882	9.69*	9.95*	10.23*	10.52*	11.25*	10.53*	10.48*	11.17*	11.06*	10.90*	11.34*	19.81*
UME	35 251	0.38	-2.17	-2.31	-3.16	-2.80	-3.79	-3.61	-2.90	-3.53	-	-	-3.58
UME	35 252	4.87	0.87	0.50	0.38	-0.06	0.59	0.57	1.40	1.66	-	-	-0.15
UME	35 872	-	-1.28	-0.86	-2.83	-1.85	28.27	10.29	-	-	-	-	-3.56
UME	35 2703	4.85	-1.93	-1.44	-1.82	-1.38	-0.73	2.22	1.78	2.38	-	-	2.69
USNO	35 101	5.80	6.28	6.24	7.55	7.53	8.31	8.90	9.40	8.92	10.57	10.71	10.70
USNO	35 104	19.98	18.98	18.88	19.91	19.37	19.46	19.19	20.23	19.69	20.54	20.37	19.47
USNO	35 106	1.60	1.58	1.52	1.13	1.87	0.95	0.98	1.32	0.90	0.94	0.46	0.81
USNO	35 108	2.48	1.96	2.09	2.01	2.25	3.31	1.57	2.30	3.22	2.67	2.01	2.36
USNO	35 114	3.51	3.86	2.79	3.67	2.32	3.15	3.26	2.67	3.39	2.75	2.66	3.04
USNO	35 120	22.40	22.58	22.03	21.82	22.11	21.65	20.51	21.25	21.02	21.04	21.07	21.34
USNO	35 142	-11.26	-12.93	-12.43	-12.63	-12.84	-12.68	-13.99	-14.41	-13.90	-14.44	-14.05	-14.64
USNO	35 145	23.43	24.27	24.12	25.05	24.27	26.20	27.16	25.62	26.93	27.34	-	-
USNO	35 146	14.19	13.78	14.05	-	-	-	-	-	-	-	-	-
USNO	35 150	-2.42	-2.35	-1.51	-1.55	-1.41	-1.82	-2.58	-2.22	-2.32	-2.80	-2.11	-2.19
USNO	35 152	2.53	2.50	2.61	2.49	1.40	1.11	2.24	2.47	1.66	3.20	2.41	3.31
USNO	35 153	5.67	6.34	6.91	7.24	6.99	7.47	-	-	-	-	-	-
USNO	35 156	10.65	10.55	11.21	10.92	10.76	10.88	10.11	10.05	10.59	10.34	11.30	11.09
USNO	35 161	22.08	21.09	21.76	21.91	22.25	23.39	22.68	23.17	23.78	24.38	25.01	25.33
USNO	35 164	1.26	1.26	1.46	0.81	0.34	0.90	0.87	1.51	1.11	1.02	1.25	0.65
USNO	35 165	7.69	6.46	6.93	8.33	8.71	8.12	7.58	6.39	6.22	4.91	5.13	4.49
USNO	35 166	52.54	51.71	51.17	51.28	51.71	51.59	50.68	49.63	49.22	49.86	48.65	48.17
USNO	35 169	-14.31	-14.73	-14.71	-14.91	-14.56	-14.57	-14.21	-14.04	-14.42	-14.23	-14.64	-14.60
USNO	35 173	-5.38	-8.55	-7.13	-7.11	-6.97	-7.84	-7.02	-7.37	-8.37	-8.62	-8.60	-8.96
USNO	35 213	12.12	10.65	10.41	11.01	11.39	10.99	10.78	-	-	-	-	-
USNO	35 226	8.06	8.87	8.28	8.47	7.99	8.66	9.60	8.16	9.62	8.41	8.71	9.37
USNO	35 227	28.19	27.55	26.57	26.43	-	-	-	-	-	-	-	-
USNO	35 231	-3.46	-3.06	-2.81	-2.64	-2.45	-3.81	-2.95	-3.84	-4.14	-4.74	-3.18	-1.83
USNO	35 233	16.26	15.81	15.88	15.26	15.50	15.62	15.55	14.87	15.05	14.79	14.81	15.53

Table 8. (Cont.)

Lab.	Clock	56684	56714	56744	56774	56804	56834	56869	56899	56929	56959	56989	57019
USNO	35 244	6.16	5.69	4.98	5.46	5.14	6.36	4.82	6.69	6.41	6.17	6.23	6.65
USNO	35 253	-27.20	-27.68	-28.32	-27.61	-28.44	-29.38	-30.27	-30.14	-30.04	-29.47	-30.20	-30.22
USNO	35 254	7.90	8.29	8.07	8.18	8.50	8.81	8.21	8.35	8.58	7.33	8.17	7.98
USNO	35 256	21.05	20.30	21.45	20.80	21.10	20.90	19.80	20.96	20.98	21.75	21.86	22.12
USNO	35 260	32.92	33.42	34.05	35.71	36.54	37.99	38.23	36.10	39.24	41.03	39.47	38.12
USNO	35 268	-6.03	-5.95	-6.37	-8.21	-8.82	-9.63	-10.45	-9.96	-9.01	-12.01	-15.45	-16.73
USNO	35 270	16.02	16.84	16.98	16.10	17.09	16.02	14.98	15.36	16.18	15.39	14.90	15.02
USNO	35 279	26.90	27.43	28.09	30.66	30.49	30.74	29.87	29.79	28.29	28.30	28.34	27.85
USNO	35 389	-20.27	-20.36	-20.08	-19.88	-19.85	-19.49	-20.14	-20.57	-19.89	-18.70	-17.90	-16.95
USNO	35 394	-38.46	-37.22	-36.28	-36.46	-36.52	-36.45	-36.61	-36.70	-36.07	-36.94	-35.87	-36.80
USNO	35 416	-2.96	-2.15	-1.45	-1.06	-0.58	-0.76	-1.61	-0.43	-0.44	-1.99	-3.05	-4.82
USNO	35 417	-6.44	-6.62	-5.96	-5.65	-5.46	-5.78	-6.53	-6.03	-6.60	-5.30	-6.82	-6.38
USNO	35 703	0.58	-0.61	0.62	0.27	-0.32	0.02	0.10	-0.88	-0.91	-2.75	-1.35	-2.32
USNO	35 717	-10.71	-11.35	-10.53	-10.89	-10.34	-10.08	-10.39	-10.49	-9.41	-9.72	-9.73	-8.94
USNO	35 762	1.57	2.21	1.71	1.53	1.52	2.16	2.03	1.48	2.08	1.98	1.96	1.87
USNO	35 763	-14.19	-14.59	-14.01	-14.37	-14.10	-14.73	-15.03	-14.47	-14.69	-	-	-
USNO	35 765	-39.20	-38.95	-38.97	-38.86	-38.54	-38.82	-37.51	-40.43	-39.34	-40.31	-40.08	-41.29
USNO	35 1096	14.16	14.91	14.17	14.19	13.77	13.82	13.89	13.65	13.82	13.84	14.48	14.41
USNO	35 1097	6.70	7.63	6.44	8.03	7.94	6.04	6.59	7.06	6.81	6.99	6.38	5.76
USNO	35 1125	-6.91	-7.85	-8.92	-10.23	-10.60	-10.93	-11.12	-11.08	-11.65	-11.47	-9.67	-10.62
USNO	35 1327	-8.95	-8.45	-8.85	-8.49	-7.76	-8.42	-7.89	-8.10	-8.75	-7.70	-7.82	-7.92
USNO	35 1328	3.21	3.65	4.03	3.91	3.97	4.29	4.67	3.85	4.14	4.06	3.98	4.05
USNO	35 1331	-37.94	-38.58	-39.91	-39.86	-37.96	-37.53	-36.92	-37.56	-38.27	-36.96	-37.32	-36.72
USNO	35 1438	-1.03	-1.17	-1.21	-1.09	-1.49	-0.61	-0.31	-0.93	-	-	-	-
USNO	35 1459	-6.57	-5.66	-6.49	-6.46	-6.83	-6.68	-6.48	-4.74	-5.45	-6.09	-6.48	-7.28
USNO	35 1462	-0.26	-0.67	-0.91	-0.87	-0.29	-0.48	-0.80	-0.68	-1.40	-1.32	-1.40	-0.14
USNO	35 1463	12.38	11.69	11.75	12.25	11.91	12.07	11.53	11.46	10.69	11.37	10.70	11.00
USNO	35 1468	4.21	4.17	4.24	5.09	4.95	5.72	5.91	5.65	5.64	6.47	6.34	6.32
USNO	35 1481	-24.05	-24.85	-24.83	-25.15	-25.06	-25.41	-25.93	-25.59	-25.73	-25.61	-26.82	-26.81
USNO	35 1543	5.60	5.64	5.01	5.14	4.70	4.01	4.35	3.62	2.79	2.50	2.89	3.14
USNO	35 1573	13.53	12.97	12.96	11.49	13.42	12.32	11.97	12.38	13.10	12.40	12.78	12.60
USNO	35 1575	-2.73	-3.34	-2.84	-2.90	-2.91	-2.07	-2.43	-2.91	-3.02	-3.17	-3.33	-3.88
USNO	35 1580	-18.24	-18.05	-17.67	-17.58	-17.73	-19.64	-19.16	-19.84	-18.92	-18.20	-16.50	-15.70
USNO	35 1585	25.80	23.83	24.01	23.87	21.77	22.75	22.46	22.09	22.57	22.43	23.84	20.34
USNO	35 1598	-11.74	-10.36	-10.52	-10.31	-10.14	-10.31	-10.89	-10.84	-11.40	-10.99	-11.17	-11.14

Table 8. (Cont.)

Lab.	Clock	56684	56714	56744	56774	56804	56834	56869	56899	56929	56959	56989	57019
USNO	35 1655	-	-	-	-	-	-	-	-	-	-	-	-6.65
USNO	35 1658	21.13	21.28	22.43	22.47	22.16	22.01	22.10	21.80	21.79	21.46	22.01	21.94
USNO	35 1692	-4.16	-3.54	-3.32	-3.96	-4.02	-3.90	-4.49	-4.14	-4.73	-4.79	-4.44	-4.81
USNO	35 1694	20.57	20.66	20.65	20.58	20.84	20.15	20.63	19.59	19.09	19.11	18.99	18.80
USNO	35 1696	11.24	11.34	11.15	10.66	10.86	10.27	10.19	10.39	9.36	10.56	10.35	10.08
USNO	35 1697	24.77	24.31	25.38	24.78	25.18	25.62	25.04	25.55	25.45	25.52	25.47	25.71
USNO	40 701	28.64	29.05	29.60	29.84	29.68	29.53	29.10	27.43	25.90	25.57	25.36	25.43
USNO	40 702	-8.81	-8.65	-8.62	-8.52	-8.57	-8.54	-8.49	-8.42	-8.36	-8.35	-8.26	-8.25
USNO	40 704	34.17	34.29	34.43	34.53	34.56	34.57	34.60	34.68	34.79	35.02	35.14	35.23
USNO	40 705	-72.77	-72.62	-72.49	-72.42	-72.44	-72.34	-72.35	-72.18	-72.07	-71.92	-71.84	-71.65
USNO	40 708	87.95	88.22	88.51	88.78	89.09	89.35	89.60	89.83	90.10	90.35	90.65	90.90
USNO	40 710	-542.48	-542.18	-541.89	-541.60	-541.28	-540.99	-540.70	-540.45	-540.11	-539.89	-539.53	-
USNO	40 711	370.28	371.58	373.00	374.52	375.81	377.16	378.85	380.50	382.00	383.41	384.80	386.32
USNO	40 712	60.36	60.38	60.37	60.37	60.43	60.36	60.24	60.11	60.08	60.04	60.00	59.99
USNO	40 713	38.66	39.33	39.91	40.50	41.09	41.64	42.26	42.87	43.46	44.07	44.77	45.60
USNO	40 714	-2.81	-2.14	-1.71	-1.50	-1.42	-1.16	-0.84	-0.12	0.15	0.45	1.01	1.27
USNO	40 715	107.46	108.13	108.91	109.51	110.21	110.69	111.12	111.63	111.94	112.37	112.86	113.36
USNO	40 716	216.98	217.14	217.18	217.29	217.47	217.62	217.69	217.79	217.93	218.04	218.16	218.30
USNO	40 717	71.50	73.26	75.04	76.78	78.56	80.54	82.60	84.55	86.16	87.78	89.66	91.13
USNO	40 718	214.69	216.33	217.89	219.67	221.13	222.59	224.20	226.19	228.10	229.90	231.67	240.19
USNO	40 719	99.77	100.81	101.89	102.85	103.88	104.84	105.87	106.93	108.01	108.99	110.01	110.96
USNO	40 720	206.21	208.29	210.26	212.37	214.21	216.42	218.76	221.10	223.84	225.96	228.33	230.44
USNO	40 721	-	-	-	-548.77	-544.52	-540.41	-535.90	-532.09	-528.03	-524.34	-520.51	-516.64
USNO	40 722	509.84	665.84	731.90	751.95	772.31	786.25	807.56	819.56	830.15	-	-	-
USNO	40 723	-67.00	-66.80	-66.75	-66.59	-66.70	-66.71	-66.66	-66.40	-66.19	-65.88	-65.82	-65.71
USNO	40 724	-101.94	-102.46	-102.53	-102.50	-102.41	-102.33	-102.39	-102.37	-102.43	-102.57	-102.53	-101.06
USNO	40 725	-38.23	-38.02	-37.79	-37.67	-37.48	-37.34	-37.25	-37.33	-37.06	-37.07	-36.96	-36.85
USNO	40 726	-	-	-	66.34	69.80	73.20	76.95	80.72	84.24	87.69	91.25	94.80
USNO	40 727	-	-	-	-773.41	-773.01	-772.08	-771.34	-770.54	-769.70	-768.32	-766.68	-764.84
USNO	40 728	354.16	357.16	360.10	363.13	366.20	369.19	372.45	375.72	378.67	381.60	384.55	387.48
USNO	40 729	188.44	193.38	198.24	202.96	207.75	212.45	217.51	222.62	227.20	231.89	236.55	240.98
USNO	40 730	242.55	245.88	249.25	252.51	255.86	259.22	262.81	266.43	269.70	272.99	276.37	279.62
USNO	40 731	-173.53	-173.98	-175.72	-175.86	-176.20	-176.63	-176.90	-176.97	-176.96	-177.14	-177.15	-177.16
USNO	40 732	-18.60	-15.67	-12.69	-9.83	-6.96	-5.10	-2.45	0.66	3.71	6.58	9.60	12.56
USNO	40 734	363.66	357.19	350.84	344.77	338.54	332.48	325.87	-	-	-	301.57	296.12

Table 8. (Cont.)

Lab.	Clock		56684	56714	56744	56774	56804	56834	56869	56899	56929	56959	56989	57019
USNO	40	735	139.72	144.63	149.53	154.10	158.51	164.09	169.63	174.87	179.59	184.31	188.79	192.65
USNO	40	736	46.88	47.75	50.38	52.84	55.65	59.26	63.29	67.58	71.75	76.11	80.75	85.50
USNO	40	737	83.17	90.78	98.95	107.53	116.31	125.03	134.81	145.02	154.43	163.60	172.66	181.93
USNO	93	2	-5.93	-5.93	-5.88	-5.91	-5.90	-5.90	-5.93	-5.97	-5.98	-6.03	-5.96	-5.93
USNO	93	3	-5.95	-5.91	-5.87	-5.73	-5.71	-5.73	-5.80	-5.84	-5.79	-5.89	-5.86	-5.85
USNO	93	4	-5.77	-5.76	-5.76	-5.77	-5.75	-5.75	-5.81	-5.80	-5.81	-5.85	-5.82	-5.80
USNO	93	5	-5.82	-5.79	-5.79	-5.84	-5.84	-5.82	-5.85	-5.87	-5.88	-5.92	-5.88	-5.87
VMI	35	2230	-20.75	-19.75	-22.48	-21.77	-20.88	-20.13	-20.93	-20.40	-20.51	-21.01	-17.01	-17.68
VMI	36	1233	-4.05	-2.38	-	-5.66	-8.47	-6.97	-6.23	-5.61	-4.55	-7.85	-1.81	-2.09
VMI	36	2314	20.01	21.96	20.05	20.79	23.05	20.82	20.40	21.07	20.46	18.35	22.73	23.25
VSL	35	179	-27.20	-27.40	-26.53	-26.16	-26.89	-26.38	-26.63	-27.24	-26.17	-	-	-
VSL	35	456	-2.80	-3.09	-3.87	-3.74	-3.08	-2.83	-2.49	-1.85	-2.02	-3.66	-3.76	-3.41
VSL	35	548	-	-	16.19	15.58	16.95	16.26	15.76	16.08	16.96	16.30	16.70	15.19
VSL	35	731	-7.70	-7.94	-8.41	-7.96	-7.88	-7.07	-7.35	-6.57	-6.02	-7.61	-8.10	-7.96
ZA	35	2233	-	-14.03	-13.84	-14.10	-13.95	-13.48	-13.58	-14.01	-14.20	-14.22	-14.01	-13.86
ZA	36	1034	-	-12.60	-13.37	-15.20	-16.56	-14.43	-14.23	-12.08	-13.75	-10.96	-13.21	-12.08
ZA	36	1821	-	-7.41	-6.69	-7.61	-6.98	-7.98	-6.91	-6.50	-7.20	-7.45	-6.90	-7.25
ZA	36	2232	-	9.60	9.41	7.40	9.29	7.24	7.52	9.36	7.13	7.65	7.06	7.21

Table 9A. Relative weights (in percent) of contributing clocks in 2014

(File available at ftp://62.161.69.5/pub/tai/scale/WTAI/wtai14.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	56684	56714	56744	56774	56804	56834	56869	56899	56929	56959	56989	57019
APL	35 904	-	-	-	-	0.000	0.000	0.000	0.000	-	0.000	0.000	0.000
APL	35 1264	-	-	-	-	0.000	0.000	0.000	0.000	-	0.000	0.000	0.000
APL	35 1791	-	-	-	-	0.000	0.000	0.000	0.000	-	0.000	0.000	0.000
APL	40 3107	-	-	-	-	0.000	0.000	0.000	0.000	0.000	1.039	1.058	1.044
APL	40 3108	-	-	-	-	0.000	0.000	0.000	0.000	0.000	1.039	1.058	1.044
APL	40 3109	-	-	-	-	0.000	0.000	0.000	0.000	0.000	1.039	1.058	1.044
AUS	35 2269	0.147	0.134	0.107	0.112	0.123	0.103	0.091	0.086	0.093	0.098	0.130	0.161
AUS	36 299	0.029	0.032	0.033	0.040	0.049	0.048	0.037	0.038	0.042	0.043	0.056	0.069
AUS	36 340	0.021	0.021	0.021	0.021	0.022	0.025	0.026	0.031	0.029	0.032	0.041	0.020
AUS	36 654	0.070	0.056	0.037	0.033	0.037	0.041	0.048	0.047	0.055	0.063	0.071	0.090
AUS	36 1141	0.013	0.011	0.010	0.011	0.013	0.016	0.015	0.011	0.011	0.011	0.014	0.011
BEV	35 1065	0.000	0.000	0.000	0.000	-	-	-	-	-	-	-	-
BEV	35 1793	0.315	0.351	0.365	0.306	0.126	0.144	0.164	0.179	0.193	0.192	0.180	0.176
BEV	35 3009	-	-	-	-	-	-	0.000	0.000	0.000	0.000	0.000	0.357
BEV	40 3452	-	-	-	0.000	0.000	0.000	0.000	0.000	0.052	0.062	0.077	0.097

Table 9A. (Cont.)

Lab.	Clock	56684	56714	56744	56774	56804	56834	56869	56899	56929	56959	56989	57019
AUS	36 1141	0.013	0.011	0.010	0.011	0.013	0.016	0.015	0.011	0.011	0.011	0.014	0.011
BEV	35 1065	0.000	0.000	0.000	0.000	-	-	-	-	-	-	-	-
BEV	35 1793	0.315	0.351	0.365	0.306	0.126	0.144	0.164	0.179	0.193	0.192	0.180	0.176
BEV	35 3009	-	-	-	-	-	-	0.000	0.000	0.000	0.000	0.000	0.357
BEV	40 3452	-	-	-	0.000	0.000	0.000	0.000	0.000	0.052	0.062	0.077	0.097
BIM	18 8058	0.046	0.048	0.034	0.027	0.030	0.034	0.040	0.034	0.020	0.020	0.023	0.026
BY	40 4222	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 4227	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.007	0.000	0.000	0.000	0.000
BY	40 4229	0.000	0.000	0.000	0.000	0.000	0.024	0.031	0.041	0.046	0.000	0.000	0.000
CH	22 112	0.000	0.000	0.000	0.009	0.010	0.000	0.000	0.000	0.000	-	-	-
CH	24 105	-	-	-	-	-	-	-	-	-	-	0.000	0.000
CH	35 2117	0.037	0.038	0.025	0.021	0.023	0.024	0.023	0.026	0.030	0.035	0.034	0.027
CH	35 2743	0.302	0.226	0.200	0.081	0.058	0.066	0.073	0.067	0.073	0.046	0.054	0.038
CH	40 5701	0.328	0.360	0.386	0.481	0.576	0.791	-	-	0.000	0.000	0.000	0.000
CNM	35 2708	0.000	0.000	-	-	0.000	0.000	0.000	0.000	-	0.000	0.000	-
CNM	35 2709	0.000	0.000	-	-	0.000	0.000	0.000	0.000	-	0.000	0.000	-
CNM	35 2885	-	-	-	-	0.000	0.000	0.000	0.000	-	0.000	0.000	-
CNM	40 7301	0.000	0.000	-	-	0.000	0.000	0.000	0.000	-	0.000	0.000	-
CNM	40 7302	-	-	-	-	0.000	0.000	0.000	0.000	-	0.000	0.000	-
CNMP	36 1752	0.029	0.031	0.031	0.018	0.020	0.023	-	0.000	0.000	0.000	0.000	-
CNMP	36 1806	0.012	0.013	0.010	0.009	0.010	0.012	-	0.000	0.000	0.000	0.000	-
CNMP	36 2873	0.041	0.044	0.046	0.052	0.058	0.061	-	0.000	0.000	0.000	0.000	-
DMDM	35 2191	0.285	0.196	0.194	0.188	0.207	0.161	-	-	0.000	0.000	0.000	0.000
DMDM	36 2033	0.000	0.000	0.000	0.000	0.070	0.072	-	-	0.000	0.000	0.000	0.000
DTAG	35 2805	0.253	0.292	0.264	0.284	0.330	0.051	0.053	-	0.000	0.000	0.000	0.000
DTAG	35 2941	0.000	0.000	0.000	0.143	0.184	0.248	0.198	-	0.000	0.000	0.000	0.000
DTAG	35 2966	-	-	-	-	-	-	0.000	-	0.000	0.000	0.000	0.000
DTAG	36 2794	0.028	0.024	0.025	0.028	0.030	-	-	-	-	-	-	-
EIM	35 716	0.000	0.000	0.009	0.012	-	0.000	-	-	-	-	-	-
EIM	35 2060	0.649	0.757	0.758	0.543	-	-	-	-	-	0.000	0.000	0.000
ESTC	22 132	0.045	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	-	-
ESTC	35 1615	0.129	0.135	0.148	0.172	0.151	0.178	0.158	0.212	0.179	0.147	-	-
ESTC	35 2025	-	-	0.000	0.000	0.000	0.000	0.000	0.237	0.322	0.372	-	-
ESTC	35 2353	0.364	0.456	0.437	0.387	0.152	-	-	-	-	-	-	-
ESTC	40 2551	0.920	0.700	0.603	0.681	0.671	0.723	0.696	0.697	0.452	0.482	-	-

Table 9A. (Cont.)

