BUREAU INTERNATIONAL DES POIDS ET MESURES

BIPM Annual Report on Time Activities

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Contents

Practical information about the BIPM Time Department

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

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BIPM Time Department

Director: E.F. Arias

(1 January 2013 to 31 December 2013)

1. International Atomic Time (TAI), Coordinated Universal Time (UTC) and Rapid UTC (UTCr) (E.F. Arias, A. Harmegnies, Z. Jiang, H. Konaté, W. Lewandowski, 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*. Starting on 1 July 2013 the official UTC rapid solution *UTCr* has been 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 2012*, volume 7, provides the definitive results for 2012 and is available electronically on the BIPM website at www.bipm.org/en/publications/time_activities.html.

2. Algorithms for time scales (W. Lewandowski, G. Panfilo, G. Petit, A. Harmegnies and L. Tisserand)

The algorithm ALGOS used for the calculation of the time scales 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 continues in the department with the aim of improving the long-term stability of EAL and the accuracy of TAI.

As a consequence of the introduction of the quadratic clock frequency prediction since September 2011, no drift of EAL has been observed during 2013. A new clock weighting procedure has been developed based on the concept of clock frequency predictability. It results in a more balanced distribution of clock weights and enhances the influence of the H-masers in the ensemble. An improvement on the short- and long-term stability of EAL is observed by applying the new weighting algorithm.

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. In the current weighting procedure the weight attributed to a clock reflects its long-term stability in order 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 and depends on the number of participating clocks. On average during 2013, about 14 % of the participating clocks were at the maximum weight. Since 2001, when the present weighting procedure was adopted, the number of hydrogen masers doubled, whilst the number of caesium clocks increased by 50 %. In order to optimize the impact of the hydrogen masers on the time scale, and for better distribution of the weight among the caesium clocks and hydrogen masers, a new weighting procedure based on the concept that a good clock is not a stable clock but instead is a predictable clock has been developed and validated. This new prediction model will be implemented in UTC calculation starting on 1 January 2014. Tests over the past eight years demonstrated that a better distribution among the clock weights is achieved, with a 40 % increase in hydrogen masers at the maximum weight. Both short- and long-term stability of EAL will improve by 20 %. The stability of EAL, as at the end of 2013, expressed in terms of an Allan deviation, is about 3 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 up to 1.8 parts in 10^{16} in 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 2013, individual measurements of the TAI frequency have been provided by eight primary frequency standards, including six caesium fountains (LNE-SYRTE FO1, LNE-SYRTE FO2, NIST F1, NPL CSF2, PTB CSF1 and PTB CSF2). Reports on the operation of the primary frequency standards are regularly published on the BIPM website and collated in the *BIPM Annual Report on Time Activities*.

During 2013, measurements of the TAI frequency by a rubidium secondary frequency standard (LNE-SYRTE FO2Rb) have been reported in *Circular T*. They have been used for TAI steering since July 2013, after the publication of the CIPM 2012 recommendations.

Since January 2013, 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 $+0.7 \times 10^{-15}$ to -0.6×10^{-15}, with a standard uncertainty of maximum 0.3×10^{-15}. No steering corrections have been applied in 2013, showing the positive impact of the new algorithm on the accuracy of TAI.

2.3 Independent atomic time scales: TT(BIPM)

Because TAI is computed in ‘real-time’ and has operational constraints, 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(BIPM12), valid until December 2012, which had an estimated accuracy of about 2-3 parts in 10^{16} over recent years. Moreover, the Time Department provides a monthly extension of TT(BIPM12) based on the most recent TAI computation. Such an extension is useful for pulsar analysis pending the yearly updates of TT(BIPM). Studies to improve the computation of TT(BIPM) are ongoing, in order to keep it in line with improvements in the primary and secondary frequency standards.

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

The Time Department continues to calculate and publish the differences between the predictions of UTC(USNO) and UTC(SU) (as broadcast by GPS and GLONASS) and UTC in BIPM *Circular T*.

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 CCTF Working Group on Primary and Secondary Frequency Standards (WGPSFS), seeking to encourage comparisons, knowledge-sharing between laboratories, the creation of better documentation, the use of high-accuracy primary frequency standards (Cs fountains) and secondary frequency standards for TAI.

The WGFS maintains a list of recommended values of standard frequencies for applications including secondary representations of the second. At its meeting in September 2012 it proposed additions and updates to microwave and optical atomic transitions in the list. 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).

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). Fifteen measurement reports of FO2Rb were submitted in 2013. With the agreement of the CCTF Working Group on Primary and Secondary Frequency Standards (WGPSFS), the Time Department updated its procedures and programs in order to include secondary frequency standards in the estimation of TAI accuracy (see §2.2) and in the computation of TT (see §2.3). These measurements have been officially used for the accuracy of TAI since July 2013 and will be used in January 2014 for the computation of TT(BIPM13).