Lab.	Clock		56684	56714	56744	56774	56804	56834	56869	56899	56929	56959	56989	57019
F	35	124	0.254	0.250	0.185	0.201	0.208	0.236	0.277	0.243	0.280	0.278	0.350	0.209
F	35	157	0.312	-	-	0.000	0.000	0.000	0.000	0.000	0.998	0.304	0.099	0.103
F	35	158	0.059	0.062	0.059	0.059	0.065	0.080	0.095	0.114	0.152	0.097	0.121	0.089
F	35	355	0.119	0.090	0.087	0.078	0.053	0.059	0.068	0.059	0.066	0.035	0.041	0.042
F	35	385	0.046	0.050	0.057	0.038	0.038	0.047	0.053	0.059	0.064	0.062	0.072	0.076
F	35	396	0.197	0.172	0.168	0.132	0.145	0.179	0.200	0.234	0.187	0.174	0.215	0.182
F	35	469	-	-	-	0.000	0.000	0.000	0.000	0.000	0.043	0.039	0.051	0.043
F	35	489	-	-	-	0.000	0.000	0.000	0.000	0.000	0.117	0.149	0.096	0.122
F	35	609	0.090	0.095	0.094	0.076	0.085	0.102	0.116	0.117	0.128	0.139	0.154	0.174
F	35	700	0.017	0.019	0.019	0.021	0.026	0.035	0.051	0.052	0.045	-	-	-
F	35	770	0.042	0.044	0.042	0.046	0.052	0.031	0.034	0.038	0.044	0.051	0.066	0.078
F	35	774	0.172	0.183	0.190	0.221	0.265	0.323	0.400	0.223	0.235	0.187	0.219	0.247
F	35	781	0.110	0.113	0.111	0.119	0.142	0.184	0.202	0.104	0.107	0.091	0.107	0.122
F	35	859	0.085	0.080	0.045	0.047	0.053	0.059	0.052	0.056	0.034	0.026	0.016	0.013
F	35	1177	0.097	0.095	0.098	0.105	0.129	0.117	0.149	0.166	0.075	0.059	0.059	0.022
F	35	1222	0.351	0.400	0.287	0.393	0.598	0.754	0.891	1.003	0.998	1.039	0.205	0.215
F	35	1321	0.091	0.056	0.043	0.028	0.031	0.036	0.031	0.034	0.023	0.024	0.030	0.030
F	35	1556	0.148	0.132	0.079	0.082	0.060	0.062	0.071	0.079	0.091	0.096	0.066	0.062
F	35	1644	0.225	-	-	0.000	0.000	0.000	0.000	0.000	0.119	0.135	0.135	0.096
F	35	2388	0.134	0.059	0.049	0.050	0.055	0.064	0.075	0.089	0.082	0.078	0.079	0.090
F	35	2609	0.371	0.434	0.251	0.200	0.227	0.272	0.314	0.339	0.369	0.357	0.437	0.456
F	35	2647	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.021	0.016	0.016
F	35	2804	0.638	0.294	0.186	0.195	0.201	0.193	0.226	0.196	0.194	0.195	0.233	0.257
F	40	809	1.075	1.058	1.067	-	-	-	0.000	0.000	0.000	0.000	0.000	1.044
F	40	810	1.075	1.058	1.067	1.023	0.998	1.010	1.013	1.015	0.998	1.039	-	-
F	40	889	1.075	1.058	1.067	1.023	0.998	1.010	1.013	1.015	0.998	1.039	1.058	1.044
F	40	890	1.075	1.058	1.067	1.023	0.998	1.010	1.013	1.015	0.998	1.039	1.058	1.044
HKO	35	2425	0.357	0.400	0.384	0.405	0.384	0.298	0.356	0.200	0.227	0.208	0.254	0.152
HKO	35	2884	0.000	0.561	0.500	0.479	0.215	0.084	0.104	0.122	0.117	0.123	0.152	0.113
IFAG	36	1167	0.061	0.054	0.055	0.028	0.031	0.019	0.012	0.013	0.014	0.011	0.014	0.016
IFAG	36	1173	0.012	0.013	0.011	0.010	0.011	0.013	0.014	-	-	-	-	-
IFAG	36	1629	0.029	0.030	0.030	0.032	0.038	0.037	0.044	0.056	0.056	0.051	0.060	0.071
IFAG	36	1732	0.126	0.084	0.082	0.071	0.078	0.092	0.071	0.060	0.061	0.065	0.064	0.052
IFAG	36	1798	0.219	0.213	0.194	0.219	0.267	0.296	0.395	0.332	0.330	0.249	0.261	0.254
IFAG	40	4418	0.891	0.823	0.828	0.954	0.708	0.850	0.993	1.015	0.998	1.039	0.981	1.044

Table 9A. (Cont.)

Lab.	Clock	56684	56714	56744	56774	56804	56834	56869	56899	56929	56959	56989	57019
IFAG	40 4439	0.107	0.120	0.122	0.139	0.160	0.178	-	-	0.000	0.000	0.000	0.000
IGNA	35 1196	0.047	-	-	0.000	0.000	0.000	-	-	0.000	0.000	0.000	-
INPL	35 2480	0.123	0.094	0.072	0.061	0.054	0.050	0.051	0.057	0.065	0.069	0.079	0.089
INPL	35 2481	0.570	0.516	0.503	0.355	0.327	0.151	0.172	0.182	0.177	0.170	0.196	0.194
INTI	35 2377	0.006	0.008	0.006	0.007	0.007	0.009	0.011	0.013	0.016	0.017	0.026	0.039
INXE	35 2393	-	0.000	0.000	0.000	0.000	0.000	0.025	0.017	0.018	0.020	0.025	0.029
IPQ	35 2012	0.000	-	0.000	0.000	0.000	-	-	-	-	-	-	-
IPQ	35 2890	0.000	-	0.000	0.000	0.000	0.000	0.000	0.114	0.057	0.070	0.088	-
IT	35 219	0.084	0.087	0.083	0.087	0.088	0.103	0.105	0.112	0.101	0.049	0.057	0.059
IT	35 505	0.191	0.167	0.123	0.131	0.073	0.077	0.087	0.098	0.103	0.087	0.110	0.115
IT	35 1115	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.009	0.014	0.016
IT	35 1373	0.223	0.228	0.169	0.188	0.209	0.267	0.246	0.229	0.255	0.280	0.299	0.206
IT	35 2118	0.115	0.114	0.116	0.128	0.150	0.161	0.210	0.249	0.276	0.270	0.363	0.360
IT	35 2487	0.282	0.263	0.275	0.344	0.308	0.380	0.420	0.239	0.206	0.137	0.169	0.186
IT	40 1101	0.482	0.500	0.489	0.459	0.495	0.580	0.706	0.858	0.920	1.013	1.058	1.044
IT	40 1102	0.281	0.284	0.271	0.285	0.352	0.421	0.514	0.430	0.502	0.476	0.474	0.555
IT	40 1103	0.493	0.557	0.582	0.534	0.667	0.922	1.013	1.015	0.998	1.039	1.058	1.044
IT	40 1104	-	-	-	-	-	-	-	0.000	0.000	0.000	0.000	0.000
JV	21 216	0.015	0.018	0.018	0.019	0.022	-	0.000	0.000	0.000	0.000	0.000	0.000
JV	36 1277	0.024	0.023	0.021	0.020	0.019	-	0.000	0.000	0.000	0.000	0.000	0.029
JV	36 2617	0.041	0.039	0.044	0.039	0.044	-	0.000	0.000	0.000	0.000	0.000	0.028
JV	36 2629	0.027	0.029	0.019	0.012	0.013	-	0.000	0.000	0.000	0.000	0.000	0.053
JV	40 8713	-	0.000	0.000	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.047
KEBS	35 2518	-	0.000	0.000	-	-	-	0.000	-	0.000	0.000	0.000	-
KIM	36 618	0.015	0.017	0.012	0.013	0.013	-	-	-	-	-	-	-
KRIS	35 321	0.000	0.246	0.287	0.352	0.236	0.158	0.101	0.118	0.121	-	-	0.000
KRIS	35 739	0.000	0.108	0.085	0.103	0.105	0.130	0.103	0.121	0.130	0.138	-	0.000
KRIS	35 1135	0.000	0.201	0.159	0.167	0.209	0.203	0.114	0.045	0.050	-	-	0.000
KRIS	35 1693	0.000	0.103	0.110	0.101	0.105	0.126	0.154	0.181	0.182	-	-	0.000
KRIS	35 1783	0.000	0.156	0.183	0.222	0.203	0.177	0.208	0.244	0.224	-	-	0.000
KRIS	40 5625	0.000	0.000	0.000	0.000	0.141	0.094	0.125	0.158	0.187	-	-	0.000
KRIS	40 5626	0.000	1.058	1.067	1.023	0.998	1.010	1.013	1.015	0.998	1.039	-	0.000
KZ	35 2202	0.041	0.049	0.050	0.056	0.065	0.047	0.000	0.000	0.000	-	-	0.000
KZ	35 2665	0.000	0.057	0.051	0.052	0.059	0.064	0.059	0.070	0.060	-	-	0.000
KZ	35 2667	0.029	0.035	0.036	0.043	0.050	0.061	0.061	0.056	0.088	-	-	0.000

Table 9A. (Cont.)

Lab.	Clock	56684	56714	56744	56774	56804	56834	56869	56899	56929	56959	56989	57019
LT	35 1362	0.018	0.018	0.011	0.013	0.015	0.018	0.018	0.018	0.021	0.022	0.028	0.029
LT	35 1868	0.080	0.096	0.077	0.089	0.103	0.128	0.105	0.073	0.080	0.085	0.090	0.102
MASM	35 2900	-	-	-	-	-	-	-	-	-	-	0.000	0.000
MIKE	36 986	-	0.000	0.000	0.000	0.000	0.000	0.022	0.029	0.037	0.032	0.034	0.039
MIKE	40 4108	-	-	-	-	0.000	-	0.000	0.000	0.000	0.000	0.000	1.044
MIKE	40 4113	-	0.000	0.000	0.000	0.000	0.000	0.242	0.096	0.019	0.018	0.024	0.028
MIKE	40 4180	-	0.000	0.000	0.000	0.000	0.000	0.595	0.818	0.730	0.816	1.058	1.044
MKEH	36 849	0.070	0.060	0.059	0.062	0.043	0.049	0.060	0.056	0.053	0.034	0.026	0.029
MSL	36 274	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	-
MSL	36 2869	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	-
MTC	35 3002	-	-	-	-	-	-	-	-	-	-	-	0.000
MTC	35 3003	-	-	-	-	-	-	-	-	-	-	-	0.000
MTC	35 3004	-	-	-	-	-	-	-	-	-	-	-	0.000
MTC	35 3005	-	-	-	-	-	-	-	-	-	-	-	0.000
NAO	35 779	-	0.000	0.000	0.000	0.000	0.000	0.549	0.739	0.889	0.032	0.010	0.009
NAO	35 1206	-	0.000	0.000	0.000	0.000	0.000	0.035	0.045	0.056	0.059	0.026	0.027
NAO	35 1214	-	0.000	0.000	0.000	0.000	0.000	0.089	0.083	0.057	0.045	0.055	0.066
NAO	35 1689	-	0.000	0.000	0.000	0.000	0.000	0.190	0.254	0.294	0.112	0.042	0.051
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	35 112	0.035	0.037	0.027	0.020	0.021	0.023	0.027	0.026	0.030	-	-	-
NICT	35 332	0.121	0.110	0.077	0.083	0.070	0.082	0.096	0.114	0.128	0.124	0.090	0.105
NICT	35 343	0.159	0.129	0.114	0.108	0.094	0.102	0.116	0.125	0.142	0.159	0.133	0.114
NICT	35 715	1.075	0.760	0.659	0.254	0.213	0.246	0.268	0.299	0.321	0.283	0.305	0.336
NICT	35 732	0.610	0.685	0.660	0.510	0.455	0.522	0.656	0.693	0.574	0.550	0.340	0.383
NICT	35 907	0.449	0.431	0.437	0.473	0.294	0.266	0.231	0.245	0.268	0.284	0.364	0.203
NICT	35 913	0.034	0.036	0.035	0.036	0.030	0.037	0.042	0.051	0.064	0.075	0.094	0.107
NICT	35 916	0.156	-	-	-	-	-	-	0.000	0.000	0.000	0.000	0.000
NICT	35 1225	0.080	-	-	0.000	0.000	0.000	0.000	0.000	0.143	0.183	0.089	0.085
NICT	35 1226	0.057	0.046	0.041	0.033	0.036	0.041	0.049	0.054	0.060	0.066	0.083	0.097
NICT	35 1611	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.079	0.074	0.090	0.087	0.088
NICT	35 1778	0.333	0.378	0.393	0.331	0.392	0.148	0.168	0.183	0.176	0.167	0.173	0.153
NICT	35 1789	0.236	0.260	0.273	0.330	0.374	0.404	0.464	0.542	0.529	0.501	0.563	0.231
NICT	35 1790	0.101	0.059	0.049	0.049	0.046	0.054	0.058	0.053	0.060	0.065	0.084	0.104
NICT	35 1866	0.154	0.174	0.122	0.099	0.115	0.143	0.168	0.195	0.193	0.186	0.240	0.257
NICT	35 1882	0.225	0.239	0.238	0.253	0.311	0.307	0.118	0.121	0.097	0.079	0.097	0.108

Table 9A. (Cont.)

Lab.	Clock	56684	56714	56744	56774	56804	56834	56869	56899	56929	56959	56989	57019
NICT	35 1887	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
NICT	35 1944	0.523	0.389	0.398	0.113	0.083	0.094	0.095	0.060	0.064	0.058	0.064	0.058
NICT	35 2010	0.179	0.238	0.089	0.098	0.113	0.142	0.109	0.111	0.127	0.133	0.151	0.178
NICT	35 2011	0.262	0.309	0.143	0.141	0.156	0.152	0.166	0.131	0.146	0.156	0.155	0.177
NICT	35 2056	0.119	0.120	0.105	0.098	0.111	0.136	0.167	0.179	0.169	0.198	0.278	0.292
NICT	35 2113	0.279	0.291	0.256	0.288	0.370	0.203	0.229	0.257	0.288	0.265	0.339	0.132
NICT	35 2116	-	-	-	-	-	-	-	-	-	-	0.000	0.000
NICT	35 2570	0.067	0.068	0.062	0.056	0.061	0.069	0.075	0.092	0.114	0.111	0.150	0.164
NICT	35 2574	0.592	0.294	0.225	0.210	0.168	0.129	0.147	0.162	0.163	0.169	0.180	0.202
NICT	35 2627	0.321	0.239	0.211	0.232	0.218	0.235	0.216	0.111	0.121	0.040	0.049	0.043
NICT	35 2628	0.138	0.131	0.102	0.110	0.068	0.055	0.064	0.071	0.077	0.082	0.106	0.104
NICT	35 2784	0.230	0.199	0.165	0.140	0.153	0.169	0.209	0.234	0.254	0.212	0.265	0.232
NICT	35 2876	-	-	-	-	-	-	-	-	0.000	0.000	0.000	0.000
NICT	35 2903	0.000	1.058	1.067	0.804	0.998	0.823	0.561	0.482	0.276	0.244	0.251	0.250
NICT	36 1217	0.012	0.013	0.008	0.009	0.009	0.011	0.012	0.011	0.013	0.013	0.016	0.017
NICT	40 2003	0.117	0.144	0.175	0.244	0.348	0.501	0.567	0.713	0.856	1.037	1.058	1.044
NICT	40 2004	1.075	1.058	1.067	1.023	0.998	1.010	1.013	1.015	0.998	1.039	1.058	1.044
NICT	40 2005	0.237	0.242	0.214	0.224	0.253	0.317	0.396	0.432	0.541	0.631	0.899	0.083
NICT	40 2006	0.394	0.388	0.342	0.310	0.361	0.457	0.573	0.722	0.800	0.957	1.058	1.044
NIM	35 1235	0.032	0.035	0.036	0.040	0.053	0.056	0.036	0.025	0.027	0.026	0.029	0.028
NIM	35 2239	0.283	0.271	0.224	0.199	0.230	0.110	0.123	0.138	-	-	-	0.000
NIM	35 2256	0.096	0.060	0.046	0.045	0.047	0.055	0.064	0.070	0.081	0.094	0.115	0.157
NIM	35 2483	0.364	0.289	0.252	0.183	0.196	0.229	0.261	0.276	0.312	0.253	-	0.000
NIM	35 2643	0.601	0.591	0.504	0.500	0.495	0.620	0.794	0.938	0.929	1.039	0.752	0.824
NIM	35 2744	0.401	0.609	0.767	0.816	0.690	0.861	0.691	0.696	0.748	0.745	0.358	0.404
NIM	35 2767	0.121	0.108	0.092	0.078	0.085	0.104	0.070	0.068	0.077	0.083	0.102	0.125
NIM	35 2769	-	-	-	-	-	-	-	-	-	0.000	0.000	0.000
NIM	40 4832	0.000	0.000	0.864	0.248	0.238	0.233	0.294	0.299	0.280	0.185	0.225	0.261
NIM	40 4835	0.000	0.000	0.000	0.000	0.010	-	-	-	-	-	-	-
NIM	40 4871	0.000	0.000	0.676	0.899	0.541	0.715	0.899	1.005	0.998	0.761	0.912	1.044
NIM	40 4878	0.000	0.000	1.035	0.340	0.115	0.129	0.164	0.196	0.191	0.181	0.221	0.152
NIM	40 4879	0.000	0.000	0.053	0.065	0.061	0.047	0.052	0.000	0.000	0.000	0.000	0.000
NIM	40 4880	0.000	0.000	0.413	0.416	0.345	0.272	0.166	0.093	0.071	0.061	0.073	0.079
NIMB	35 600	0.000	0.000	0.000	0.000	0.012	0.017	0.023	0.028	0.033	0.022	0.028	0.033
NIMT	35 2246	0.000	0.000	0.000	-	-	0.000	0.000	0.000	0.000	0.000	0.052	0.069

Table 9A. (Cont.)

Lab.	Clock	56684	56714	56744	56774	56804	56834	56869	56899	56929	56959	56989	57019
NIMT	35 2247	0.000	0.000	0.000	0.000	0.116	0.010	0.008	0.010	0.012	0.009	0.007	0.008
NIS	35 1126	-	-	-	-	-	-	0.000	0.000	0.000	0.000	0.000	0.000
NIST	35 282	-	-	-	0.000	0.000	0.000	0.000	0.000	0.094	0.120	0.172	0.181
NIST	35 408	0.278	0.295	0.285	0.220	0.249	0.232	0.185	0.193	0.172	0.166	0.129	0.130
NIST	35 1074	0.053	0.049	-	0.000	0.000	0.000	0.000	0.000	0.205	0.265	0.246	0.289
NIST	35 1519	0.198	0.199	0.198	0.113	0.083	0.056	0.051	0.056	0.060	0.059	0.075	0.066
NIST	35 2031	0.065	0.051	0.029	-	-	-	-	-	-	0.000	0.000	0.000
NIST	35 2032	0.000	0.000	0.077	0.086	0.094	0.115	0.078	0.090	0.103	0.097	0.141	0.160
NIST	35 2034	0.222	0.242	0.238	0.263	0.308	0.237	0.125	0.135	0.150	0.151	0.192	0.202
NIST	35 2579	0.250	0.269	0.120	0.038	0.036	0.041	0.041	0.045	0.049	0.052	0.056	0.066
NIST	35 2672	0.236	0.163	0.111	0.116	0.130	0.138	0.125	0.135	0.131	0.137	0.174	0.215
NIST	35 2935	-	-	-	-	-	-	-	-	0.000	0.000	0.000	0.000
NIST	40 204	1.075	1.058	1.067	1.023	0.998	1.010	-	-	-	-	-	-
NIST	40 205	1.075	1.058	0.096	0.100	0.998	1.010	1.013	1.015	0.998	1.039	1.058	1.044
NIST	40 206	1.075	1.058	1.067	1.023	0.998	1.010	1.013	1.015	0.959	0.991	1.058	1.032
NIST	40 212	-	-	-	-	-	-	-	-	0.000	0.000	0.000	0.000
NIST	40 222	1.075	1.058	1.067	1.023	0.998	1.010	1.013	1.015	0.998	1.039	1.058	1.044
NMIJ	35 224	0.347	0.496	0.786	1.023	0.998	0.498	0.485	0.145	0.153	0.157	0.178	0.199
NMIJ	35 523	0.321	0.252	0.223	0.245	0.220	0.260	0.227	0.218	0.162	0.100	0.124	0.115
NMIJ	40 5002	-	-	-	-	-	-	-	-	0.000	0.000	0.000	0.000
NMIJ	40 5003	1.075	1.058	1.067	1.023	0.998	1.010	1.013	1.015	-	-	0.000	0.000
NMIJ	40 5015	1.075	1.058	1.067	1.023	0.998	0.457	-	-	-	-	-	-
NMLS	35 328	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
NPL	35 1275	0.045	0.044	0.044	0.041	0.048	0.060	0.057	0.063	0.079	0.085	0.098	0.116
NPL	40 1701	1.075	1.058	1.049	0.882	0.033	0.017	0.019	0.020	0.022	0.023	0.029	0.034
NPL	40 1708	1.075	1.058	1.067	1.023	0.998	1.010	1.013	1.015	0.998	0.956	0.940	1.044
NPLI	35 57	0.059	0.066	0.069	0.066	0.077	0.065	0.081	0.052	0.039	0.039	0.020	0.021
NPLI	35 140	0.000	0.000	0.000	0.000	0.000	0.016	0.023	0.023	0.008	0.007	0.009	0.008
NPLI	35 1324	0.066	0.078	0.087	0.078	0.069	0.071	0.084	0.092	0.106	0.071	0.080	0.071
NPLI	35 2245	0.290	0.253	0.225	0.246	0.254	0.154	0.142	0.119	0.128	0.128	0.153	0.172
NPLI	35 2796	0.404	0.382	0.412	0.462	0.525	0.650	0.779	0.759	0.314	0.210	0.182	0.201
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	0.000
NRC	35 2150	0.109	0.109	0.110	0.104	0.079	0.088	0.096	0.099	0.115	0.097	0.078	0.089
NRC	35 2152	0.159	0.187	0.151	0.174	0.179	0.180	0.159	0.097	0.107	0.074	0.068	0.077
NRC	36 2219	0.064	0.065	0.067	0.076	0.068	0.082	0.097	0.091	0.112	0.057	0.059	0.057

Table 9A. (Cont.)

Lab.	Clock		56684	56714	56744	56774	56804	56834	56869	56899	56929	56959	56989	57019
NRC	40	304	0.000	0.000	0.000	0.017	-	-	-	-	-	-	-	-
NRC	40	306	0.000	0.000	0.000	0.163	0.140	0.192	0.082	0.095	0.103	0.107	0.137	0.163
NRL	35	714	-	-	0.000	0.000	0.000	0.000	-	-	-	-	-	-
NRL	35	719	-	-	0.000	0.000	0.000	0.000	-	-	-	-	-	-
NRL	35	1245	-	-	0.000	0.000	0.000	0.000	-	-	-	-	-	-
NRL	35	2460	-	-	-	0.000	-	-	-	-	-	-	-	-
NRL	35	2464	-	-	-	0.000	-	-	-	-	-	-	-	-
NRL	35	2580	-	-	-	0.000	-	-	-	-	-	-	-	-
NRL	36	387	-	-	0.000	0.000	0.000	0.000	-	-	-	-	-	-
NRL	40	1001	-	-	0.000	0.000	0.000	0.000	-	-	-	-	-	-
NRL	40	1003	-	-	0.000	0.000	0.000	0.000	-	-	-	-	-	-
NRL	40	1009	-	-	0.000	0.000	0.000	0.000	-	-	-	-	-	-
NRL	40	1010	-	-	0.000	0.000	0.000	0.000	-	-	-	-	-	-
NTSC	35	1007	-	-	-	-	-	-	-	-	-	0.000	0.000	-
NTSC	35	1011	0.043	0.048	0.043	0.049	0.059	0.055	0.055	0.062	0.049	0.027	0.029	0.033
NTSC	35	1016	0.055	0.065	0.070	0.080	0.091	0.109	0.082	0.090	0.085	0.093	0.100	0.087
NTSC	35	1018	0.059	0.061	0.063	0.059	0.070	0.063	0.050	0.053	0.058	0.062	0.079	0.095
NTSC	35	1818	0.025	0.026	0.026	0.029	0.037	0.048	0.059	0.072	0.078	0.061	0.080	0.095
NTSC	35	1820	0.082	0.098	0.111	0.153	0.259	0.579	0.702	0.441	0.221	0.122	0.148	0.127
NTSC	35	1823	0.352	0.385	0.509	0.775	0.696	0.417	0.238	0.237	0.182	0.134	0.165	0.187
NTSC	35	2096	0.127	0.084	0.077	0.083	0.090	0.101	0.112	0.062	0.062	-	-	-
NTSC	35	2098	0.074	0.081	0.085	0.096	0.109	0.137	0.163	0.185	0.205	0.228	0.268	0.162
NTSC	35	2131	0.119	0.117	0.110	0.114	0.131	0.144	0.153	0.089	0.082	0.070	0.087	0.101
NTSC	35	2141	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
NTSC	35	2142	0.418	0.452	0.344	0.301	0.157	0.130	0.125	0.136	0.150	0.160	0.182	0.214
NTSC	35	2143	0.055	0.061	0.050	0.054	0.063	0.070	0.086	0.085	0.089	0.090	0.063	0.058
NTSC	35	2144	0.033	0.038	0.033	0.040	0.050	0.065	0.063	0.063	0.064	-	-	-
NTSC	35	2145	0.706	0.357	0.328	0.329	0.328	0.291	0.325	0.358	0.097	0.060	0.068	0.074
NTSC	35	2147	0.345	0.389	0.342	0.351	0.242	0.288	0.334	-	-	-	-	-
NTSC	35	2573	0.245	0.171	0.164	0.157	0.177	0.186	0.221	0.182	0.197	0.219	0.253	0.275
NTSC	35	2831	0.054	0.057	0.054	0.055	0.061	0.075	0.083	-	-	-	-	-
NTSC	35	2852	0.461	0.517	0.635	0.886	0.382	0.122	0.109	0.111	0.120	0.119	0.147	0.159
NTSC	35	2855	0.139	0.144	0.119	0.127	0.105	0.097	0.103	0.091	0.102	-	-	-
NTSC	35	2921	0.073	0.051	0.059	0.070	0.086	0.072	0.082	0.083	0.092	0.101	0.135	0.138
NTSC	35	2922	0.416	0.168	0.185	0.218	0.216	0.149	0.177	0.164	0.131	0.131	0.143	0.141

Table 9A. (Cont.)

Lab.	Clock	56684	56714	56744	56774	56804	56834	56869	56899	56929	56959	56989	57019
NTSC	35 2924	0.177	0.229	0.259	0.317	0.386	0.462	0.371	0.399	0.347	0.165	-	-
NTSC	35 2926	0.125	0.153	0.168	0.199	0.190	0.126	0.106	0.114	0.120	0.123	0.151	0.178
NTSC	35 2928	0.179	0.226	0.238	0.198	0.237	0.237	0.269	0.134	0.159	0.165	0.202	0.231
NTSC	35 2933	0.241	0.185	0.074	0.074	0.086	0.105	0.124	0.149	0.164	0.158	0.188	0.184
NTSC	35 2959	-	-	-	-	-	0.000	0.000	0.000	0.000	0.000	0.111	0.132
NTSC	35 2962	-	-	-	-	-	0.000	0.000	0.000	0.000	0.000	0.542	0.746
NTSC	35 2964	-	-	-	-	-	0.000	0.000	0.000	0.000	0.000	0.171	0.228
NTSC	35 2965	-	-	-	-	-	0.000	0.000	0.000	0.000	0.000	0.193	0.135
NTSC	35 2976	-	-	-	-	-	0.000	0.000	0.000	0.000	0.000	0.039	0.052
NTSC	35 2978	-	-	-	-	-	0.000	0.000	0.000	0.000	0.000	0.106	0.060
NTSC	35 2980	-	-	-	-	-	0.000	0.000	0.000	0.000	0.000	0.166	0.211
NTSC	35 2981	-	-	-	-	-	0.000	0.000	0.000	0.000	0.000	0.112	0.153
NTSC	40 296	-	-	-	-	-	-	-	0.000	0.000	0.000	0.000	0.000
NTSC	40 297	-	-	-	-	-	-	-	0.000	0.000	0.000	0.000	0.000
NTSC	40 4926	0.096	0.126	0.111	0.092	0.108	0.125	0.131	0.098	0.098	0.102	-	-
NTSC	40 4927	0.000	0.000	0.000	0.000	0.000	0.006	0.006	0.007	0.008	0.006	-	-
NTSC	40 4943	0.000	0.000	0.000	0.000	0.103	0.113	0.148	0.174	0.209	0.234	0.301	0.352
NTSC	40 4945	0.000	0.000	0.000	0.000	0.008	0.012	0.015	0.018	0.022	0.024	-	-
NTSC	40 4946	0.000	0.000	0.000	0.000	0.030	0.044	-	-	-	-	-	-
ONBA	36 2228	-	-	0.000	0.000	0.000	0.000	0.000	0.061	0.076	-	-	0.000
ONRJ	35 102	0.175	0.178	0.091	0.100	0.107	0.104	0.079	0.076	0.050	0.041	-	0.000
ONRJ	35 103	0.084	0.074	0.068	0.066	0.073	0.043	0.051	0.046	0.048	0.044	0.046	0.048
ONRJ	35 123	0.066	0.062	0.065	0.078	0.104	0.146	0.183	0.253	0.203	0.086	0.106	0.117
ONRJ	35 129	0.150	0.145	0.114	0.114	0.115	0.142	0.170	0.184	0.211	0.232	0.321	0.421
ONRJ	35 147	0.115	0.124	0.112	0.115	0.134	0.160	0.148	0.143	0.159	0.174	0.241	0.277
ONRJ	35 1153	0.377	0.356	0.131	0.135	0.098	0.113	0.128	0.136	0.151	0.157	0.187	0.169
ONRJ	35 1942	0.409	0.442	0.460	0.616	0.344	0.280	0.314	0.342	0.369	0.373	0.228	0.101
ONRJ	40 1950	0.000	0.000	0.000	0.000	0.005	0.000	0.000	0.000	0.000	0.000	0.000	0.000
ONRJ	40 1958	0.025	0.020	0.016	0.016	0.017	0.014	0.012	0.012	0.013	0.015	0.019	0.023
ORB	35 2722	0.232	0.251	0.247	0.251	0.288	0.327	0.384	0.412	0.297	0.324	0.187	0.087
ORB	35 2723	0.196	0.170	0.158	0.124	0.120	0.132	0.140	0.118	0.134	0.146	0.161	0.188
ORB	35 2724	0.000	0.000	0.000	0.099	0.137	0.188	0.245	0.293	0.347	0.375	0.460	1.044
ORB	36 593	0.038	0.039	0.020	0.019	0.021	0.022	0.018	0.013	0.013	0.014	0.016	0.018
PL	25 124	0.008	0.010	0.006	0.006	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
PL	25 125	0.028	0.034	0.024	0.027	0.030	0.035	0.043	0.047	0.024	0.026	0.031	0.000

Table 9A. (Cont.)

Lab.	Clock		56684	56714	56744	56774	56804	56834	56869	56899	56929	56959	56989	57019
PL	35	441	0.219	0.226	-	-	0.000	0.000	0.000	0.000	0.000	0.154	0.215	0.217
PL	35	502	0.121	0.102	0.092	0.081	0.083	-	-	0.000	0.000	-	-	-
PL	35	745	0.077	0.023	0.016	0.014	0.015	0.015	0.015	0.016	0.017	0.019	0.022	0.024
PL	35	761	0.020	0.022	0.022	0.023	0.022	0.029	0.040	0.055	0.069	0.043	0.032	0.026
PL	35	1120	0.226	0.302	0.307	0.118	0.094	0.109	0.081	0.072	0.074	0.079	0.078	0.053
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	0.000	0.000	0.000	0.000	0.134	0.189	0.180	0.185	0.198	0.221	0.263	0.255
PL	35	2175	0.169	0.176	0.100	0.106	0.115	0.099	0.071	0.075	0.082	0.088	0.114	-
PL	35	2394	0.196	0.121	0.115	0.117	0.074	0.069	0.079	0.090	0.102	0.114	0.081	0.088
PL	35	2891	-	-	-	-	0.000	0.000	0.000	0.000	0.000	0.142	0.151	0.159
PL	40	4004	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	40	4601	1.075	0.593	0.514	0.527	0.574	0.670	0.761	0.877	0.998	1.039	1.058	1.044
PL	40	4602	0.056	0.049	0.017	0.017	0.019	0.021	0.022	0.025	0.029	0.019	0.020	0.016
PTB	35	128	0.103	0.109	0.093	0.061	0.057	0.061	0.070	0.055	0.060	0.064	0.075	0.038
PTB	35	415	0.054	0.044	0.037	0.037	0.041	0.049	0.058	0.051	0.048	0.047	0.055	0.064
PTB	35	1072	0.151	0.123	0.132	0.162	0.102	0.103	0.067	0.055	0.055	0.056	0.059	0.063
PTB	35	2987	-	-	-	-	-	-	-	-	-	-	-	0.000
PTB	40	506	0.058	0.067	0.075	0.102	0.024	0.030	0.032	0.031	0.032	0.033	0.041	0.048
PTB	40	508	0.000	0.000	0.000	0.000	0.049	0.068	0.073	0.084	0.101	0.090	0.112	0.113
PTB	40	509	0.354	0.397	0.454	0.485	0.593	0.744	0.884	1.015	0.998	1.039	1.058	0.311
PTB	40	590	1.075	1.058	1.067	1.023	0.998	1.010	1.003	1.015	0.998	1.039	-	-
PTB	92	1	0.665	0.650	0.690	0.802	0.956	0.805	0.942	0.820	0.757	0.804	1.013	0.739
PTB	92	2	0.261	0.278	0.246	0.281	0.239	0.292	0.306	0.352	0.386	0.425	0.526	0.617
ROA	35	583	0.204	0.236	0.228	0.247	0.282	0.240	0.227	0.263	0.290	0.332	0.386	0.202
ROA	35	718	0.128	0.118	0.111	0.118	0.137	0.167	0.207	0.183	0.149	0.166	0.193	0.222
ROA	35	1699	0.185	0.210	0.179	0.207	0.209	0.231	0.213	0.220	0.132	0.132	0.124	0.142
ROA	35	2270	0.151	0.170	0.094	0.074	0.046	0.051	0.056	0.063	0.054	0.052	0.046	0.045
ROA	36	1488	0.038	0.034	0.033	0.036	0.042	0.042	0.047	0.036	0.037	0.040	0.050	0.056
ROA	36	1490	0.064	0.032	0.027	0.000	0.000	0.000	0.000	0.000	0.012	0.009	0.013	0.014
ROA	40	1436	0.427	0.314	0.320	0.200	0.219	0.198	0.156	0.145	0.151	0.161	0.196	0.233
SASO	35	221	0.000	0.000	0.000	0.000	0.011	0.014	-	0.000	0.000	0.000	0.000	0.000
SASO	35	1628	0.000	0.000	0.000	0.000	0.013	0.019	-	0.000	0.000	0.000	0.000	0.000
SASO	35	2923	0.000	0.000	0.000	0.000	0.369	0.209	-	0.000	0.000	0.000	0.000	0.000
SASO	35	2932	0.000	0.000	0.000	0.000	0.151	0.086	-	0.000	0.000	0.000	0.000	0.000
SCL	35	2178	0.128	0.139	0.126	0.137	0.109	0.107	-	0.000	0.000	0.000	0.000	-

Table 9A. (Cont.)

Lab.	Clock	56684	56714	56744	56774	56804	56834	56869	56899	56929	56959	56989	57019
SCL	35 2525	0.153	0.171	0.170	0.189	0.227	0.259	-	0.000	0.000	0.000	0.000	-
SG	35 188	-	-	-	-	-	-	-	0.000	0.000	0.000	0.000	0.000
SG	35 475	0.192	0.197	0.125	0.123	0.143	0.173	0.213	0.258	0.223	0.153	0.167	0.160
SG	35 1889	0.052	0.056	-	-	-	-	-	-	-	-	-	-
SG	36 522	0.061	0.063	0.062	0.071	0.073	0.061	0.060	0.047	0.039	0.036	0.044	0.042
SG	40 7701	0.021	0.018	0.017	0.016	0.018	0.022	0.026	0.000	0.000	0.000	0.000	0.000
SIQ	36 1268	0.025	0.027	0.021	0.014	0.010	0.011	0.013	0.015	0.017	0.018	0.018	0.021
SMD	35 1766	0.470	0.512	0.206	0.244	0.209	0.259	0.295	0.378	0.419	0.397	0.424	0.310
SMD	35 2003	0.064	0.079	0.075	0.088	0.068	0.069	0.081	0.095	0.114	0.107	0.140	0.114
SMD	35 2543	0.185	0.230	0.221	0.262	0.307	0.345	0.308	0.385	0.103	0.019	0.022	0.024
SMD	40 7909	0.000	0.000	0.000	0.000	0.017	0.013	0.010	0.012	0.011	0.011	0.011	0.008
SMU	36 1193	0.000	0.000	-	-	0.000	0.000	0.000	0.000	-	-	0.000	0.000
SP	35 572	0.246	0.154	0.114	0.110	0.125	0.128	0.140	0.130	0.130	0.141	0.185	0.158
SP	35 641	0.312	0.395	0.498	0.694	0.413	0.323	0.269	0.269	0.177	0.146	0.180	0.190
SP	35 767	0.000	0.000	0.000	0.083	0.110	0.148	0.192	0.235	0.254	0.224	0.206	0.204
SP	35 1188	-	-	0.000	0.000	0.000	0.000	0.000	0.128	0.104	0.109	0.124	0.108
SP	35 1642	0.194	0.215	0.195	0.211	0.239	0.121	0.141	0.137	0.150	0.165	0.201	0.219
SP	35 2166	0.191	0.165	0.159	0.129	0.144	0.170	0.160	0.186	0.219	0.194	0.166	0.190
SP	35 2745	0.000	0.000	0.000	0.176	0.127	0.092	0.107	0.099	0.107	0.100	0.072	0.066
SP	35 2746	0.000	0.000	0.000	0.116	0.142	0.171	0.187	0.196	0.232	0.257	0.142	0.108
SP	35 2749	0.000	0.000	0.000	0.196	0.183	0.109	0.041	0.042	0.047	0.051	0.059	0.068
SP	35 2750	0.000	0.000	0.000	0.000	0.000	0.236	0.185	0.121	0.093	0.095	0.125	0.147
SP	35 2758	0.000	0.000	0.000	0.803	0.998	0.874	1.013	0.813	0.610	0.450	0.446	0.526
SP	36 223	0.020	0.022	0.018	0.018	0.021	0.020	0.021	0.026	0.033	0.033	0.042	0.050
SP	36 1175	0.029	0.023	0.021	0.023	0.024	0.028	0.034	0.039	0.027	0.030	0.041	0.042
SP	36 1187	0.101	0.041	0.033	0.027	0.019	0.020	0.022	0.022	0.015	0.016	0.019	0.022
SP	36 1531	0.058	0.064	0.056	0.064	0.068	0.077	0.087	0.085	0.091	0.091	0.065	0.064
SP	36 2068	0.036	-	0.000	0.000	0.000	0.000	0.000	0.037	0.013	0.016	0.018	0.022
SP	36 2218	0.294	0.189	0.144	0.160	0.138	0.107	0.122	0.123	0.108	0.104	0.106	0.123
SP	36 2295	0.054	0.057	0.044	0.042	0.049	0.058	0.061	0.058	0.064	0.058	0.075	0.035
SP	36 2297	0.157	0.082	0.040	0.034	0.035	0.038	0.042	0.046	0.047	0.047	0.055	0.058
SP	40 7201	0.117	0.102	0.098	0.102	0.118	0.145	0.148	0.168	0.216	0.288	0.396	0.421
SP	40 7203	1.075	1.058	1.067	1.023	0.998	1.010	-	-	-	-	0.000	0.000
SP	40 7210	0.197	0.120	0.105	0.109	0.079	0.085	0.071	0.080	0.089	0.094	0.043	-
SP	40 7211	1.045	0.996	0.886	0.915	0.971	0.813	0.776	0.879	0.942	0.875	1.058	1.044

Table 9A. (Cont.)

Lab.	Clock	56684	56714	56744	56774	56804	56834	56869	56899	56929	56959	56989	57019
SP	40 7212	1.075	1.058	1.067	1.023	0.998	1.010	1.013	1.015	0.998	1.039	1.058	1.044
SP	40 7221	1.075	1.058	1.067	1.023	0.998	1.010	1.013	1.015	0.998	1.039	1.058	1.044
SP	40 7223	-	-	0.000	0.000	0.000	0.000	0.000	1.015	0.998	1.039	1.058	1.044
SP	40 7231	-	-	-	-	-	-	0.000	0.000	0.000	0.000	0.000	0.408
SP	40 7232	-	-	-	-	-	-	0.000	0.000	0.000	0.000	0.000	0.006
SU	40 3809	1.014	1.058	1.049	1.023	0.998	1.010	1.013	1.015	0.998	1.039	1.058	1.044
SU	40 3810	1.075	1.058	1.067	1.023	0.998	1.010	1.013	1.015	0.998	1.039	1.058	1.044
SU	40 3811	-	-	-	-	-	0.000	0.000	0.000	0.000	0.000	1.058	1.044
SU	40 3812	1.075	1.058	1.067	1.023	0.998	1.010	1.013	1.015	0.998	1.039	1.058	1.044
SU	40 3814	1.075	1.058	1.067	1.023	0.998	1.010	1.013	1.015	0.998	1.039	-	-
SU	40 3815	1.075	1.058	1.067	1.023	0.998	1.010	1.013	1.015	0.998	1.039	1.058	1.044
SU	40 3816	1.075	1.058	1.067	1.023	0.998	1.010	1.013	1.015	0.998	1.039	-	-
SU	40 3817	0.174	0.208	0.174	0.199	0.166	0.203	0.241	0.272	0.319	0.370	0.268	0.307
SU	40 3818	0.000	0.000	0.000	0.085	0.117	0.159	0.201	0.247	0.292	0.319	0.412	1.044
TCC	35 768	0.000	0.010	0.012	0.014	0.017	0.022	0.028	0.024	-	-	-	-
TCC	35 1881	0.000	0.040	0.026	0.029	0.035	0.039	0.041	0.048	-	-	-	-
TCC	40 8620	0.000	0.000	0.000	0.000	0.013	0.013	0.012	0.015	-	-	-	-
TCC	40 8624	0.000	0.030	0.036	0.040	0.048	0.057	0.041	0.043	-	-	-	-
TL	35 1012	0.086	0.081	0.076	0.089	0.102	0.139	0.129	0.061	0.048	0.050	0.057	0.064
TL	35 1498	0.279	0.311	0.188	0.066	0.069	0.079	0.083	0.093	0.098	0.098	0.116	0.140
TL	35 1500	0.080	0.086	0.086	0.097	0.106	0.134	0.162	0.202	0.225	0.275	0.457	0.537
TL	35 1712	0.359	0.234	0.205	0.198	0.235	0.208	0.137	0.152	0.150	0.100	0.075	0.068
TL	35 2365	0.091	0.087	0.084	0.056	0.042	0.045	0.050	0.056	0.060	0.066	0.089	0.095
TL	35 2366	0.064	0.066	0.063	0.056	0.061	0.073	0.076	0.090	0.092	0.107	0.149	0.162
TL	35 2367	0.134	0.090	0.059	0.064	0.075	0.079	0.090	0.087	0.094	0.094	0.083	0.054
TL	35 2368	0.126	0.135	0.104	0.112	0.147	0.107	0.124	0.131	0.144	0.153	0.203	0.250
TL	35 2630	0.122	0.129	0.125	0.124	0.139	0.137	0.160	0.148	0.154	0.162	0.202	0.252
TL	35 2634	0.019	0.016	0.000	0.000	0.000	0.000	0.000	0.014	0.015	0.014	0.019	0.016
TL	35 2636	0.036	0.037	0.036	0.039	0.046	0.058	0.074	0.086	0.110	0.110	0.088	0.100
TL	35 2853	0.435	0.502	0.527	0.618	0.811	1.010	1.013	0.360	0.233	0.224	0.276	0.286
TL	35 2910	0.323	0.340	0.274	0.307	0.550	0.615	0.763	0.783	0.759	0.100	0.109	0.093
TL	40 57	0.088	0.068	0.066	0.053	0.043	0.050	0.049	0.043	0.049	0.052	0.068	0.026
TL	40 3011	-	-	-	-	-	-	-	-	0.000	0.000	0.000	0.000
TL	40 3052	0.000	0.000	0.000	0.000	0.089	0.123	0.132	0.131	0.158	0.155	0.202	0.238
TP	35 163	0.067	0.076	0.071	0.078	0.093	0.098	0.065	0.056	0.063	0.069	0.064	0.055

Table 9A. (Cont.)