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 some laboratories which maintain local representations of UTC. A successful experiment was conducted using BIPM GPS equipment in parallel to the fibre link regularly operated between two representations of 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 allowed the validation of the new BIPM calibration system with u_B within 1 ns. Several other fibre links between contributing laboratories are calculated on a regular basis, with a potential measurement uncertainty of about 100 ps in the future. In order to benefit from the quality of these links, the Time Department initiated a discussion with the laboratories already implementing time transfer via optical fibres with the aim of establishing standards for data transmission and validating the compatibility of the different techniques.

In parallel, the Time Department continued with activities in the frame 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.

4. **Time links used for TAI** (E.F. Arias, A. Harmegnies, Z. Jiang, H. Konaté, W. Lewandowski, G. Panfilo, G. Petit and L. Tisserand)

At the end of 2013, 73 time laboratories supplied data for the calculation of TAI 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 have almost disappeared from use, 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 TAI, 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.

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 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.

GPS PPP alone or in combination with TWSTFT are in use for TAI clock comparison 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.

Testing continues on other time and frequency comparison methods and techniques.

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 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 in 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 TAI computation, using procedures and software developed in collaboration with the ORB. These P3 time links are now routinely computed and compared to other available techniques, notably two-way time transfer. After one year of operation, the software that produces GPS P3 (iono-free) data has been upgraded and is now able to produce GLONASS P3. It will be implemented in some receivers to automatically produce both formatted GPS and GLONASS P3 code results. In the future, these newly available data are likely to be used in multi-GNSS system time links, but further studies on inter-frequency biases have to be carried out.

4.3. Two-way time transfer

Two meetings of the TWSTFT participating stations were held during 2013. The 21st annual meeting of the CCTF WG on TWSTFT was held at the TL premises in Chinese Taipei in September 2013.

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 TAI; fourteen are combined with GPS PPP solutions. Some of the TWSTFT links are used for particular studies such as the Time Transfer by Laser Link (T2L2) experiment. The TWSTFT technique applied to clock comparisons in TAI is at present reaching its maximum potential with sessions scheduled every two hours.

The BIPM is also involved in the calibration of two-way time-transfer links by comparison with GPS.

Results of 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

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. The BIPM continues to organize and run campaigns to measure the relative delays of GPS time equipment in time laboratories that contribute to TAI.

The method developed to perform absolute calibration of the Ashtech Z12-T hardware delays has allowed the BIPM to use this receiver for differential calibrations of similar receivers world-wide; calibration campaigns began in January 2001 and have been continued and expanded to include other types of receivers (Septentrio PolaRx2-3-4, Dicom GTR50 and Javad JPS E-GGD). New types of receivers are being investigated in collaboration with the laboratories that are equipped with them. In all cases, at least two receivers remain at the BIPM to serve as a local reference to which the travelling receiver is 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.

Starting in 2012, the BIPM initiated work to adopt a new organization for calibrations:

- In the frame of the Pilot Project of the UTC time link calibration, a time transfer system, consisting of two GNSS receivers, antennas, additional equipment and a calibration scheme has been developed with the aim of performing time link calibrations that could be transferred to any other technique on a same baseline. In 2013 this equipment had visited five laboratories in Europe and Asia under the pilot experiment to validate METODE (MEasurement of TOtal DElay).
- Following a recommendation by the CCTF, the Time Department has issued BIPM Guidelines for GNSS equipment calibration in UTC contributing laboratories, which are in the process of being revised by the CCTF Working Groups on GNSS and on the CIPM MRA. This process will be concluded in early 2014. This document is addressed to Regional Metrology Organizations with the aim of establishing a permanent cooperation for sharing the organization of campaigns to determine the relative delays of time transfer equipment in UTC contributing laboratories.

Work continues on absolute calibration of GNSS receivers in collaboration with the CNES.

The BIPM is not directly involved in TWSTFT calibration trips, but provides support whenever requested using a GPS receiver from its time laboratory.

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 regularly in the form of the monthly BIPM *Circular T*.

Key comparison of stabilized lasers CCL-K11

The BIPM continues to support the CCL-K11 key comparison in terms of participation in measurement campaigns as well as by providing general advice. This follows a decision at the 98th meeting of the CIPM in 2009. This comparison is the internationally recognized and CCL supervised traceability chain to the SI metre. Even though this adds to the work load of the pilot and the four node laboratories that run the comparison, it effectively provides traceability to the metre for some eight NMIs per year. During 2013, staff from the Time Department were only involved in the reporting of measurement results and no BIPM presence for measurement campaigns took place.