Lab.	Clock	56684	56714	56744	56774	56804	56834	56869	56899	56929	56959	56989	57019
TP	35 1227	0.317	-	-	0.000	0.000	0.000	0.000	0.000	0.094	0.119	0.151	0.153
TP	35 2476	0.166	0.184	0.195	0.073	0.056	0.063	0.068	0.047	0.052	0.047	0.049	0.056
TP	35 2970	-	-	-	0.000	0.000	0.000	0.000	0.000	0.102	0.090	0.098	0.124
UA	35 2465	0.000	0.000	0.000	0.068	0.057	0.013	0.000	0.000	0.000	0.000	0.000	0.015
UA	40 7854	0.000	0.000	0.000	0.144	0.194	0.227	0.250	0.184	0.126	0.131	0.118	0.113
UA	40 7881	0.000	0.000	0.000	0.182	0.230	0.207	0.186	0.193	0.200	0.220	0.071	0.058
UA	40 7882	0.000	0.000	0.000	0.532	0.379	0.153	0.186	0.180	0.205	0.217	0.250	0.117
UME	35 251	0.355	0.070	0.022	0.023	0.055	0.064	0.063	0.059	0.063	-	-	0.000
UME	35 252	0.224	0.021	0.015	0.016	0.024	0.023	0.026	0.027	0.031	-	-	0.000
UME	35 872	-	0.000	0.000	0.000	0.000	0.000	0.000	-	-	-	-	0.000
UME	35 2703	0.039	0.000	0.000	0.000	0.000	0.000	0.007	0.008	0.011	-	-	0.000
USNO	35 101	0.038	0.051	0.058	0.068	0.098	0.160	0.213	0.260	0.162	0.094	0.111	0.117
USNO	35 104	0.154	0.120	0.121	0.083	0.093	0.109	0.126	0.106	0.106	0.095	0.117	0.092
USNO	35 106	0.349	0.390	0.400	0.380	0.265	0.185	0.217	0.221	0.221	0.230	0.260	0.262
USNO	35 108	0.319	0.319	0.331	0.396	0.452	0.210	0.074	0.072	0.067	0.063	0.069	0.076
USNO	35 114	0.035	0.042	0.032	0.036	0.030	0.037	0.045	0.050	0.052	0.054	0.073	0.090
USNO	35 120	0.092	0.098	0.088	0.096	0.104	0.129	0.115	0.095	0.108	0.119	0.160	0.190
USNO	35 142	0.100	0.070	0.064	0.070	0.081	0.098	0.088	0.103	0.094	0.103	0.115	0.136
USNO	35 145	0.130	0.145	0.148	0.151	0.095	0.064	0.069	0.039	0.039	0.040	-	-
USNO	35 146	0.832	0.330	0.346	-	-	-	-	-	-	-	-	-
USNO	35 150	0.075	0.081	0.065	0.072	0.084	0.095	0.094	0.107	0.127	0.142	0.141	0.179
USNO	35 152	0.041	0.044	0.044	0.049	0.051	0.066	0.058	0.069	0.071	0.051	0.055	0.060
USNO	35 153	0.182	0.180	0.176	0.204	0.207	0.259	-	-	-	-	-	-
USNO	35 156	0.163	0.173	0.129	0.139	0.157	0.188	0.163	0.190	0.164	0.180	0.144	0.167
USNO	35 161	0.000	0.000	0.000	0.000	0.102	0.079	0.073	0.091	0.106	0.116	0.147	0.172
USNO	35 164	0.000	0.000	0.000	0.000	0.269	0.160	0.210	0.164	0.174	0.189	0.246	0.213
USNO	35 165	0.159	0.120	0.117	0.067	0.071	0.073	0.072	0.055	0.061	0.057	0.061	0.072
USNO	35 166	0.023	0.028	0.031	0.037	0.043	0.054	0.059	0.059	0.073	0.069	0.093	0.120
USNO	35 169	0.194	0.179	0.185	0.214	0.238	0.326	0.383	0.564	0.460	0.485	0.428	0.498
USNO	35 173	0.150	0.033	0.026	0.028	0.030	0.034	0.035	0.039	0.041	0.046	0.062	0.083
USNO	35 213	0.069	0.048	0.046	0.045	0.049	0.058	0.070	-	-	-	-	-
USNO	35 226	0.057	0.059	0.053	0.059	0.068	0.076	0.081	0.057	0.048	0.039	0.049	0.054
USNO	35 227	0.108	0.116	0.103	0.113	-	-	-	-	-	-	-	-
USNO	35 231	0.131	0.133	0.129	0.149	0.188	0.097	0.098	0.092	0.104	0.105	0.057	0.048
USNO	35 233	0.034	0.039	0.041	0.050	0.069	0.122	0.167	0.199	0.305	0.378	0.473	0.259

Table 9A. (Cont.)

Lab.	Clock	56684	56714	56744	56774	56804	56834	56869	56899	56929	56959	56989	57019
USNO	35 244	0.148	0.157	0.145	0.123	0.142	0.079	0.059	0.039	0.042	0.042	0.053	0.062
USNO	35 253	0.177	0.201	0.207	0.117	0.124	0.129	0.143	0.139	0.140	0.102	0.114	0.132
USNO	35 254	0.157	0.157	0.153	0.165	0.172	0.198	0.179	0.217	0.244	0.116	0.103	0.118
USNO	35 256	0.226	0.175	0.111	0.104	0.115	0.135	0.103	0.078	0.087	0.081	0.102	0.119
USNO	35 260	0.000	0.000	0.011	0.015	0.019	0.025	0.029	0.016	0.013	0.013	0.014	0.015
USNO	35 268	0.053	0.060	0.064	0.051	0.065	0.086	0.106	0.072	0.050	0.024	0.016	0.018
USNO	35 270	0.081	0.085	0.091	0.087	0.093	0.090	0.082	0.082	0.068	0.065	0.080	0.091
USNO	35 279	0.230	0.231	0.196	0.052	0.052	0.057	0.042	0.044	0.035	0.036	0.044	0.052
USNO	35 389	0.190	0.204	0.187	0.192	0.227	0.275	0.223	0.222	0.184	0.101	0.108	0.111
USNO	35 394	0.085	0.058	0.048	0.050	0.054	0.062	0.071	0.083	0.087	0.079	0.080	0.077
USNO	35 416	0.147	0.128	0.111	0.124	0.147	0.149	0.095	0.083	0.093	0.055	0.059	0.048
USNO	35 417	0.212	0.216	0.182	0.194	0.231	0.245	0.177	0.186	0.187	0.088	0.063	0.067
USNO	35 703	0.138	0.104	0.068	0.075	0.085	0.097	0.117	0.101	0.114	0.061	0.045	0.049
USNO	35 717	0.150	0.128	0.108	0.116	0.123	0.148	0.167	0.194	0.135	0.132	0.168	0.165
USNO	35 762	0.484	0.333	0.265	0.286	0.330	0.270	0.313	0.282	0.256	0.265	0.339	0.400
USNO	35 763	0.307	0.301	0.251	0.248	0.270	0.260	0.292	0.229	0.257	-	-	-
USNO	35 765	0.380	0.413	0.398	0.451	0.517	0.558	0.176	0.031	0.029	0.028	0.033	0.035
USNO	35 1096	0.132	0.105	0.094	0.103	0.117	0.145	0.178	0.231	0.291	0.354	0.339	0.438
USNO	35 1097	0.077	0.073	0.050	0.041	0.045	0.034	0.037	0.040	0.045	0.048	0.062	0.071
USNO	35 1125	0.049	0.052	0.050	0.052	0.060	0.071	0.084	0.087	0.101	0.111	0.059	0.056
USNO	35 1327	0.116	0.128	0.118	0.136	0.148	0.131	0.157	0.174	0.151	0.107	0.132	0.149
USNO	35 1328	0.088	0.093	0.093	0.106	0.132	0.179	0.253	0.181	0.218	0.245	0.326	0.383
USNO	35 1331	0.062	0.060	0.044	0.050	0.033	0.039	0.045	0.043	0.039	0.037	0.046	0.052
USNO	35 1438	0.170	0.154	0.136	0.149	0.145	0.132	0.157	0.133	-	-	-	-
USNO	35 1459	0.059	0.056	0.053	0.061	0.075	0.106	0.125	0.061	0.059	0.053	0.063	0.064
USNO	35 1462	0.160	0.157	0.156	0.188	0.197	0.277	0.332	0.405	0.274	0.284	0.361	0.123
USNO	35 1463	0.118	0.120	0.122	0.114	0.139	0.185	0.224	0.257	0.216	0.146	0.166	0.175
USNO	35 1468	0.000	0.000	0.000	0.103	0.141	0.141	0.182	0.173	0.194	0.161	0.195	0.226
USNO	35 1481	0.422	0.304	0.313	0.351	0.393	0.472	0.523	0.398	0.445	0.448	0.190	0.212
USNO	35 1543	0.113	0.123	0.115	0.125	0.139	0.159	0.158	0.176	0.181	0.218	0.214	0.203
USNO	35 1573	0.167	0.179	0.197	0.128	0.044	0.047	0.052	0.055	0.055	0.051	0.063	0.073
USNO	35 1575	0.154	0.138	0.131	0.153	0.194	0.175	0.187	0.176	0.207	0.222	0.286	0.311
USNO	35 1580	0.092	0.103	0.107	0.128	0.164	0.066	0.072	0.080	0.060	0.052	0.043	0.047
USNO	35 1585	0.109	0.070	0.068	0.071	0.050	0.041	0.046	0.052	0.052	0.057	0.054	0.019
USNO	35 1598	0.058	0.039	0.037	0.037	0.040	0.048	0.052	0.061	0.069	0.074	0.106	0.152

Table 9A. (Cont.)

Lab.	Clock	56684	56714	56744	56774	56804	56834	56869	56899	56929	56959	56989	57019
USNO	35 1655	-	-	-	-	-	-	-	-	-	-	-	0.000
USNO	35 1658	0.401	0.366	0.118	0.125	0.128	0.145	0.170	0.188	0.217	0.242	0.232	0.283
USNO	35 1692	0.380	0.281	0.269	0.222	0.252	0.298	0.274	0.247	0.239	0.260	0.284	0.313
USNO	35 1694	0.659	0.846	1.061	1.023	0.998	0.546	0.421	0.208	0.208	0.203	0.241	0.272
USNO	35 1696	0.129	0.158	0.180	0.184	0.207	0.226	0.279	0.289	0.201	0.094	0.116	0.130
USNO	35 1697	0.334	0.337	0.164	0.157	0.167	0.180	0.160	0.167	0.185	0.202	0.262	0.311
USNO	40 701	0.160	0.192	0.203	0.228	0.206	0.218	0.209	0.087	0.070	0.071	0.080	0.073
USNO	40 702	1.075	1.058	1.067	1.023	0.998	1.010	1.013	1.015	0.998	1.039	1.058	1.044
USNO	40 704	0.000	0.000	1.067	1.023	0.998	1.010	1.013	1.015	0.998	1.039	1.058	1.044
USNO	40 705	1.075	1.058	1.067	1.023	0.998	1.010	1.013	1.015	0.998	1.039	1.058	1.044
USNO	40 708	1.075	1.058	1.067	1.023	0.998	1.010	1.013	1.015	0.998	1.039	1.058	1.044
USNO	40 710	0.000	1.058	1.067	1.023	0.998	1.010	1.013	1.015	0.998	1.039	1.058	-
USNO	40 711	0.000	0.000	1.067	1.023	0.998	1.010	1.013	1.015	0.998	1.039	1.058	1.044
USNO	40 712	0.000	0.000	0.000	1.023	0.998	1.010	1.013	1.015	0.998	1.039	1.058	1.044
USNO	40 713	1.075	1.058	1.067	1.023	0.998	1.010	1.013	1.015	0.998	1.039	1.058	1.044
USNO	40 714	0.608	0.484	0.455	0.492	0.500	0.609	0.753	0.599	0.733	0.840	1.052	1.044
USNO	40 715	0.000	0.000	0.000	0.000	0.000	0.071	0.098	0.127	0.154	0.177	0.236	0.281
USNO	40 716	1.075	1.058	1.067	1.023	0.998	1.010	1.013	1.015	0.998	1.039	1.058	1.044
USNO	40 717	0.000	0.000	1.067	1.023	0.998	1.010	1.013	1.015	0.998	1.039	1.058	1.044
USNO	40 718	1.075	1.058	1.067	1.023	0.998	1.010	1.013	1.015	0.998	1.039	1.058	0.000
USNO	40 719	1.075	1.058	1.067	1.023	0.998	1.010	1.013	1.015	0.998	1.039	1.058	1.044
USNO	40 720	0.000	1.014	0.838	1.013	0.883	1.010	1.013	1.015	0.555	0.585	0.734	0.748
USNO	40 721	-	-	-	0.000	0.000	0.000	0.000	0.000	0.403	0.397	0.567	0.726
USNO	40 722	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	-	-	-
USNO	40 723	1.075	1.058	1.067	1.023	0.998	1.010	1.013	1.015	0.998	1.039	1.058	1.044
USNO	40 724	0.088	0.085	0.088	0.095	0.102	0.120	0.146	0.178	0.224	0.288	0.544	0.134
USNO	40 725	1.075	1.058	1.067	1.023	0.998	1.010	1.013	1.015	0.998	1.039	1.058	1.044
USNO	40 726	-	-	-	0.000	0.000	0.000	0.000	0.000	0.998	1.039	1.058	1.044
USNO	40 727	-	-	-	0.000	0.000	0.000	0.000	0.000	0.220	0.176	0.153	0.130
USNO	40 728	0.406	0.454	0.469	0.567	0.749	1.010	1.013	1.015	0.998	1.039	1.058	1.044
USNO	40 729	1.075	1.058	1.067	1.023	0.998	1.010	1.013	1.015	0.998	1.039	1.058	1.044
USNO	40 730	1.075	1.058	1.067	1.023	0.998	1.010	1.013	1.015	0.998	1.039	1.058	1.044
USNO	40 731	1.075	1.058	0.152	0.152	0.161	0.181	0.186	0.185	0.199	0.215	0.281	0.353
USNO	40 732	1.075	1.058	1.067	1.023	0.998	0.321	0.326	0.325	0.276	0.266	0.299	0.341
USNO	40 734	0.024	0.033	0.043	0.060	0.091	0.144	0.239	-	-	-	0.000	0.000

Table 9A. (Cont.)

Lab.	Clock		56684	56714	56744	56774	56804	56834	56869	56899	56929	56959	56989	57019
USNO	40	735	0.155	0.174	0.184	0.201	0.216	0.182	0.205	0.241	0.271	0.285	0.306	0.192
USNO	40	736	0.000	0.000	0.000	0.026	0.025	0.024	0.026	0.029	0.032	0.033	0.041	0.047
USNO	40	737	0.000	0.000	0.000	0.082	0.074	0.087	0.094	0.090	0.098	0.108	0.139	0.171
USNO	93	2	1.075	1.058	1.067	1.023	0.998	1.010	1.013	1.015	0.998	1.039	1.058	1.044
USNO	93	3	1.075	1.058	1.067	1.023	0.998	1.010	1.013	1.015	0.998	1.039	1.058	1.044
USNO	93	4	1.075	1.058	1.067	1.023	0.998	1.010	1.013	1.015	0.998	1.039	1.058	1.044
USNO	93	5	1.075	1.058	1.067	1.023	0.998	1.010	1.013	1.015	0.998	1.039	1.058	1.044
VMI	35	2230	0.000	0.000	0.000	0.000	0.000	0.017	0.023	0.029	0.035	0.037	0.014	0.015
VMI	36	1233	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
VMI	36	2314	0.000	0.000	0.000	0.000	0.000	0.010	0.013	0.017	0.020	0.017	0.008	0.010
VSL	35	179	0.195	0.200	0.156	0.169	0.112	0.129	0.141	0.134	0.095	-	-	-
VSL	35	456	0.070	0.075	0.068	0.075	0.078	0.093	0.109	0.124	0.135	0.055	0.069	0.076
VSL	35	548	-	-	0.000	0.000	0.000	0.000	0.000	0.060	0.061	0.061	0.081	0.049
VSL	35	731	0.071	0.076	0.072	0.074	0.085	0.089	0.104	0.115	0.141	0.057	0.067	0.078
ZA	35	2233	-	0.000	0.000	0.000	0.000	0.000	0.516	0.347	0.391	0.463	0.538	0.587
ZA	36	1034	-	0.000	0.000	0.000	0.000	0.000	0.000	0.012	0.012	0.011	0.009	0.011
ZA	36	1821	-	0.000	0.000	0.000	0.000	0.000	0.000	0.064	0.069	0.081	0.100	0.114
ZA	36	2232	-	0.000	0.000	0.000	0.000	0.000	0.018	0.015	0.013	0.016	0.021	0.025

Table 9B: Statistical data on the weights attributed to the clocks in 2014

Interval		Number of Clocks			Number of clocks with a given weight: Weight = 0*			Weight = 0**			Max weight			Max relative weight
		HM	5071A	Total	HM	5071A	Total	HM	5071A	Total	HM	5071A	Total	
2014	Jan.	105	277	431	29	27	59	11	19	32	36	1	41	1.075
2014	Feb.	109	278	441	22	33	64	18	11	32	38	1	43	1.058
2014	Mar.	113	281	449	26	38	74	10	10	23	37	1	42	1.067
2014	Apr.	116	290	462	20	40	71	11	10	24	38	2	44	1.023
2014	May	121	291	469	20	36	68	7	9	19	39	4	47	0.998
2014	June	119	298	468	18	43	72	6	8	18	39	1	44	1.010
2014	July	114	289	453	16	34	58	7	11	26	37	2	43	1.013
2014	Aug.	116	290	458	18	37	64	8	8	22	41	0	45	1.015
2014	Sep.	116	288	456	17	30	55	9	8	23	41	2	47	0.998
2014	Oct.	116	280	446	16	37	61	9	5	19	42	2	48	1.039
2014	Nov.	110	275	436	18	30	58	9	5	18	43	0	47	1.058
2014	Dec.	108	286	441	13	41	58	10	5	19	46	1	51	1.044

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 Hewlett-Packard 5071A units with high performance tube.
Clocks with missing data during an one-month interval of computation are excluded.

Table 10. Relative drifts of contributing clocks in 2014

(File available at ftp://62.161.69.5/pub/tai/scale/DTAI/dtai14.ar)

Clock drifts are computed using a monthly realization of TT(BIPM) as reference for 4-months intervals ending at the MJD dates given in the table. "-" denotes that the clock was not used. Unit is ns/day/30 days.

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	56684	56714	56744	56774	56804	56834	56869	56899	56929	56959	56989	57019
APL	35 0904	-	-	-	-	0.5110	-0.0233	0.1134	0.2409	-	-1.2301	0.8544	1.6186
APL	35 1264	-	-	-	-	-3.3084	-0.5483	-0.1382	-0.2673	-	-0.1364	-0.0099	0.2884
APL	35 1791	-	-	-	-	2.0470	-0.4723	-0.0948	0.0296	-	-0.6575	-0.6124	-0.2398
APL	40 3107	-	-	-	-	0.1270	0.1781	0.1951	0.2000	0.2100	0.2053	0.2081	0.2216
APL	40 3108	-	-	-	-	3.0447	2.9603	2.9656	2.9879	2.9784	2.9666	2.9438	2.9068
APL	40 3109	-	-	-	-	-0.5793	-0.4698	-0.4546	-0.4420	-0.4389	-0.4337	-0.4386	-0.4545
AUS	35 2269	-0.1291	-0.1757	-0.0310	-0.0183	0.1643	0.0328	-0.2870	-0.3518	-0.2658	-0.1694	0.0039	0.0704
AUS	36 0299	-0.2790	-0.1868	0.1363	0.3104	0.3732	0.0549	0.2172	0.2144	0.2557	0.0903	0.1350	-0.0622
AUS	36 0340	0.2719	-0.0155	-0.1252	0.2600	0.0222	-0.0830	-0.1370	-0.3842	-0.3881	-0.2294	-0.3105	0.1916
AUS	36 0654	0.0855	0.1851	0.0548	-0.3167	-0.4216	-0.6169	-0.6844	-0.2849	-0.0738	0.0109	-0.1284	-0.1680
AUS	36 1141	0.5706	0.1105	-0.2821	0.0047	0.3776	0.1911	0.0624	0.0388	-0.1329	-0.3102	-0.3992	0.0687
BEV	35 1065	0.5279	1.2068	2.4067	0.0826	-	-	-	-	-	-	-	-
BEV	35 1793	-0.0765	0.0176	-0.0028	0.0045	-0.1399	-0.2102	-0.1814	-0.1358	-0.1567	-0.0037	0.0809	0.0794
BEV	35 3009	-	-	-	-	-	-	-0.3108	0.2860	0.3103	0.2995	0.2797	0.2049
BEV	40 3452	-	-	-	5.7372	5.1924	5.6679	6.2188	6.1900	6.1136	6.0987	5.8760	5.6046

Table 10. (Cont.)

Lab.	Clock	56684	56714	56744	56774	56804	56834	56869	56899	56929	56959	56989	57019
BIM	18 8058	0.5655	0.5264	0.4753	0.2632	0.2466	0.1200	0.0272	0.1062	0.0693	-0.2954	-0.3976	-0.4683
BY	40 4222	0.9258	-1.6925	-2.8676	-4.2203	-4.2777	-3.1365	-1.1919	-0.6429	0.1957	0.9009	1.4550	3.6312
BY	40 4227	-0.8170	-0.8567	-0.1583	0.2950	-0.1841	-0.4579	0.0389	-0.3488	-1.0974	-1.3872	-1.9133	-1.7585
BY	40 4229	1.8470	1.7072	1.6470	1.5255	1.1305	0.1492	0.5574	0.4282	0.5810	1.4656	2.0085	2.5651
CH	22 0112	3.3789	3.2447	4.3036	5.3110	5.2344	3.6124	0.3236	-2.5797	-4.9791	-	-	-
CH	24 0105	-	-	-	-	-	-	-	-	-	-	2.4563	1.4852
CH	35 2117	0.0987	0.1446	-0.3358	-0.0622	-0.0968	0.0271	0.1238	0.2339	0.0347	0.0476	-0.2167	0.0472
CH	35 2743	-0.0420	-0.0091	-0.0674	-0.3359	-0.2118	-0.2223	-0.1691	0.1360	0.4121	0.1568	0.1322	-0.1844
CH	40 5701	-0.5629	-0.4949	-0.3876	-0.2811	-0.3182	-0.3439	-	-	0.7641	1.0970	0.6096	0.2786
CNM	35 2708	-0.4756	-0.0209	-	-	-0.0821	0.0681	-0.3683	-0.0913	-	-0.8358	-0.1341	-
CNM	35 2709	-11.7532	-0.6160	-	-	-0.7781	-0.2948	0.1637	0.5121	-	1.7836	-0.3691	-
CNM	35 2885	-	-	-	-	-1.9576	0.3518	0.1366	0.1981	-	1.6774	-0.0687	-
CNM	40 7301	-12.9429	-0.8509	-	-	0.3121	0.0467	-0.1005	-0.1170	-	-0.8118	-1.6333	-
CNM	40 7302	-	-	-	-	11.5407	11.1211	11.1427	11.2020	-	10.4271	10.6865	-
CNMP	36 1752	0.0375	-0.3580	-0.2924	-0.0522	0.1466	0.6275	-	0.2861	-1.7191	-0.1444	0.4447	-
CNMP	36 1806	0.1959	0.2337	0.2718	0.2515	-0.2184	-0.2116	-	0.0049	-1.6830	-1.0786	-0.4410	-
CNMP	36 2873	-0.2541	0.1148	0.3060	0.2415	0.2604	0.2535	-	4.5409	1.3576	0.1627	-0.0786	-
DMDM	35 2191	-0.0473	-0.1920	-0.2823	-0.2984	-0.2199	-0.0827	-	-	-1.1079	0.3669	-0.1654	-0.4199
DMDM	36 2033	0.0518	0.3577	0.3606	0.1612	-0.0344	-0.0862	-	-	-4.1422	-1.7020	-0.7369	-0.0099
DTAG	35 2805	-0.0112	-0.0013	0.0588	0.1609	0.1585	-0.2512	-0.6160	-	-0.0965	0.2780	0.3302	0.2415
DTAG	35 2941	0.2988	0.0631	-0.0308	-0.0557	-0.0462	-0.0756	0.1478	-	-0.6931	0.5109	0.3619	0.0713
DTAG	35 2966	-	-	-	-	-	-	1.3392	-	-0.1856	0.3413	0.1953	0.1468
DTAG	36 2794	-0.1984	-0.1290	-0.0555	-0.1101	-0.1178	-	-	-	-	-	-	-
EIM	35 0716	1.2134	0.9719	0.4928	0.1968	-	-16.3059	-	-	-	-	-	-
EIM	35 2060	0.0791	0.0664	0.0901	0.0136	-	-	-	-	-	-1.0792	-0.2646	-0.1142
ESTC	22 0132	-2.7073	-3.2485	-4.4860	-5.4811	-5.6987	-5.1519	-5.6194	-5.9838	-6.4771	-6.5030	-	-
ESTC	35 1615	-0.0076	-0.0152	0.0406	0.0335	-0.1413	-0.2906	-0.1764	-0.1322	-0.0117	0.2559	-	-
ESTC	35 2025	-	-	0.8338	-0.2780	0.0385	-0.0208	0.0770	0.1010	0.1394	0.1406	-	-
ESTC	35 2353	0.1075	0.1026	-0.0196	-0.0155	-0.1351	-	-	-	-	-	-	-
ESTC	40 2551	-2.6274	-2.5300	-2.3848	-2.2931	-2.2382	-2.2355	-2.1916	-2.1154	-1.9915	-1.9109	-	-
HKO	35 2425	-0.0349	0.0685	0.0339	-0.0603	-0.1098	-0.1933	-0.1904	-0.0730	-0.0040	-0.0252	0.0629	-0.1147
HKO	35 2884	0.3364	0.3245	0.2518	0.2455	0.3790	0.2593	0.1604	0.1128	0.1216	0.1221	0.2564	0.3608
IFAG	36 1167	-0.4371	-0.4662	-0.4129	-0.0562	0.3265	0.9061	0.6087	0.6725	0.2383	-0.2360	-0.7614	-0.6399
IFAG	36 1173	-0.3390	-1.2804	-1.1277	-0.4185	0.4097	0.8047	0.8004	-	-	-	-	-
IFAG	36 1629	-0.8524	-0.5463	-0.2074	-0.1651	-0.2681	0.0102	0.2777	0.4339	0.2872	0.0353	-0.3803	-0.6233

Table 10. (Cont.)

Lab.	Clock	56684	56714	56744	56774	56804	56834	56869	56899	56929	56959	56989	57019
IFAG	36 1732	-0.0595	-0.3358	-0.5125	-0.5477	-0.5016	-0.2423	-0.2693	-0.2387	-0.1773	-0.0596	0.2206	0.2594
IFAG	36 1798	0.0575	0.0002	0.0193	0.0301	0.0387	0.1301	0.1360	0.1220	-0.0173	-0.1928	-0.2855	-0.2114
IFAG	40 4418	0.4598	0.3752	0.3258	0.2770	0.1719	0.1518	0.1278	0.1318	0.1292	0.1802	0.2346	0.2617
IFAG	40 4439	-0.2604	-0.3368	-0.5177	-0.6182	-0.6539	-0.7272	-	-	-0.7411	-0.7336	-0.6065	-0.6003
IGNA	35 1196	-0.2026	-	-	-1.0411	0.4092	-0.6856	-	-	0.7401	0.3531	-0.0148	-
INPL	35 2480	-0.1026	-0.2847	-0.2564	0.0956	-0.0007	0.1321	0.1846	0.0840	0.0191	0.1274	0.1644	0.2741
INPL	35 2481	-0.1224	-0.1086	-0.1186	-0.0468	0.1148	0.0263	-0.0877	-0.1659	-0.3534	-0.4828	-0.5298	-0.5774
INTI	35 2377	-0.1418	-0.5184	0.0365	0.2639	-0.2467	0.1276	0.1607	-0.1706	-0.0874	0.2614	0.2537	0.3056
INXE	35 2393	-	3.2779	0.7747	0.5768	-0.1348	0.0356	0.1939	0.0036	0.0469	0.0375	-0.0574	0.0495
IPQ	35 2012	1.6354	-	-1.4222	-0.5817	0.0325	-	-	-	-	-	-	-
IPQ	35 2890	-1.1520	-	-1.2576	0.2645	0.7110	0.4972	0.3706	0.3904	0.1651	-0.0020	-0.1129	-
IT	35 0219	0.1468	0.0068	0.0811	0.0673	-0.0357	0.0299	0.1616	0.1411	0.2845	0.0407	-0.1383	-0.2668
IT	35 0505	-0.0061	-0.0867	-0.2918	-0.3720	-0.1100	-0.0238	-0.0539	0.0216	0.0454	0.1180	0.3001	0.2697
IT	35 1115	-4.6858	-6.1902	-6.2948	-4.8592	-2.2817	0.1142	0.2376	0.6470	0.5242	0.1886	-0.2036	-0.3422
IT	35 1373	-0.1951	-0.2229	-0.1090	0.0139	0.1946	0.2671	0.1817	0.0296	-0.0248	-0.0811	-0.0202	-0.0517
IT	35 2118	0.0712	-0.0655	-0.0724	-0.0669	-0.2633	-0.2521	-0.1968	-0.2393	-0.2134	-0.1264	-0.1512	-0.1694
IT	35 2487	0.0019	0.0605	0.1248	0.2050	0.1108	0.0318	-0.0829	0.0364	0.0172	0.1758	0.2219	0.3037
IT	40 1101	5.2177	5.1960	5.1688	5.1055	5.0132	4.9180	4.8423	4.8537	4.9039	4.9186	4.9069	4.8499
IT	40 1102	5.6537	5.5383	5.4462	5.3211	5.2301	5.1459	5.0957	5.0065	4.9300	4.8242	4.7326	4.6655
IT	40 1103	0.9620	0.9843	1.0038	0.9429	0.8836	0.8618	0.8820	0.9022	0.9571	0.9517	0.9416	0.9320
IT	40 1104	-	-	-	-	-	-	-	-9.4442	-9.1969	-10.9238	-12.2013	-11.6765
JV	21 0216	1.6942	1.4818	1.5930	1.3982	1.4011	-	-1.0950	3.1653	3.3204	2.5286	1.4100	1.7856
JV	36 1277	-0.0066	-0.0284	-0.1569	0.1419	-0.1618	-	3.3707	0.3447	-0.0756	-0.2681	-0.2064	-0.0332
JV	36 2617	0.0013	-0.1183	-0.0608	0.0229	-0.0931	-	-1.2793	0.3994	0.0118	0.3096	0.0669	0.1767
JV	36 2629	0.0694	-0.0240	-0.3595	0.1300	0.1021	-	-2.0593	-0.3285	-0.1261	-0.3476	-0.2420	-0.1336
JV	40 8713	-	6.8573	1.7385	1.2976	0.2483	-	-3.9450	-2.7674	-3.0021	-2.7968	-2.7672	-2.5439
KEBS	35 2518	-	-6.8399	-1.3148	-	-	-	-2.1922	-	0.6064	0.5658	0.7090	-
KIM	36 0618	-0.3829	-0.0342	0.6534	0.7844	0.2762	-	-	-	-	-	-	-
KRIS	35 0321	-0.0915	-0.1338	-0.1247	-0.2203	-0.2832	-0.2363	-0.3332	-0.3779	-0.5035	-	-	-0.9063
KRIS	35 0739	0.1612	0.1388	0.0384	-0.1882	-0.2615	-0.2387	-0.0614	0.1061	0.0874	0.1214	-	-2.3738
KRIS	35 1135	0.4703	0.4373	0.3098	0.1618	0.0269	-0.1139	-0.3057	-0.1237	-0.0541	-	-	-13.3143
KRIS	35 1693	0.0296	0.0875	0.2579	0.1233	0.0644	-0.0185	-0.1094	-0.1234	0.0149	-	-	-1.4892
KRIS	35 1783	-0.1378	-0.0763	-0.1006	-0.0951	0.0124	-0.0750	-0.1192	-0.0442	-0.1011	-	-	0.0914
KRIS	40 5625	0.0682	0.0806	0.1473	0.1502	0.2892	0.2600	0.2503	0.2348	0.1899	-	-	0.2285
KRIS	40 5626	0.2445	0.2345	0.2140	0.2030	0.1929	0.2134	0.2365	0.2604	0.2474	0.2140	-	0.2114

Table 10. (Cont.)

Lab.	Clock	56684	56714	56744	56774	56804	56834	56869	56899	56929	56959	56989	57019
KZ	35 2202	-0.0556	-0.1489	-0.0477	-0.1102	-0.0406	0.1174	1.0957	1.5715	2.2865	-	-	-0.9681
KZ	35 2665	0.1139	0.0597	0.0211	-0.0083	0.1470	0.0098	0.1375	0.1329	0.1158	-	-	-0.6492
KZ	35 2667	0.1729	0.0902	0.0936	0.0490	0.0313	0.0181	0.2075	0.1115	0.1586	-	-	-1.0503
LT	35 1362	0.2348	0.5710	0.2261	-0.0192	0.0483	-0.3236	-0.1367	0.0883	-0.0481	0.0753	0.3422	0.2766
LT	35 1868	0.0317	0.0675	0.3276	0.3826	0.3536	0.3944	0.3069	-0.0292	-0.1610	-0.2431	-0.1275	0.1184
MASM	35 2900	-	-	-	-	-	-	-	-	-	-	0.3135	-1.0281
MIKE	36 0986	-	1.1967	-0.2096	-0.5236	0.2583	0.2019	0.1569	0.0583	-0.0370	-0.1591	-0.0867	-0.1674
MIKE	40 4108	-	-	-	-	-1.5468	-	0.2550	0.3684	0.3674	0.3946	0.3936	0.3900
MIKE	40 4113	-	-0.9084	0.1038	0.5070	0.4242	0.3608	0.3907	0.5704	1.0808	1.3084	1.3704	1.2381
MIKE	40 4180	-	0.3327	0.1693	0.4500	0.4141	0.4056	0.4271	0.4487	0.3853	0.4194	0.4113	0.4124
MKEH	36 0849	0.3013	-0.0449	-0.0684	-0.1441	-0.0569	-0.0011	0.0901	-0.0970	-0.0418	0.0817	0.1072	0.1168
MSL	36 0274	-	-8.7564	-2.0281	3.8509	4.7321	4.9857	4.7979	4.4238	2.4955	1.9592	0.9432	-
MSL	36 2869	-	-21.4147	-4.1478	2.9918	4.1107	4.9089	4.5883	4.5634	2.3401	1.5838	0.5719	-
MTC	35 3002	-	-	-	-	-	-	-	-	-	-	-	-1.3898
MTC	35 3003	-	-	-	-	-	-	-	-	-	-	-	7.4799
MTC	35 3004	-	-	-	-	-	-	-	-	-	-	-	-1.6332
MTC	35 3005	-	-	-	-	-	-	-	-	-	-	-	2.2822
NAO	35 0779	-	0.7201	0.3808	0.3337	0.2083	0.2403	0.2768	0.3175	0.3095	-0.0188	-0.9095	-1.1785
NAO	35 1206	-	0.6619	0.0816	0.0010	-0.0532	-0.3757	-0.2265	-0.2242	-0.1909	-0.0037	0.6004	0.5567
NAO	35 1214	-	1.1899	-0.8125	-0.3169	-0.1870	-0.0710	-0.1166	0.0562	-0.0954	-0.0441	-0.0598	-0.0407
NAO	35 1689	-	-1.5736	-0.0988	0.2231	0.2138	0.1035	0.1315	0.1998	0.1393	-0.0282	-0.3940	-0.7199
NAO	40 1301	-	2.0333	-2.6813	-2.3158	-1.8159	-2.6149	-1.6251	-0.4099	-0.2552	-0.6947	-0.7307	-2.3750
NICT	35 0112	-0.1461	0.1444	0.1933	0.4463	0.6135	0.5073	0.6413	0.5476	0.1231	-	-	-
NICT	35 0332	-0.1940	-0.3146	-0.0537	0.0508	-0.1172	-0.1412	-0.0632	-0.1558	-0.1685	-0.0115	-0.1910	-0.2889
NICT	35 0343	0.1326	0.1734	0.1525	0.1132	-0.0698	-0.1240	-0.0404	-0.0937	-0.1900	-0.1668	-0.0879	-0.0767
NICT	35 0715	-0.1098	-0.1006	-0.0029	-0.0807	-0.0547	-0.0548	-0.1216	-0.0955	-0.0079	-0.1329	-0.1061	-0.0169
NICT	35 0732	-0.0532	-0.0274	-0.0749	-0.1885	-0.2403	-0.1924	-0.1322	-0.1111	-0.0527	-0.0418	-0.1032	-0.1148
NICT	35 0907	-0.1861	-0.2680	-0.3024	-0.2712	-0.3386	-0.2930	-0.4200	-0.4087	-0.3851	-0.3272	-0.3886	-0.2190
NICT	35 0913	0.8470	0.7641	0.5227	0.1053	-0.0938	-0.4112	-0.4720	-0.4888	-0.4132	-0.2048	-0.0739	0.0722
NICT	35 0916	-0.1827	-	-	-	-	-	-	0.1558	-0.3034	-0.2978	-0.0966	-0.0855
NICT	35 1225	-0.1188	-	-	1.7223	0.0660	0.0677	0.2017	0.2839	0.2329	0.2758	0.1135	0.0582
NICT	35 1226	-0.6347	-0.1974	0.2130	0.0079	0.0446	-0.0710	-0.2833	-0.2438	-0.1556	-0.3440	-0.3185	-0.3998
NICT	35 1611	1.1865	-1.2898	-1.3902	-0.5843	0.0272	0.4207	0.6155	-0.4370	-0.1650	-0.2084	-0.4834	-0.4558
NICT	35 1778	0.0868	-0.0260	-0.0929	-0.1832	-0.2857	-0.1105	0.0128	0.1143	0.1582	0.1791	0.0437	0.1505
NICT	35 1789	-0.0908	-0.0774	-0.0072	-0.0201	-0.0207	-0.0785	-0.0360	-0.0001	-0.0127	0.0290	-0.0447	-0.1972

Table 10. (Cont.)

Lab.	Clock	56684	56714	56744	56774	56804	56834	56869	56899	56929	56959	56989	57019
NICT	35 1790	-0.0964	-0.2518	-0.2439	-0.2437	-0.2423	-0.2135	-0.1088	-0.0648	0.0436	0.0631	0.1108	0.2115
NICT	35 1866	0.0511	-0.0133	-0.1160	-0.0262	0.0213	0.0229	0.0404	0.1441	-0.0252	-0.1092	-0.1397	-0.0965
NICT	35 1882	-0.1773	-0.1806	-0.1581	-0.2162	-0.1888	-0.1837	-0.0020	0.0138	0.1683	0.1809	0.1831	0.0026
NICT	35 1887	-1.7393	0.3339	2.0473	2.0761	1.7472	3.2060	5.3454	6.8678	6.1817	2.9258	-1.1607	-3.2961
NICT	35 1944	-0.0208	0.0250	0.0920	0.3440	0.2955	0.3499	0.4258	0.7052	0.7768	0.9099	0.7286	0.3646
NICT	35 2010	-0.1429	-0.1202	0.1581	0.2042	0.1220	0.1127	-0.0771	-0.1831	-0.0981	-0.0008	-0.0123	0.0633
NICT	35 2011	0.3944	0.3282	0.1019	0.0592	-0.0020	0.1033	0.1202	0.0920	-0.0632	-0.0921	-0.0255	0.0883
NICT	35 2056	0.2693	0.2369	0.2347	0.2830	0.2636	0.1360	0.1448	0.2018	0.2309	0.1613	0.1174	0.0203
NICT	35 2113	0.2177	0.1317	0.0040	-0.0365	-0.1054	0.0707	0.2560	0.4013	0.4561	0.5042	0.5252	0.4187
NICT	35 2116	-	-	-	-	-	-	-	-	-	-	0.2518	-0.2548
NICT	35 2570	-0.0213	-0.4247	-0.3616	-0.1722	0.1076	0.1581	0.0927	-0.0704	-0.2616	-0.2495	-0.1484	-0.0108
NICT	35 2574	0.1546	0.2026	0.1253	0.2203	0.1606	0.2354	0.2584	0.4214	0.3898	0.3797	0.1608	0.0380
NICT	35 2627	-0.1814	-0.1033	-0.0979	-0.0714	-0.0428	0.0927	0.0464	0.2790	0.3576	0.0418	-0.1796	-0.1493
NICT	35 2628	-0.8278	-0.6514	-0.3436	-0.1554	-0.3240	-0.2641	-0.2001	-0.1140	0.0862	0.2245	0.0987	0.0030
NICT	35 2784	0.2247	0.1237	0.1119	0.2056	0.2523	0.2330	0.2449	0.1110	0.0577	0.0449	0.0100	0.0053
NICT	35 2876	-	-	-	-	-	-	-	-	1.6658	0.1169	0.0889	0.0347
NICT	35 2903	0.0281	0.0049	-0.0300	0.0098	0.0403	0.1024	0.2458	0.2803	0.1580	0.1480	0.1718	0.2597
NICT	36 1217	0.2102	-0.5220	-0.4144	-0.2438	-0.3698	-0.1075	-0.4757	-0.6372	-0.4504	0.0221	0.2172	0.1836
NICT	40 2003	-0.2049	-0.1350	-0.0963	-0.1334	-0.2146	-0.2417	-0.1869	-0.1194	-0.0276	0.0352	0.0672	0.0910
NICT	40 2004	1.7831	1.8354	1.8690	1.8860	1.8413	1.8181	1.7994	1.7954	1.8015	1.8331	1.8793	1.9239
NICT	40 2005	1.7744	1.8618	1.7267	1.5727	1.4458	1.4205	1.4051	1.3577	1.3505	1.3688	1.3666	1.6773
NICT	40 2006	1.4722	1.5556	1.6823	1.8066	1.8863	1.9289	1.9250	1.9239	1.8691	1.8405	1.7898	1.7395
NIM	35 1235	0.5569	0.3532	0.1939	-0.0862	-0.1512	-0.1642	0.3237	0.3404	0.4862	0.3466	0.2360	0.0282
NIM	35 2239	0.0631	-0.0671	-0.0660	-0.1987	-0.2518	-0.0162	0.0953	0.1350	-	-	-	-0.4743
NIM	35 2256	-0.0474	0.1700	0.0992	0.2161	0.0610	0.0962	-0.1032	0.0489	-0.0146	0.0671	-0.0203	-0.1055
NIM	35 2483	0.1380	0.1323	0.1852	0.1455	0.0514	0.0306	-0.1008	-0.1668	-0.1096	-0.0388	-	-0.6081
NIM	35 2643	0.2328	0.1126	0.0742	0.0760	0.0881	0.1109	0.1498	0.1396	0.1296	0.0794	0.0347	0.0005
NIM	35 2744	0.5214	0.4224	0.3740	0.3643	0.3132	0.2762	0.1759	0.1399	0.1461	0.1923	0.0999	0.0425
NIM	35 2767	-0.1022	-0.3570	-0.3241	-0.1674	-0.0144	-0.0287	0.2615	0.2075	0.1811	0.2132	0.0944	-0.0578
NIM	35 2769	-	-	-	-	-	-	-	-	-	-0.0609	0.1952	0.3701
NIM	40 4832	2.6439	2.6671	2.7030	2.8645	3.0078	3.2113	3.3265	3.3000	3.1684	2.9725	2.7953	2.7030
NIM	40 4835	-0.0761	-0.3821	-0.1521	-0.0487	0.5191	-	-	-	-	-	-	-
NIM	40 4871	4.2802	4.2703	4.2713	4.2880	4.1966	4.1364	4.1148	4.1279	4.1451	4.1381	4.1207	4.1111
NIM	40 4878	4.0162	4.0027	4.0333	4.1595	4.3966	4.6630	4.8380	4.9153	4.8281	4.6582	4.5490	4.3563
NIM	40 4879	5.8586	5.6646	5.8030	5.7203	5.5982	5.1973	4.9497	3.9941	3.2334	3.1060	2.7868	2.6935

Table 10. (Cont.)

Lab.	Clock	56684	56714	56744	56774	56804	56834	56869	56899	56929	56959	56989	57019
NIM	40 4880	7.4874	7.4305	7.3522	7.2236	7.0736	6.9023	6.6481	6.3464	5.9660	5.5949	5.3190	5.1268
NIMB	35 0600	1.7935	0.5224	-0.0438	-0.4723	-0.3731	-0.7097	-0.4781	-0.2741	-0.1456	0.0730	0.4094	0.5948
NIMT	35 2246	1.0911	0.9028	0.4604	-	-	2.6541	0.1560	0.5380	0.5140	0.3104	0.2237	0.1162
NIMT	35 2247	-0.1290	0.1522	-0.2329	-0.3050	-0.2228	0.2976	0.2209	0.2486	0.1038	0.3044	-0.3206	-0.0190
NIS	35 1126	-	-	-	-	-	-	59.5907	6.4139	1.7716	-1.5953	-4.8156	-5.1416
NIST	35 0282	-	-	-	1.6298	0.5053	-0.1608	0.0210	-0.0236	-0.0203	-0.0629	-0.0099	-0.1566
NIST	35 0408	0.0206	0.1057	0.1623	0.0499	-0.0757	-0.1655	-0.0938	-0.0087	0.0230	0.0496	-0.0164	-0.1105
NIST	35 1074	-0.4107	-0.4001	-	1.2937	0.6261	0.3578	0.0868	0.0143	-0.0590	-0.1520	-0.1031	-0.0027
NIST	35 1519	0.6519	0.6931	0.6625	0.4814	0.5827	0.4100	0.3965	0.4024	0.4353	0.4232	0.6321	0.4234
NIST	35 2031	-0.0873	0.0742	0.3769	-	-	-	-	-	-	1.8454	0.4848	0.5054
NIST	35 2032	0.1742	0.0636	0.0161	0.0244	-0.0471	-0.0839	0.0452	0.0810	0.0421	0.2031	0.1969	0.0645
NIST	35 2034	-0.0682	-0.1137	-0.2035	-0.1693	-0.0781	-0.2138	-0.0829	-0.0511	0.0061	0.0008	-0.0110	-0.0818
NIST	35 2579	-0.5426	-0.6300	-0.5182	0.0718	0.2546	0.3957	0.2439	-0.0284	-0.1981	-0.0313	0.1600	0.3082
NIST	35 2672	0.1732	0.2696	0.2366	0.1502	0.1115	0.0432	-0.0820	0.0293	0.1301	0.1502	0.1768	0.2725
NIST	35 2935	-	-	-	-	-	-	-	-	1.5664	0.1655	0.1636	-0.1583
NIST	40 0204	0.2593	0.2585	0.2597	0.2658	0.2558	0.2589	-	-	-	-	-	-
NIST	40 0205	0.0357	-1.9277	0.0351	0.0343	0.0199	0.0174	0.0152	0.0216	0.0326	0.0544	0.0757	0.0850
NIST	40 0206	0.6321	0.6605	0.6726	0.6315	0.5692	0.5526	0.5928	0.6945	0.8148	0.8911	0.9582	0.9532
NIST	40 0212	-	-	-	-	-	-	-	-	6.9595	6.9825	7.0885	7.1648
NIST	40 0222	0.1140	0.1203	0.1211	0.1190	0.1103	0.1019	0.0997	0.1057	0.1038	0.1159	0.1420	0.1472
NMIJ	35 0224	-0.3418	-0.3221	-0.2773	-0.2491	-0.2002	-0.0862	0.0593	-0.0225	-0.0772	-0.1424	-0.1771	-0.1503
NMIJ	35 0523	0.3335	0.2183	0.0150	-0.1556	-0.1441	-0.0675	-0.0810	-0.0451	0.0764	-0.0272	-0.0486	-0.1320
NMIJ	40 5002	-	-	-	-	-	-	-	-	-1.8176	-1.1918	-1.6331	-1.6842
NMIJ	40 5003	0.0015	-0.0093	-0.0092	0.0059	0.0152	-0.0014	-0.0078	0.0242	-	-	0.1558	0.0481
NMIJ	40 5015	3.2726	3.2569	3.2280	3.1631	3.1546	3.0287	-	-	-	-	-	-
NMLS	35 0328	-5.7797	-5.0713	-2.7446	0.5844	0.6563	5.9092	8.3733	8.6212	4.6627	0.1340	-4.8884	-4.6249
NPL	35 1275	-0.5615	-0.1457	-0.0728	0.0508	0.1880	0.3650	0.2022	0.0144	-0.1499	-0.1240	-0.0428	0.1551
NPL	40 1701	0.3689	0.3482	0.3738	0.3467	-0.1762	-0.0695	0.0942	0.2275	0.4209	0.6205	0.2908	0.3445
NPL	40 1708	0.2957	0.2609	0.2809	0.2921	0.2287	0.1275	0.0742	0.0695	0.1168	0.2000	0.3183	0.3751
NPLI	35 0057	-0.3490	-0.1484	-0.1720	0.0369	0.0896	0.3476	0.5516	0.3802	-0.0337	-0.1921	-0.0124	0.4110
NPLI	35 0140	-0.6388	-0.4647	-0.1439	0.4976	0.3664	0.4049	0.9938	0.9015	-0.0251	-0.0892	-0.4308	-0.9468
NPLI	35 1324	-0.0391	0.1229	0.0255	-0.1052	-0.0725	0.0635	0.1654	0.1971	0.1814	-0.2024	-0.3016	-0.0871
NPLI	35 2245	-0.2229	-0.1907	-0.2397	-0.2272	-0.1581	0.0778	0.0683	0.2691	0.2885	0.2321	0.1233	0.1788
NPLI	35 2796	0.2388	0.1581	0.1369	0.0445	0.0361	0.0182	0.0709	0.0369	0.1474	0.0971	0.1938	0.2482
NPLI	40 5201	0.9804	0.1603	-1.6504	-1.8546	-3.3659	-2.8509	0.0049	3.0560	2.9602	2.9705	1.3972	0.3401

Table 10. (Cont.)

Lab.	Clock	56684	56714	56744	56774	56804	56834	56869	56899	56929	56959	56989	57019
NRC	35 2150	-0.1185	-0.1660	-0.1139	0.1144	-0.0501	-0.0521	-0.0064	0.0077	-0.0081	0.2064	0.0548	-0.0138
NRC	35 2152	0.0403	0.0688	0.0466	0.0026	-0.2000	-0.1567	-0.2416	-0.0181	0.0511	-0.0285	0.0321	0.1591
NRC	36 2219	0.0640	0.1483	0.0395	0.1999	0.1693	-0.0023	-0.1430	-0.0221	0.1545	0.1038	0.1008	0.1547
NRC	40 0304	0.6854	0.4642	-0.2656	-0.4704	-	-	-	-	-	-	-	-
NRC	40 0306	6.8457	6.8967	6.9776	7.0718	7.2684	7.4023	7.6882	7.9091	8.1036	8.2770	8.4085	8.3620
NRL	35 0714	-	-	-0.8428	0.2704	0.5240	0.2482	-	-	-	-	-	-
NRL	35 0719	-	-	-2.0051	-0.8817	-0.2983	-0.1682	-	-	-	-	-	-
NRL	35 1245	-	-	2.5652	-0.1999	0.3460	0.1388	-	-	-	-	-	-
NRL	35 2460	-	-	-	2.0412	-	-	-	-	-	-	-	-
NRL	35 2464	-	-	-	1.5749	-	-	-	-	-	-	-	-
NRL	35 2580	-	-	-	-2.4640	-	-	-	-	-	-	-	-
NRL	36 0387	-	-	-0.7296	-0.6300	-0.4140	0.1408	-	-	-	-	-	-
NRL	40 1001	-	-	-1.1102	-1.2380	-0.0719	0.2645	-	-	-	-	-	-
NRL	40 1003	-	-	-0.8702	-0.8587	-0.6660	-0.5664	-	-	-	-	-	-
NRL	40 1009	-	-	-1.1651	-1.5606	-1.5085	-1.7523	-	-	-	-	-	-
NRL	40 1010	-	-	10.8281	2.5597	-2.2459	-4.5466	-	-	-	-	-	-
NTSC	35 1007	-	-	-	-	-	-	-	-	-	-1.0175	-0.1257	-
NTSC	35 1011	0.6127	0.6113	0.1477	-0.0439	-0.0322	0.2241	0.2035	0.1718	-0.1535	-0.0700	0.1391	0.5235
NTSC	35 1016	-0.6343	-0.8891	-0.9013	-0.7244	-0.4583	-0.2045	0.1164	0.3562	0.3570	0.3213	0.1662	0.1335
NTSC	35 1018	0.4065	0.3169	0.2621	0.1046	-0.1306	0.0012	-0.0579	-0.0073	0.0426	-0.0037	0.0195	0.1944
NTSC	35 1818	-0.2941	-0.3450	-0.4322	-0.2998	-0.3862	-0.2543	-0.3335	-0.2211	-0.3766	-0.1907	-0.1037	-0.0220
NTSC	35 1820	0.3451	0.3558	0.2191	0.1335	0.0905	0.0304	0.0630	-0.0065	0.0849	0.0369	-0.0209	0.0211
NTSC	35 1823	0.1472	0.1104	0.0344	-0.0170	0.0410	-0.0300	0.0925	0.0855	-0.0073	0.0090	0.0858	0.0343
NTSC	35 2096	-0.1665	0.0210	0.1174	0.1465	0.0142	0.1209	-0.0508	-0.2323	-0.3196	-	-	-
NTSC	35 2098	-0.0250	-0.0508	-0.0531	-0.1794	0.0345	0.0781	0.0090	-0.0275	-0.1039	-0.1642	-0.2450	-0.0999
NTSC	35 2131	-0.2057	-0.0514	-0.0985	-0.1088	-0.1516	0.0401	0.1460	0.0980	0.0835	-0.0184	-0.1685	-0.2871
NTSC	35 2141	-2.5942	-2.1000	-1.9726	0.3290	3.4130	4.0193	1.0195	0.1212	-0.7753	-1.8451	-1.4261	-0.8325
NTSC	35 2142	-0.0578	-0.1336	-0.1530	-0.1833	-0.0272	-0.0650	-0.0032	-0.0251	0.0128	-0.0514	-0.0452	-0.1505
NTSC	35 2143	0.4222	0.6843	0.6335	0.4185	0.1626	-0.0305	0.0380	0.2048	0.1539	-0.0038	-0.1999	-0.2492
NTSC	35 2144	-0.3194	-0.2055	0.0081	0.0317	0.2588	0.3971	0.3330	0.0432	0.0280	-	-	-
NTSC	35 2145	-0.2180	-0.3568	-0.4113	-0.4033	-0.3290	-0.2095	-0.0933	-0.0689	-0.2877	-0.6664	-0.8624	-0.9043
NTSC	35 2147	0.0984	0.0645	0.1261	0.0690	-0.0417	-0.0757	-0.1474	-	-	-	-	-
NTSC	35 2573	0.2244	0.1104	-0.0344	-0.1240	-0.1045	-0.0728	-0.0720	-0.0374	-0.0602	0.0213	0.0394	-0.0788
NTSC	35 2831	0.5371	0.4681	0.5729	0.3755	0.5300	0.4686	0.4129	-	-	-	-	-
NTSC	35 2852	0.1274	0.1474	0.1258	0.1489	0.2684	0.1341	0.1817	0.1619	0.0755	-0.0277	0.0471	-0.0097

Table 10. (Cont.)

Lab.	Clock	56684	56714	56744	56774	56804	56834	56869	56899	56929	56959	56989	57019
NTSC	35 2855	0.3386	0.3611	0.2011	0.2323	0.2497	0.2693	0.2952	0.2540	0.1472	-	-	-
NTSC	35 2921	0.2004	0.1638	0.0815	0.0863	0.0762	-0.1941	-0.0840	-0.0465	-0.0823	-0.0475	0.0539	-0.0972
NTSC	35 2922	-0.1540	-0.0866	0.0040	0.0607	0.0010	0.1208	0.0955	0.2773	0.2787	0.2198	0.1475	0.0797
NTSC	35 2924	0.1058	-0.0304	-0.0256	0.0085	-0.0187	-0.0566	-0.0105	0.0335	0.1204	0.0241	-	-
NTSC	35 2926	0.1405	0.1416	0.1309	0.0235	0.0958	0.0829	0.1648	0.1294	0.1724	0.2610	0.3644	0.2807
NTSC	35 2928	0.1532	0.0593	0.0323	0.1155	0.0774	0.0142	-0.0254	0.1028	0.1181	0.2386	0.3084	0.2920
NTSC	35 2933	-0.0164	0.1087	-0.0480	-0.0522	0.0544	0.0157	-0.0230	0.0841	0.0171	-0.0550	-0.1239	-0.0985
NTSC	35 2959	-	-	-	-	-	0.4495	0.6953	0.6565	0.4008	0.3343	0.1927	0.0842
NTSC	35 2962	-	-	-	-	-	-0.4111	-0.3919	-0.0789	0.0516	0.0137	-0.0280	-0.0410
NTSC	35 2964	-	-	-	-	-	-1.0145	-0.0655	0.0129	-0.1120	-0.0282	0.0585	0.1375
NTSC	35 2965	-	-	-	-	-	1.0906	0.5516	0.0740	0.1246	0.0645	0.0347	-0.1096
NTSC	35 2976	-	-	-	-	-	1.5878	1.2459	0.9704	0.7147	0.6188	0.8579	0.9282
NTSC	35 2978	-	-	-	-	-	2.2083	0.2265	0.2306	0.1207	0.2053	0.2014	0.0391
NTSC	35 2980	-	-	-	-	-	0.4049	0.2760	0.2891	0.2394	0.1019	0.1701	0.1314
NTSC	35 2981	-	-	-	-	-	0.4735	0.1039	0.1161	-0.0084	0.1673	0.1828	0.2348
NTSC	40 0296	-	-	-	-	-	-	-	2.4083	2.4737	2.5450	2.5500	2.5551
NTSC	40 0297	-	-	-	-	-	-	-	2.6003	2.6231	2.7311	2.7767	2.7527
NTSC	40 4926	6.4038	6.3855	6.5059	6.7836	7.0079	7.0605	6.9468	6.6555	6.3503	6.2288	-	-
NTSC	40 4927	1.1760	1.0582	0.1298	-0.7526	-1.8175	-2.4628	-2.8206	-2.6085	-1.9036	-0.7187	-	-
NTSC	40 4943	0.0598	-0.1976	-0.0687	-0.1116	0.0131	0.0029	0.0536	0.0026	-0.0213	-0.1120	-0.0284	-0.0226
NTSC	40 4945	0.6610	0.2307	-0.6999	-0.0500	0.1590	0.2675	0.3463	0.3067	-0.1842	-0.1840	-	-
NTSC	40 4946	0.0573	0.1101	-0.6566	-0.5494	-0.4177	-0.3907	-	-	-	-	-	-
ONBA	36 2228	-	-	0.5561	-0.7340	-0.2756	-0.1436	0.1057	0.0651	0.2049	-	-	-0.2652
ONRJ	35 0102	0.4547	0.4873	0.2873	0.0205	-0.1165	-0.2071	-0.0276	0.2566	0.1042	0.1686	-	1.3188
ONRJ	35 0103	0.0407	-0.0376	-0.0237	0.0429	0.1822	-0.1471	-0.2733	-0.2985	-0.3717	-0.1224	0.2853	0.2592
ONRJ	35 0123	0.5031	0.1905	0.1120	-0.0545	-0.0155	-0.0486	0.0731	0.0650	-0.0546	0.0641	0.0844	0.1284
ONRJ	35 0129	-0.1213	-0.1631	-0.0106	-0.0124	-0.0467	-0.0016	0.1103	0.1639	0.2939	0.2595	0.3077	0.3157
ONRJ	35 0147	0.1039	0.1220	0.0634	0.1855	0.2456	0.0841	0.2113	0.2400	0.1410	0.0746	-0.0009	-0.0262
ONRJ	35 1153	0.0858	0.1298	-0.0370	-0.2558	-0.2224	-0.2624	-0.1582	0.0274	-0.0043	-0.0410	0.1037	0.3031
ONRJ	35 1942	-0.2525	-0.2216	-0.2453	-0.2509	-0.3753	-0.3406	-0.3275	-0.2870	-0.2864	-0.2309	-0.3981	-0.2762
ONRJ	40 1950	-2.1238	1.8002	3.1746	3.1110	3.4113	5.3956	8.4056	10.5353	10.6100	9.0546	6.6986	4.7175
ONRJ	40 1958	0.2347	0.7932	1.7698	2.4460	2.4504	1.9516	1.0974	0.2908	-0.2973	-0.5096	-0.4867	-0.4549
OP	35 0124	-0.0480	0.0762	-0.0205	-0.0884	-0.1979	-0.1783	-0.2330	-0.1109	-0.0741	0.0396	0.1203	0.0856
OP	35 0157	-0.0481	-	-	-0.0468	0.0064	-0.1867	-0.1501	-0.0852	-0.0710	0.0455	-0.0158	-0.0056
OP	35 0158	0.7164	0.7327	0.5049	0.1994	0.2674	0.2904	0.3760	0.4042	0.4098	0.1718	0.1057	0.1931

Table 10. (Cont.)

Lab.	Clock	56684	56714	56744	56774	56804	56834	56869	56899	56929	56959	56989	57019
OP	35 0355	-0.0652	-0.0780	-0.1566	-0.1622	0.0110	0.2662	0.2724	0.2338	0.1746	0.2348	0.4820	0.6083
OP	35 0385	0.1049	0.1263	0.0010	0.3251	0.2977	0.3336	0.2782	0.0354	-0.1366	-0.1311	-0.0659	-0.1076
OP	35 0396	0.0029	-0.1418	-0.2110	-0.0655	-0.0454	0.0338	0.0707	0.0562	0.0779	0.0500	0.1556	0.1312
OP	35 0469	-	-	-	2.4457	-0.4291	-0.2963	-0.0001	0.0291	0.1414	0.4955	0.7341	0.6544
OP	35 0489	-	-	-	-0.7600	-0.5323	-0.0199	0.2325	0.1090	0.0318	-0.0268	0.0196	0.0901
OP	35 0609	-0.8396	-0.7159	-0.5627	-0.5814	-0.6740	-0.7789	-0.7184	-0.5129	-0.2285	-0.2178	-0.3070	-0.4486
OP	35 0700	0.7137	0.3703	0.0100	-0.1649	-0.1163	0.0098	-0.0412	-0.1781	0.0154	-	-	-
OP	35 0770	-0.2059	-0.0132	0.3063	0.2875	0.0307	-0.3029	-0.4308	-0.4197	-0.3772	-0.2205	-0.0260	-0.1029
OP	35 0774	0.0729	0.0196	0.0492	0.0745	0.0113	-0.0184	0.1006	0.0196	-0.0107	-0.1156	-0.1780	-0.1596
OP	35 0781	0.1787	0.0125	-0.1495	-0.1569	-0.0508	0.0335	0.1416	-0.0143	-0.2165	-0.2103	-0.1487	-0.0804
OP	35 0859	-0.1046	-0.1641	-0.0601	0.2466	0.2517	0.2348	-0.0082	-0.4278	-0.3337	0.1212	0.0498	0.3524
OP	35 1177	0.1021	-0.0343	0.0346	-0.1810	-0.2973	-0.2368	-0.1086	-0.0211	-0.1386	-0.1133	-0.3070	0.0919
OP	35 1222	0.0586	-0.0085	0.0264	0.0730	0.0849	0.1259	0.1009	0.0511	0.0982	0.1332	-0.0118	-0.0767
OP	35 1321	0.2446	0.1091	0.1067	-0.2775	-0.6538	-0.7779	-0.5041	-0.5561	0.0165	0.2028	0.2285	-0.0169
OP	35 1556	-0.2308	-0.2618	-0.0678	0.1401	-0.0444	0.0236	-0.0606	-0.0391	0.1432	0.3252	0.0723	-0.2074
OP	35 1644	-0.0902	-	-	1.8080	-0.1119	0.1908	0.0174	0.0110	-0.0099	-0.0612	-0.2684	-0.2018
OP	35 2388	-0.1089	0.3180	0.4252	0.3500	0.3927	0.3484	0.2681	0.4708	0.3968	0.1619	0.1662	0.2949
OP	35 2609	-0.0574	-0.0900	-0.0880	-0.1550	-0.1145	-0.1375	-0.1429	-0.2062	-0.1125	-0.1571	-0.1625	-0.1158
OP	35 2647	-	1.9133	6.8066	4.3393	2.5910	1.8260	1.1753	0.1467	-0.1196	0.1403	-0.0900	0.0835
OP	35 2804	0.0723	0.1678	0.1408	0.1511	0.0928	0.1286	0.1036	0.1298	0.1087	0.1626	0.1172	0.1895
OP	40 0809	0.7912	0.7725	0.7426	-	-	-	0.6150	0.7825	0.7989	0.7746	0.7611	0.7628
OP	40 0810	0.7893	0.7869	0.7952	0.7799	0.7311	0.7222	0.7106	0.7244	0.7208	0.6995	-	-
OP	40 0889	0.3643	0.3826	0.3867	0.3741	0.3451	0.3395	0.3231	0.3297	0.3335	0.3377	0.3358	0.3358
OP	40 0890	0.1967	0.1786	0.1738	0.1552	0.1370	0.1470	0.1419	0.1505	0.1654	0.1627	0.1525	0.1470
ORB	35 2722	0.1104	0.0547	0.0571	0.0232	0.0499	0.1300	0.0803	0.1050	-0.0001	-0.0579	0.0640	-0.0870
ORB	35 2723	0.1748	0.0077	-0.0044	0.1825	0.0954	0.1829	0.1985	0.0045	-0.1595	-0.1803	-0.1690	-0.1089
ORB	35 2724	0.2818	0.1388	0.1447	0.0854	0.0082	-0.0215	-0.0170	0.0259	0.0800	0.0740	0.1075	0.1709
ORB	36 0593	0.0457	0.4456	0.1160	0.1476	-0.0566	-0.2927	-0.1172	-0.2110	-0.3973	-0.2899	-0.0833	-0.2824
PL	25 0124	0.7174	0.8812	0.3243	0.0983	-1.1040	-1.3273	-1.5895	-1.2845	-1.3225	0.4667	1.5260	1.6541
PL	25 0125	-1.8263	-1.8738	-1.7278	-1.6406	-1.4105	-1.3357	-1.4283	-1.6753	-1.3325	-0.9835	-0.7969	-1.4788
PL	35 0441	-0.0052	-0.0685	-	-	1.6287	0.6857	0.5292	0.3777	0.2036	0.2133	0.2023	0.1509
PL	35 0502	-0.0608	-0.3935	-0.7514	-0.8510	-0.7225	-	-	7.9935	2.2136	-	-	-
PL	35 0745	-0.0298	0.3556	0.9888	1.3493	1.5127	1.0471	0.1941	-0.3115	-0.1954	-0.2071	0.0863	0.1228
PL	35 0761	0.1720	-0.0052	0.1385	0.2338	-0.0279	-0.1940	-0.3173	-0.2923	-0.3271	0.1170	0.6261	0.6535
PL	35 1120	-0.0767	-0.0794	-0.1174	-0.0273	0.0306	0.0735	0.2321	0.1962	0.0170	0.0753	-0.1676	-0.6068

Table 10. (Cont.)

Lab.	Clock	56684	56714	56744	56774	56804	56834	56869	56899	56929	56959	56989	57019
PL	35 1746	0.6578	1.4058	2.5762	3.3128	5.4501	7.1621	7.3307	6.5129	4.1269	0.0521	-2.6290	-3.2336
PL	35 1934	-0.2855	0.1803	0.0914	-0.0054	0.0744	0.0916	-0.0413	0.0395	0.1051	0.0866	0.1941	0.2166
PL	35 2175	-0.1261	0.0506	-0.0922	-0.0465	-0.0708	-0.0237	-0.0592	0.0776	0.0593	0.0497	0.0707	-
PL	35 2394	0.2201	0.1377	0.1574	0.1074	-0.0825	-0.0866	0.0909	0.0476	0.0768	0.1971	0.2782	0.3523
PL	35 2891	-	-	-	-	-1.5221	-0.3628	-0.4211	-0.1816	-0.1215	-0.0538	0.1018	0.1723
PL	40 4004	-31.2062	-26.3211	-25.8134	-27.4246	-29.7687	-29.4600	-27.5386	-23.9362	-23.0902	-23.3690	-24.3537	-24.9087
PL	40 4601	0.7775	0.7194	0.7034	0.7121	0.6994	0.6819	0.7578	0.7178	0.6947	0.6928	0.7270	0.7187
PL	40 4602	8.4180	8.4957	8.0348	7.7529	7.4710	7.2777	7.5037	7.9698	8.0701	7.6401	7.0382	6.2326
PTB	35 0128	0.0906	0.2389	0.2153	0.0086	0.0085	-0.0656	0.0086	-0.0412	-0.0479	-0.2490	-0.2070	0.2572
PTB	35 0415	-1.2371	-1.3480	-1.1024	-0.8198	-0.7771	-0.6258	-0.6231	-0.3455	0.1327	0.1844	0.1004	-0.0388
PTB	35 1072	-0.1839	-0.1270	-0.1082	0.0083	0.2928	0.5225	0.4029	0.2517	0.1324	-0.0864	0.0091	0.1481
PTB	35 2987	-	-	-	-	-	-	-	-	-	-	-	-0.7692
PTB	40 0506	1.4770	1.4884	1.5234	1.5635	2.0609	2.3883	2.5027	2.3895	2.0795	1.5854	1.5436	1.5418
PTB	40 0508	0.6557	3.6383	3.5837	3.4855	3.3730	3.2080	3.0191	2.9938	2.9888	3.1010	3.2646	3.3093
PTB	40 0509	0.2132	0.3622	0.3828	0.3544	0.3216	0.3160	0.3234	0.3501	0.3799	0.3793	0.3900	0.5330
PTB	40 0590	0.4151	0.4386	0.4447	0.3711	0.3127	0.3275	0.4054	0.4735	0.5053	0.4660	-	-
PTB	92 0001	-0.0379	-0.0114	-0.0212	-0.0210	-0.0679	-0.0813	-0.0545	0.0685	0.1058	0.1159	0.0657	0.0051
PTB	92 0002	0.0596	-0.1171	-0.1534	-0.1393	-0.0010	0.1518	0.1486	0.0829	0.0041	-0.0721	-0.0358	-0.0313
ROA	35 0583	-0.0282	-0.1236	-0.0728	-0.0795	-0.0412	-0.0014	0.1293	0.2274	0.2858	0.2837	0.1574	-0.0479
ROA	35 0718	-0.2831	-0.2971	-0.3300	-0.1995	-0.1436	-0.1851	-0.2441	-0.1220	-0.1053	-0.1003	-0.0314	-0.0385
ROA	35 1699	-0.0233	0.0453	-0.0755	-0.0861	-0.1282	-0.1078	-0.2155	-0.2829	-0.2542	-0.1973	0.0745	0.2358
ROA	35 2270	0.0128	0.1224	-0.0526	-0.2478	-0.2261	-0.1751	-0.0842	0.0994	-0.0460	-0.2905	-0.5007	-0.4413
ROA	36 1488	-0.2312	-0.1379	-0.1220	-0.1083	-0.0134	0.3579	0.2197	0.0116	-0.0607	-0.0371	-0.0401	0.0740
ROA	36 1490	0.1216	-0.1577	-0.5655	-0.0149	-0.0419	0.0168	0.6366	0.5079	-0.3161	0.2085	0.2161	0.0198
ROA	40 1436	2.8880	2.8771	2.9012	3.1244	3.2288	3.1817	2.9409	2.7507	2.5081	2.4172	2.4426	2.4751
SASO	35 0221	-1.4822	0.6427	0.8279	0.5283	0.2691	0.0460	-	-2.8511	-1.5513	-0.2665	-0.1628	-0.1308
SASO	35 1628	-1.2376	-0.7547	0.2124	0.4426	0.2163	0.2288	-	-2.6214	0.5957	0.8060	0.3539	0.0641
SASO	35 2923	-0.1496	0.0743	0.0731	0.0309	0.0828	0.2203	-	0.6392	0.2575	0.0888	0.2592	0.3439
SASO	35 2932	0.5352	0.1385	-0.0063	-0.0319	-0.0984	-0.0007	-	1.7295	0.7891	0.5707	0.3356	0.1463
SCL	35 2178	-0.0123	-0.0331	0.0791	0.0577	0.1311	0.1827	-	-6.5231	-0.3769	-0.0593	0.0663	-
SCL	35 2525	0.0715	0.0910	-0.0525	-0.1001	-0.1369	-0.3125	-	-2.5562	0.0754	0.6621	0.4046	-
SG	35 0188	-	-	-	-	-	-	-	1.5306	0.1337	0.1692	0.0735	0.0789
SG	35 0475	-0.0226	0.1766	0.0777	0.0751	-0.0068	-0.0368	-0.0404	0.0181	-0.1620	-0.0926	0.0247	0.0251
SG	35 1889	0.2492	0.0151	-	-	-	-	-	-	-	-	-	-
SG	36 0522	0.2999	0.2700	0.1571	0.1061	0.2353	0.0598	-0.1113	-0.0447	-0.2600	-0.2661	-0.0124	-0.0741

Table 10. (Cont.)

Lab.	Clock	56684	56714	56744	56774	56804	56834	56869	56899	56929	56959	56989	57019
SG	40 7701	3.9058	4.6013	5.1526	5.7422	6.1376	6.4556	6.5703	5.6579	5.8226	6.0306	6.1644	6.3663
SIQ	36 1268	0.6706	0.5813	0.4504	-0.2892	-0.3244	0.0029	0.1850	0.5428	0.6812	0.2587	-0.0324	-0.1917
SMD	35 1766	0.0460	-0.0018	0.1186	0.1818	0.1219	0.0814	0.0150	-0.0537	0.0021	0.1115	0.1015	0.0199
SMD	35 2003	-0.3600	-0.1018	-0.2270	-0.1729	-0.4481	-0.4627	-0.3835	-0.1936	-0.1170	-0.0663	-0.2191	-0.1364
SMD	35 2543	0.1573	0.0907	0.0611	0.1061	0.1022	0.0205	-0.0856	-0.0533	0.1616	0.8432	1.3864	1.7434
SMD	40 7909	-4.1610	4.7281	-4.1404	-4.0247	-3.4689	-3.8060	-4.3788	-4.5182	-4.4482	-4.1907	-3.1378	-2.9693
SMU	36 1193	0.0388	0.5300	-	-	-0.1816	0.0849	0.0804	0.0385	-	-	2.2198	0.3087
SP	35 0572	0.0844	-0.1701	-0.2074	-0.1482	0.0208	0.0343	-0.0182	-0.0857	-0.1486	-0.1467	-0.0881	0.0240
SP	35 0641	-0.1119	-0.0162	0.0223	0.0844	-0.0409	-0.0298	-0.0820	-0.1595	-0.1018	0.0613	0.1418	0.2461
SP	35 0767	0.5557	0.2927	0.1159	0.0903	0.0780	-0.0528	0.0472	0.0842	0.0890	0.0457	-0.0374	-0.0431
SP	35 1188	-	-	0.3367	0.0237	0.0683	-0.2469	-0.1469	-0.1509	-0.0575	0.0918	0.1771	0.2441
SP	35 1642	0.0326	0.1437	0.2640	0.2348	0.3556	0.1959	0.0955	-0.0739	-0.1342	-0.1051	0.0651	0.1257
SP	35 2166	0.0783	0.1442	0.1834	0.0273	0.0659	-0.0043	0.0351	0.1582	0.2860	0.3846	0.3224	0.2096
SP	35 2745	0.5849	0.3152	0.2103	0.0947	-0.2097	-0.1835	-0.1893	-0.0780	-0.0455	0.0769	-0.1366	-0.0686
SP	35 2746	-0.1699	0.0307	0.0454	-0.0428	-0.1786	-0.1575	-0.1595	-0.1268	-0.0618	-0.0593	0.0319	-0.0136
SP	35 2749	0.0738	-0.0095	-0.0352	-0.1044	-0.0673	-0.2559	-0.0062	0.0226	-0.0189	-0.0632	-0.1328	-0.3230
SP	35 2750	0.9908	0.4888	0.4673	0.2974	0.2449	0.3194	0.2345	0.3496	0.3375	0.2148	0.1097	0.1353
SP	35 2758	0.1309	0.1615	0.1086	0.0905	0.0655	-0.0256	-0.0443	0.0254	-0.0069	0.0649	0.0676	0.0314
SP	36 0223	-0.5174	-0.1191	0.0212	-0.0914	-0.2195	0.0373	0.0663	-0.1019	0.0762	-0.0777	-0.1856	0.0134
SP	36 1175	-0.3456	-0.1598	-0.3482	-0.1191	-0.0733	0.2955	0.3071	0.4508	0.0377	-0.1943	-0.3233	-0.1889
SP	36 1187	0.5451	0.7845	0.7247	0.4414	-0.0682	-0.3241	-0.7679	-0.5403	0.0714	0.4366	0.5656	0.9380
SP	36 1531	0.1439	0.1152	0.3005	0.3477	0.4795	0.2515	0.2238	0.0420	0.0944	0.0617	0.2306	0.1829
SP	36 2068	0.0310	-	3.2852	0.6598	0.2829	-0.0887	-0.3676	-0.4395	-0.0411	0.2578	0.3381	0.3115
SP	36 2218	0.0133	-0.0239	-0.0937	-0.0900	-0.0463	-0.1177	-0.2640	-0.1174	0.0184	0.1589	0.2964	0.2494
SP	36 2295	0.2447	0.1515	0.1322	-0.0063	0.0622	-0.0722	0.0010	0.0620	0.2752	0.4286	0.6369	0.2866
SP	36 2297	-0.0685	0.1233	-0.0057	0.2133	0.0356	-0.0943	-0.1430	-0.0310	-0.0885	0.1448	0.1918	0.2261
SP	40 7201	2.5249	2.7303	2.9645	2.8636	2.8345	2.8059	2.8810	3.0732	3.2052	3.2428	3.2650	3.2882
SP	40 7203	0.7791	0.7891	0.8015	0.7955	0.7718	0.7665	-	-	-	-	1.0061	0.9355
SP	40 7210	2.3205	2.1811	2.2421	2.2408	2.3650	2.6491	2.7259	2.6259	2.4888	2.2811	1.9262	-
SP	40 7211	1.4998	1.5484	1.5904	1.6264	1.6332	1.6408	1.5606	1.5097	1.4946	1.4620	1.4810	1.4944
SP	40 7212	0.4252	0.4129	0.4123	0.4209	0.4066	0.4061	0.4106	0.3954	0.3926	0.3832	0.3767	0.3756
SP	40 7221	0.1823	0.1943	0.1968	0.1895	0.1672	0.1639	0.1712	0.1886	0.2035	0.2097	0.2053	0.2032
SP	40 7223	-	-	0.8578	0.8771	0.8785	0.8762	0.8971	0.9141	0.9313	0.9843	1.0348	1.0688
SP	40 7231	-	-	-	-	-	-	6.1778	6.5840	6.7947	6.8648	6.9351	7.0170
SP	40 7232	-	-	-	-	-	-	2.7664	2.1334	1.2835	0.3921	-0.4622	-1.1381

Table 10. (Cont.)

Lab.	Clock	56684	56714	56744	56774	56804	56834	56869	56899	56929	56959	56989	57019
SU	40 3809	0.2134	0.2039	0.1715	0.2421	0.2248	0.2197	0.2247	0.2531	0.2619	0.3004	0.3521	0.3721
SU	40 3810	0.1938	0.1741	0.1432	0.2138	0.2020	0.2067	0.2127	0.2264	0.2172	0.2210	0.2237	0.2269
SU	40 3811	-	-	-	-	-	0.6415	0.6617	0.7220	0.7592	0.7927	0.8076	0.8355
SU	40 3812	0.2258	0.2221	0.1906	0.2547	0.2361	0.2293	0.2351	0.2514	0.2473	0.2507	0.2586	0.2479
SU	40 3814	0.7996	0.7911	0.7548	0.8159	0.7943	0.7858	0.7844	0.7969	0.7883	0.7900	-	-
SU	40 3815	0.5170	0.5049	0.4727	0.5334	0.5075	0.4961	0.4935	0.5049	0.4988	0.4993	0.5041	0.4923
SU	40 3816	0.6522	0.6365	0.5732	0.5963	0.5587	0.5591	0.5770	0.6096	0.6303	0.6458	-	-
SU	40 3817	0.8578	0.7338	0.5392	0.4590	0.5672	0.5940	0.5621	0.6008	0.5597	0.4658	0.5897	0.7158
SU	40 3818	0.5080	0.2960	0.1906	0.1452	0.0366	0.0954	0.1554	0.2128	0.2375	0.2576	0.2770	0.2809
TCC	35 0768	0.5836	0.1106	0.0406	-0.0988	-0.1785	-0.1874	0.1669	-0.2175	-	-	-	-
TCC	35 1881	0.0275	-0.0894	0.1609	0.1841	0.0118	0.0426	0.0552	-0.1568	-	-	-	-
TCC	40 8620	-1.1119	-1.4178	-2.9498	-2.4506	-0.1436	0.1361	-0.1025	-0.2010	-	-	-	-
TCC	40 8624	0.1923	0.2811	0.4296	0.4097	0.2463	-0.1732	0.0984	0.3607	-	-	-	-
TL	35 1012	-0.0759	-0.0466	-0.0015	0.0051	-0.1457	-0.1641	0.0551	-0.1705	-0.0933	0.0339	-0.0812	-0.1312
TL	35 1498	-0.0262	-0.0502	-0.2276	-0.0930	-0.0992	0.0568	0.2529	0.3207	0.1343	0.1258	0.1025	0.0901
TL	35 1500	0.1097	0.0461	0.0308	-0.1725	-0.0788	0.0445	0.0341	0.0278	-0.0460	-0.1622	-0.2471	-0.3378
TL	35 1712	0.0890	0.0116	-0.0824	-0.0036	0.0155	-0.0402	0.0981	0.1190	0.0989	0.0106	0.1156	-0.0852
TL	35 2365	-0.0312	0.0032	0.0429	0.2344	0.1711	-0.1357	-0.0964	-0.1465	-0.1742	0.0540	0.1429	-0.0047
TL	35 2366	-0.5091	-0.5516	-0.6455	-0.4100	-0.1290	-0.1397	-0.0432	-0.0127	-0.1178	-0.0772	-0.1988	-0.2167
TL	35 2367	0.0356	-0.0527	0.0681	0.1446	0.2480	0.1499	0.2705	0.0103	0.0048	-0.0478	-0.2034	-0.1790
TL	35 2368	0.1561	-0.0231	-0.3449	-0.3889	-0.3967	-0.2157	-0.0121	0.0907	0.0142	0.0098	-0.0777	-0.0292
TL	35 2630	0.0016	0.0515	-0.0172	0.0695	-0.0026	0.2094	0.2522	0.1845	0.1732	0.1346	0.0286	0.0537
TL	35 2634	0.1155	0.4280	-0.3573	-0.8086	-0.9633	-1.2314	-1.0222	0.0799	0.5852	0.7571	0.5832	0.7378
TL	35 2636	-0.0186	0.3225	0.5860	0.3538	0.1622	0.2531	0.2768	0.4471	0.5879	0.5678	0.3414	0.2270
TL	35 2853	0.1501	0.0789	0.0284	0.0539	0.0187	0.0478	0.0187	0.1348	0.1148	0.1589	0.1885	0.1306
TL	35 2910	-0.0019	0.0168	0.0961	0.1745	0.1636	0.1611	0.1277	0.1441	0.2316	0.0798	-0.0123	0.0605
TL	40 0057	-2.2219	-2.1574	-2.1758	-2.2928	-2.8143	-3.1318	-2.9341	-2.6913	-2.4239	-2.3062	-2.3204	-1.9453
TL	40 3011	-	-	-	-	-	-	-	-	0.2635	0.5281	0.8344	1.0924
TL	40 3052	-0.6392	-1.1316	-1.2568	-1.4880	-1.4804	-1.5254	-1.3629	-1.1742	-0.9855	-0.9156	-0.8367	-0.8220
TP	35 0163	0.6988	0.6997	0.4257	0.3227	0.3994	0.2631	0.3915	0.3447	0.2548	0.2739	0.1063	0.0151
TP	35 1227	0.1162	-	-	-1.7577	0.4104	0.0948	0.0116	-0.0106	-0.0470	-0.1725	-0.0945	-0.1605
TP	35 2476	-0.1500	-0.1012	-0.0214	0.2711	0.6175	0.9179	0.9473	0.6888	0.3404	0.0363	-0.1916	-0.3439
TP	35 2970	-	-	-	1.9418	0.8183	0.3587	0.4681	0.3705	0.2455	0.2687	0.1974	0.1387
UA	35 2465	-0.4347	-0.6707	-0.8220	-0.7460	-0.4994	-0.9449	-0.2924	-0.2974	-0.6105	-0.5298	-0.1630	-0.7154
UA	40 7854	0.2298	0.1100	0.0303	0.0530	0.0306	-0.0095	-0.0048	-0.0889	-0.0236	0.0028	-0.0745	-0.0749

Table 10. (Cont.)

Lab.	Clock	56684	56714	56744	56774	56804	56834	56869	56899	56929	56959	56989	57019
UA	40 7881	0.0890	-0.2399	-0.3072	-0.2722	-0.2470	-0.1215	0.1310	0.1939	0.2124	0.2594	0.0024	-0.3397
UA	40 7882	0.2745	0.2436	0.2368	0.2374	0.3054	0.2289	0.1124	0.1181	0.0865	0.0414	0.1774	0.3734
UME	35 0251	-0.3618	-3.5573	-0.9754	-1.0165	-0.8991	-0.6882	-0.3068	-0.1246	-0.0260	-	-	-0.0766
UME	35 0252	0.2392	-3.0646	-0.7281	-0.9098	-0.9703	-0.7239	-0.0760	0.1313	0.2751	-	-	0.4959
UME	35 0872	-	1.3579	0.4206	-1.0545	-0.2466	5.6605	4.2129	-	-	-	-	0.4925
UME	35 2703	-0.2297	-7.1531	-2.0829	-2.3369	-1.8394	-0.8017	0.6830	0.8268	0.9391	-	-	-0.5601
USNO	35 0101	0.2071	0.3423	0.3708	0.4303	0.3993	0.4819	0.5433	0.5724	0.3706	0.4841	0.4578	0.4244
USNO	35 0104	0.0759	-0.0632	-0.2671	-0.1887	-0.0667	-0.0105	0.0659	0.1328	0.0365	0.2162	0.2553	0.0957
USNO	35 0106	0.1365	0.1159	0.0632	-0.0393	0.0294	-0.0785	-0.1166	-0.0594	-0.0789	-0.1070	-0.0818	-0.0957
USNO	35 0108	0.0091	-0.0200	0.0003	-0.0291	-0.0004	0.1121	0.0388	0.0436	0.1480	0.0934	-0.0187	0.1156
USNO	35 0114	0.3294	0.6162	0.5625	0.4222	0.0941	-0.2168	-0.1322	-0.0372	-0.0080	0.0760	-0.0576	-0.0217
USNO	35 0120	-0.0310	0.0476	-0.0015	-0.2115	-0.2356	-0.1486	-0.3313	-0.2294	-0.2037	-0.1568	-0.0213	0.1031
USNO	35 0142	-0.1279	-0.1988	-0.1269	-0.1374	-0.2391	-0.2349	-0.2081	-0.3807	-0.3323	-0.3331	-0.2112	-0.0806
USNO	35 0145	0.3422	0.3826	0.4253	0.5622	0.3602	0.3981	0.5769	0.4552	0.4295	0.4619	-	-
USNO	35 0146	0.4142	0.2250	0.1118	-	-	-	-	-	-	-	-	-
USNO	35 0150	-0.0486	-0.2282	-0.1481	0.0985	0.2807	0.1480	-0.0712	-0.1778	-0.1746	-0.1934	-0.0398	0.0733
USNO	35 0152	0.0112	-0.0433	-0.2117	-0.1362	-0.3772	-0.3179	-0.1965	-0.0204	0.0249	0.2936	0.2238	0.1687
USNO	35 0153	0.0963	0.2024	0.1851	0.2784	0.3181	0.2989	-	-	-	-	-	-
USNO	35 0156	-0.1972	-0.1784	-0.0906	0.0116	0.1085	0.0195	-0.1201	-0.2203	-0.0985	-0.0582	0.1264	0.2531
USNO	35 0161	0.4185	-0.2883	-0.0929	0.0000	0.0695	0.2713	0.3443	0.2884	0.3170	0.3513	0.4029	0.5612
USNO	35 0164	-0.4105	-0.3458	-0.1624	-0.2398	-0.2890	-0.1829	-0.1211	0.0400	0.1483	0.1489	0.0734	-0.0190
USNO	35 0165	0.0157	-0.2408	-0.3375	-0.0700	0.1685	0.2785	0.2502	-0.1321	-0.4728	-0.6899	-0.6205	-0.5656
USNO	35 0166	0.0007	-0.1188	-0.3058	-0.1573	-0.0844	-0.1387	-0.1084	-0.2494	-0.4549	-0.4620	-0.4748	-0.4301
USNO	35 0169	0.2665	0.0825	0.0255	-0.0485	-0.0797	-0.0391	0.0921	0.1498	0.1386	0.0965	0.0187	-0.0693
USNO	35 0173	0.0843	-0.1225	-0.1012	-0.2286	-0.2201	-0.2228	0.1408	-0.0440	-0.1840	-0.2702	-0.2569	-0.3636
USNO	35 0213	0.3475	0.0936	-0.2707	-0.2195	-0.2509	-0.0902	0.0495	-	-	-	-	-
USNO	35 0226	0.2389	0.2433	0.1200	0.0010	-0.1422	-0.0089	0.1256	0.1127	0.2163	0.1216	-0.0240	0.0154
USNO	35 0227	-0.5270	-0.3582	-0.2603	-0.3627	-	-	-	-	-	-	-	-
USNO	35 0231	-0.1355	-0.1814	0.0123	0.1635	0.1996	0.0093	-0.0484	-0.1600	-0.2431	-0.3083	-0.0376	0.1922
USNO	35 0233	-0.2770	-0.1542	-0.1094	-0.2114	-0.1835	-0.1671	-0.0628	-0.0982	-0.0563	-0.1289	-0.1453	-0.0072
USNO	35 0244	-0.2635	-0.2807	-0.3544	-0.2785	-0.3574	-0.0443	-0.0540	0.1895	0.2077	0.1929	0.1067	0.2391
USNO	35 0253	-0.3526	-0.3736	-0.5353	-0.3596	-0.2836	-0.3659	-0.4742	-0.4709	-0.4567	-0.1650	-0.0142	0.0347
USNO	35 0254	-0.0461	-0.0482	-0.1469	-0.1552	-0.0497	0.1365	0.0521	0.0480	0.0221	-0.1731	-0.1559	-0.0808
USNO	35 0256	0.1122	0.0424	0.0232	0.0512	0.0595	0.0392	-0.0948	-0.1194	0.0141	0.1725	0.3253	0.4408
USNO	35 0260	0.4138	0.6425	1.3735	1.4836	1.2964	1.0437	1.0325	0.5283	0.3983	0.6035	0.5020	0.3248

Table 10. (Cont.)

Lab.	Clock	56684	56714	56744	56774	56804	56834	56869	56899	56929	56959	56989	57019
USNO	35 0268	-0.2015	-0.1119	-0.2165	-0.5292	-0.7546	-0.8342	-0.9471	-0.7184	-0.2391	-0.3728	-0.8671	-1.3421
USNO	35 0270	0.1213	0.1465	0.1510	0.0988	0.0929	-0.0382	-0.3384	-0.3502	-0.1562	-0.2021	-0.0914	-0.0458
USNO	35 0279	0.1420	0.1493	0.2679	0.6114	0.7347	0.8360	0.5113	0.1634	-0.3997	-0.4890	-0.4833	-0.3834
USNO	35 0389	0.1072	-0.1255	-0.1977	-0.0740	0.0541	0.1464	0.0658	-0.0706	-0.0720	0.1257	0.3739	0.7102
USNO	35 0394	-0.4095	-0.1243	0.3389	0.5101	0.5833	0.3344	0.0750	-0.0410	0.0520	-0.0178	0.0704	0.0078
USNO	35 0416	-0.1019	-0.0475	0.2796	0.4777	0.5262	0.4673	0.1243	0.0931	0.0643	-0.1379	-0.3273	-0.6812
USNO	35 0417	0.2040	0.0723	-0.0157	0.1024	0.2141	0.1771	0.0195	-0.0697	-0.1643	0.0028	-0.0201	0.0166
USNO	35 0703	-0.0054	-0.1744	-0.2244	-0.2112	-0.1955	-0.0632	0.0400	-0.1783	-0.1677	-0.3937	-0.3784	-0.3988
USNO	35 0717	0.2692	0.0449	0.0506	-0.0298	-0.0121	0.1432	0.1755	0.0617	0.1734	0.1411	0.1408	0.2642
USNO	35 0762	-0.1015	0.0534	0.0357	0.0364	-0.0334	0.0029	0.0013	0.0458	0.0871	0.0568	-0.0018	0.0142
USNO	35 0763	0.0758	-0.0009	0.0641	-0.0432	-0.0398	-0.0593	-0.1431	-0.1149	-0.0533	-	-	-
USNO	35 0765	0.1866	0.1769	0.1623	0.1072	0.0622	0.0643	0.2083	-0.0907	-0.1793	-0.3611	-0.3863	-0.5364
USNO	35 1096	-0.3067	-0.1205	-0.2382	-0.1652	-0.1041	-0.1661	-0.1856	-0.0835	-0.0327	0.0291	0.1209	0.1598
USNO	35 1097	0.1159	0.3060	0.1598	0.1461	0.0742	-0.0539	-0.1927	-0.0815	-0.1949	-0.0181	0.0952	-0.1419
USNO	35 1125	-0.3992	-0.4827	-0.5877	-0.9309	-1.0561	-0.8639	-0.6383	-0.3580	-0.2102	-0.1373	0.1548	0.2146
USNO	35 1327	0.1416	0.2066	0.1113	0.2384	0.2877	0.1417	0.1389	0.1569	-0.0176	0.0117	0.0989	0.0583
USNO	35 1328	0.0104	0.1645	0.1216	0.0952	0.1331	0.1813	0.1894	0.0912	0.0626	0.0064	-0.0694	-0.0654
USNO	35 1331	0.4097	0.2653	-0.0895	-0.3205	-0.2533	0.0695	0.4482	0.5410	0.2353	0.0437	-0.0133	0.0457
USNO	35 1438	0.6052	0.6070	0.4798	0.3181	0.0175	0.0331	0.2587	0.2410	-	-	-	-
USNO	35 1459	-0.1735	-0.0242	0.0474	-0.0344	-0.0120	-0.1256	-0.1342	0.2484	0.3268	0.2777	0.0688	-0.2370
USNO	35 1462	0.2067	0.1104	0.0578	-0.0425	-0.0067	-0.0215	0.0026	0.0289	-0.1068	-0.2066	-0.1755	0.0269
USNO	35 1463	-0.0788	-0.2344	-0.3043	-0.1793	-0.0873	-0.0565	-0.0375	-0.1006	-0.2567	-0.1665	-0.1899	-0.0852
USNO	35 1468	-0.4846	-0.3463	-0.2535	-0.0653	0.1136	0.2674	0.3317	0.2725	0.1494	0.2133	0.1517	0.1605
USNO	35 1481	-0.0533	-0.0859	-0.1197	-0.1433	-0.1876	-0.2330	-0.2280	-0.1766	-0.1198	-0.0811	-0.1438	-0.1978
USNO	35 1543	-0.2059	-0.1894	-0.1674	-0.0905	-0.2456	-0.3271	-0.2956	-0.2685	-0.3794	-0.3881	-0.3125	-0.2250
USNO	35 1573	-0.0651	-0.1534	-0.2613	-0.4801	-0.2699	-0.2032	-0.1672	-0.0796	0.1293	-0.0487	0.1435	0.1312
USNO	35 1575	0.2095	0.0175	0.0840	0.0045	-0.0271	0.1131	0.1793	0.0643	-0.0279	-0.1216	-0.2301	-0.2506
USNO	35 1580	0.0620	0.1962	0.2986	0.1788	0.1060	-0.1998	-0.3378	-0.4716	-0.3336	0.0115	0.5813	0.8053
USNO	35 1585	-0.2525	-0.4503	-0.5425	-0.4770	-0.6587	-0.6391	-0.3632	-0.3560	-0.1603	0.0630	0.1528	-0.1903
USNO	35 1598	-0.6341	-0.6158	-0.5818	-0.4002	-0.0088	0.2262	-0.0334	-0.0693	-0.1813	-0.1726	-0.1184	-0.0392
USNO	35 1655	-	-	-	-	-	-	-	-	-	-	-	-0.2823
USNO	35 1658	-0.2956	-0.3262	-0.0386	0.1478	0.1849	0.1565	0.0316	-0.1421	-0.1359	-0.1253	-0.0549	-0.0089
USNO	35 1692	-0.1067	-0.0312	0.0044	-0.0698	-0.0627	-0.0469	-0.1924	-0.1356	-0.1010	-0.1225	-0.0721	-0.0310
USNO	35 1694	-0.1043	-0.0934	-0.1213	-0.0910	-0.0234	-0.0663	-0.0509	-0.1467	-0.2711	-0.3393	-0.2889	-0.3112
USNO	35 1696	0.1362	0.1913	0.0831	-0.0233	-0.1424	-0.2020	-0.2373	-0.1640	-0.2068	-0.1086	0.0056	0.0125

Table 10. (Cont.)

Lab.	Clock	56684	56714	56744	56774	56804	56834	56869	56899	56929	56959	56989	57019
USNO	35 1697	0.0114	-0.0635	-0.0397	-0.0225	0.0294	0.1519	0.1032	0.0488	0.1105	0.0671	0.0308	0.0977
USNO	40 0701	0.2261	0.3993	0.4563	0.4462	0.3307	0.1693	-0.0184	-0.3611	-0.7236	-0.8881	-0.9013	-0.7122
USNO	40 0702	0.0468	0.0635	0.0723	0.0792	0.0493	0.0296	0.0222	0.0433	0.0532	0.0684	0.0727	0.0615
USNO	40 0704	0.1551	0.1335	0.1246	0.1202	0.0842	0.0679	0.0496	0.0534	0.0638	0.1035	0.1374	0.1492
USNO	40 0705	0.1513	0.1530	0.1481	0.1375	0.0833	0.0627	0.0435	0.0637	0.0862	0.1194	0.1303	0.1483
USNO	40 0708	0.2683	0.2727	0.2800	0.2779	0.2669	0.2657	0.2689	0.2703	0.2649	0.2607	0.2707	0.2752
USNO	40 0710	0.2656	0.2626	0.2701	0.2712	0.2671	0.2796	0.2861	0.2941	0.2969	0.2898	0.2987	-
USNO	40 0711	1.4703	1.4045	1.3848	1.3585	1.3511	1.3695	1.4113	1.4498	1.4777	1.5076	1.5025	1.4768
USNO	40 0712	0.1133	0.0639	0.0354	0.0236	0.0001	-0.0128	-0.0272	-0.0374	-0.0519	-0.0607	-0.0471	-0.0344
USNO	40 0713	0.5807	0.6292	0.6459	0.5875	0.5697	0.5743	0.5689	0.5834	0.5860	0.5959	0.6223	0.6695
USNO	40 0714	0.1844	0.2797	0.2793	0.3580	0.3024	0.2848	0.2304	0.2935	0.3576	0.4042	0.4407	0.4241
USNO	40 0715	-0.8316	-0.7091	-0.3223	0.2850	1.0955	0.6386	0.5835	0.5337	0.4786	0.4340	0.4347	0.4464
USNO	40 0716	0.1057	0.1096	0.1060	0.0943	0.0791	0.1050	0.1117	0.1321	0.1319	0.1266	0.1310	0.1381
USNO	40 0717	1.7166	1.7143	1.7188	1.7296	1.7369	1.7786	1.8302	1.8680	1.8536	1.8033	1.7604	1.6983
USNO	40 0718	1.6770	1.6396	1.6071	1.6128	1.6007	1.5747	1.5421	1.5784	1.6366	1.7339	1.8058	2.7813
USNO	40 0719	0.9925	1.0060	1.0211	1.0157	1.0068	0.9954	0.9849	0.9871	1.0043	1.0125	1.0260	1.0210
USNO	40 0720	2.2890	2.2517	2.2151	2.1354	2.0310	2.0119	2.0503	2.1110	2.2250	2.3077	2.3460	2.3342
USNO	40 0721	-	-	-	4.3863	4.2651	4.1705	4.1633	4.0526	4.0124	3.9143	3.8485	3.8161
USNO	40 0722	5.7611	51.5609	62.5962	59.9512	60.9379	49.2175	25.4910	17.0542	15.1582	-	-	-
USNO	40 0723	0.1790	0.1993	0.1873	0.1635	0.0937	0.0350	0.0146	0.0550	0.0996	0.1847	0.2165	0.2108
USNO	40 0724	0.3561	0.1564	-0.0784	-0.3253	-0.2448	-0.0665	0.0198	0.0439	0.0277	-0.0094	-0.0221	0.1850
USNO	40 0725	0.1843	0.1852	0.1824	0.1744	0.1517	0.1587	0.1433	0.1158	0.1158	0.0967	0.0966	0.1016
USNO	40 0726	-	-	-	3.3543	3.4205	3.4141	3.4389	3.4670	3.4782	3.4904	3.5123	3.5217
USNO	40 0727	-	-	-	2.2812	0.6727	0.7202	0.7213	0.7424	0.7589	0.8824	1.0418	1.2837
USNO	40 0728	3.0226	3.0415	3.0306	3.0067	2.9834	2.9910	3.0092	3.0343	3.0241	3.0050	2.9918	2.9689
USNO	40 0729	4.9087	4.9017	4.8958	4.8633	4.8208	4.7818	4.7382	4.7302	4.7077	4.6897	4.6830	4.6421
USNO	40 0730	3.3397	3.3347	3.3394	3.3227	3.3068	3.3133	3.3248	3.3430	3.3480	3.3366	3.3347	3.3223
USNO	40 0731	-0.1826	-0.1993	-0.4257	-0.5699	-0.6570	-0.6499	-0.4946	-0.2573	-0.2030	-0.1355	-0.0688	-0.0397
USNO	40 0732	2.8431	2.8586	2.8894	2.8907	2.8929	2.7347	2.5789	2.5276	2.5780	2.6926	2.8906	2.9726
USNO	40 0734	-7.0076	-6.8313	-6.6304	-6.4523	-6.3371	-6.2416	-6.1554	-	-	-	-5.8819	-5.4757
USNO	40 0735	4.8484	4.9468	4.9820	4.9004	4.7577	4.7868	4.8912	4.9726	5.0148	4.9859	4.7942	4.5902
USNO	40 0736	0.2989	0.5139	0.9820	1.3219	1.9490	2.4994	3.0382	3.3730	3.7058	3.9749	4.1785	4.3770
USNO	40 0737	7.4828	7.5138	7.6464	7.8183	8.1084	8.3933	8.6740	8.9053	9.0885	9.2156	9.2764	9.2726
USNO	93 0002	0.0098	0.0129	0.0168	0.0106	-0.0150	-0.0121	-0.0095	-0.0031	0.0003	-0.0048	0.0040	0.0125
USNO	93 0003	0.0083	0.0128	0.0166	0.0291	0.0229	0.0350	0.0200	0.0108	-0.0033	-0.0098	-0.0018	0.0047

Table 10. (Cont.)

Lab.	Clock	56684	56714	56744	56774	56804	56834	56869	56899	56929	56959	56989	57019
USNO	93 0004	0.0022	0.0073	0.0080	-0.0023	-0.0180	-0.0131	-0.0107	0.0039	0.0060	0.0020	0.0083	0.0128
USNO	93 0005	0.0030	0.0141	0.0209	0.0104	-0.0200	-0.0238	-0.0170	0.0015	0.0083	0.0049	0.0074	0.0099
VMI	35 2230	1.3131	1.2365	-0.5657	-0.4830	-0.1969	0.0463	0.0824	0.4006	0.2228	0.0075	0.4522	0.7085
VMI	36 1233	-3.9052	1.5315	-	2.0103	-3.6045	-0.2593	-0.0219	0.2886	0.4609	0.3302	0.6905	0.7834
VMI	36 2314	-0.4629	1.5100	0.1744	0.0497	0.4971	0.2806	-0.0371	0.1338	-0.1358	-0.5436	0.1615	0.4942
VSL	35 0179	0.0940	0.1721	0.3904	0.4186	0.2264	0.1409	0.0779	-0.1223	-0.0348	-	-	-
VSL	35 0456	-0.3419	-0.1604	-0.0106	0.0366	-0.0238	-0.0194	0.1956	0.4122	0.3713	0.0262	-0.1954	-0.3091
VSL	35 0548	-	-	0.6967	-0.3900	0.3997	0.1930	-0.0053	0.0057	0.1404	0.0260	0.1760	0.0043
VSL	35 0731	-0.0593	-0.0858	-0.0499	-0.0864	0.0641	0.0927	0.1934	0.3361	0.3809	0.1654	-0.1181	-0.2264
ZA	35 2233	-	0.1579	0.1672	-0.0185	-0.0323	0.1003	0.1037	0.0701	0.0188	-0.0650	-0.0812	-0.0114
ZA	36 1034	-	-6.1953	-1.2946	-1.5596	-1.3540	-0.7205	-0.3454	0.3352	0.5681	0.9004	0.3891	0.2877
ZA	36 1821	-	-5.1839	-0.3099	-0.4643	-0.1359	-0.2514	-0.0575	0.0405	0.1172	0.0187	0.1059	-0.0749
ZA	36 2232	-	0.4424	0.0304	-0.9799	-0.3195	-0.5131	-0.4397	-0.0548	-0.0227	-0.1470	-0.0264	-0.1628

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 second.

The following tables are based on information received at the BIPM in March 2015.

AUTHORITIES RESPONSIBLE FOR THE TIME SIGNAL EMISSIONS

Signal	Authority
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 305-340 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

Signal	Authority
MIKES	VTT Technical Research Centre of Finland Ltd Centre for Metrology MIKES P.O. Box 1000, FI-02044 VTT, Finland
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, 847.00 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
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.
EBC	San Fernando Spain 36° 28'N 6° 12'W	15006 4998	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.

Station	Location Latitude Longitude	Frequency (kHz)	Schedule (UTC)	Form of the signal
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 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	01 h 06 m to 01 h 36 m 05 h 06 m to 05 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	10 h 06 m to 10 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	06 h 06 m to 06 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	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.
RJH-90	Nizhni Novgorod Russia 56° 11'N 43° 57'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.

Station	Location Latitude Longitude	Frequency (kHz)	Schedule (UTC)	Form of the signal
RTZ	Irkutsk Russia 52° 26'N 103° 41'E	50	00 h 00 m to 18 h 00 m 19 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.
RWM (2)	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.

(2) 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* x 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* x 0.02 s.

Station	Location Latitude Longitude	Frequency (kHz)	Schedule (UTC)	Form of the signal
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.

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 2015.

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

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 305-340 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	Swiss Federal Institute of Metrology Length, Optics and Time Section 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 100013 - 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, 847.00 325 Broadway Boulder, Colorado 80305, USA
NMIJ	Time and Frequency Division 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 Laboratory SIRIM Berhad, 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 Cecilio Pujazón 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 Russia
VSL	VSL Dutch Metrology Institute Postbus 654 2600 AR Delft 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 three different time zones for Mexico; Central Time, Pacific Time and Northwest Time as well the UTC(CNM). The access numbers are:

+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 J. Mauricio López at jlopez@cenam.mx

(1) Information based on the Annual Report 2013, not confirmed by the Laboratory.

	Network Time Protocol Operates one 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	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 for paying organizations and institutions. 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 is 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 as above.
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

HKO (1)	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: http://pda.weather.gov.hk/clocke.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	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
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.
IPQ	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.

(1) Information based on the Annual Report 2013, not confirmed by the Laboratory.

JV (1)	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	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 one primary time server using the “Network Time Protocol” (NTP) : Hostname: ntp-p1.obspm.fr 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/
MASM	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

(1) Information based on the Annual Report 2013, not confirmed by the Laboratory.

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

Network Time Protocol
METAS operates public NTP servers in free access.
Host names:
ntp.metas.ch
metasntp11.metas.ch
metasntp12.metas.ch
metasntp13.metas.ch

More information at http://www.metas.ch and http://www.ntp.org

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)

ntp2.mikes.fi	194.100.49.132	Synchronized to a prediction of UTC(USNO) broadcast by GPS
ntp4.mikes.fi	194.100.49.134	Synchronized to a prediction of UTC(USNO) broadcast by GPS
ntp1.mikes.funet.fi	193.166.4.49	Synchronized to UTC(MIKE)
ntp2.mikes.funet.fi	193.166.4.50	Synchronized to a prediction of UTC(USNO) broadcast by GPS

Stratum-2 NTP servers (public service)
time.mikes.fi
Further information can be found from www.mikes.fi.

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.

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 (1)	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.

(1) Information based on the Annual Report 2013, not confirmed by the Laboratory.

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/or 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 (1)	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.

(1) Information based on the Annual Report 2013, not confirmed by the Laboratory.

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 (1)

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.observatoire.be/D1/TIME/ntp_en.php/ 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/en/org/q/q4/q42/_index.htm 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 : ntp0.roa.es Synchonized to UTC(ROA) better than 10 microseconds Service policy : restricted Note : server used as prototype to check new software, hardware, etc.
SG	Website: http://www.a-star.edu.sg/nmc/metrology-TFM-td.htm. Network Time Service (NeTS) Transmits digital time code via the Internet using three protocols - Time Protocol, Daytime Protocol and Network Time Protocol. Operates one time server at address 203.117.180.36. Automated Computer Time Service (ACTS) Transmits digital time code (NIST format) via telephone modem for setting time in computers. The coded time information is referenced to UTC(SG). Includes 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

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

(1) Information based on the Annual Report 2013, not confirmed by the Laboratory