Activities in gravimetry

The contribution of the Time Department to gravimetry covers two aspects:

a) The follow-up of the International Comparison of Absolute Gravimeters (ICAG), which has been under the responsibility of the NMIs since 2010. The key comparison CCM.G-K1 has been defined as part of the ICAG. The ICAG 2013 took place in Luxembourg piloted by the METAS. The BIPM provided support to the organization of this comparison and a member of the Time Department was present during the measurement campaign. The Time Department has also contributed to the CCM Working Group on Gravimetry (WGG).

b) A series of relevant publications related to gravity measurements at the BIPM, including a contribution to the watt balance experiment have been published.

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

From January 2012 until the end of June 2013 the Time Department conducted a pilot experiment to produce a “rapid UTC” (UTCr), that is, daily values of [*UTCr* – *UTC*(*k*)] evaluated on a weekly solution. About 40 laboratories that contribute approximately 60 % to 70 % of the clocks in UTC contributed to the pilot experiment.

UTCr became an official publication of the BIPM on 1 July 2013. This followed CCTF approval of a report which demonstrated that UTCr has reached the expected quality, providing a weekly solution which is consistently better than ± 2 ns peak to peak with the values published in the monthly BIPM *Circular T*. The results (ftp://tai.bipm.org/UTCr) have been published every Wednesday, without interruption since the end of February 2012.

The new product 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 and W. Lewandowski)

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

The actions of BIPM delegates during this process have been critical at the International Telecommunication Union (ITU), and also in disseminating information and promoting decision making at the level of national representatives. Particularly important in 2013 was the organization of a joint workshop by the BIPM and the ITU on the future of the international time scale. This event was held in Geneva, Switzerland, on 19-20 September 2013. The workshop was in preparation for the next World Radiocommunication Conference in 2015 (WRC15), where a decision is to be taken on the redefinition of UTC without leap second adjustments. This meeting provided a unique opportunity to solicit input from most of the relevant communities, among then the two fully operational GNSS providers: GPS and GLONASS, the forthcoming GNSS Galileo and BeiDou, the telecommunications sector, time stamping authorities, and scientific organizations that represent astronomers, geodesists and geophysicists.

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) and 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 being developed 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 on these matters.

Cooperation continues for 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 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 of 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. These tasks are carried out with the help of the Advisory Board for the *IERS Conventions* updates, including representatives from all groups involved in the IERS. Since the completion of the latest reference edition, *IERS Conventions* (2010) in December 2010, work is continuing to provide updates to the *Conventions* (2010) which are regularly posted on the website (http://tai.bipm.org/iers/convupdt).

10. Comb activities (L. Robertsson)

As a result of the reorganization of activities in the Time Department, 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. Defraigne P., Aerts W., Harmegnies A., Petit G. *et al*., Advances in multi-GNSS time transfer, *Proc. IFCS-EFTF 2013*, 2013, 508-512.
2. Fang H., Kiss A., de Mirandés E., Lan J., Robertsson L., Solve S., Picard A., Stock M., Status of the BIPM watt balance, *IEEE Trans. Instrum. Meas*., 2013, **62**, 1491-1498.
3. Harmegnies A., Defraigne P., Petit G., Combining GPS and GLONASS in all-in-view for time transfer, *Metrologia*, 2013, **50** (3), 277-287.
4. Jiang Z., *et al*., On the gravimetric contribution to watt balance experiments, *Metrologia*, 2013, **50**, 452–471.
5. Jiang Z., Arias E.F., Use of the Global Navigation Satellite Systems for the construction of the international time reference UTC, *Proc. China Satellite Navigation Conference*, 457-468.
6. Jiang Z., Improving the time link calibration for the generation of UTC, *Proc. Asia-Pacific Time and Frequency Workshop*, on the internet only, Session A3 – Time and Frequency Transfer, http://www.apmpweb.org/fms/workshop3.php?tc_id=TF.
7. Jiang Z., Petit G., Tisserand L., Uhrich P., Rovera G.D. and Lin S.Y., Progress in the link calibration for UTC time transfer, *Proc. IFCS-EFTF 2013*, 2013, 861-864.
8. Jiang Z., Konaté H. and Lewandowski W., Review and Preview of Two-way Time Transfer for UTC generation – from TWSTFT to TWOTFT, *Proc. IFCS-EFTF 2013*, 2013, 501-504.
9. Panfilo G. and Harmegnies A., A new weighting procedure for UTC, *Proc. IFCS-EFTF 2013*, 2013, 652-653.
10. Panfilo G., Harmegnies A., Tisserand L., Arias E.F., The algorithm for the generation of UTC: latest improvements, *Proc. 45th PTTI Meeting*, 2013.
11. Petit G., Arias E.F., Harmegnies A., Panfilo G., Tisserand L., UTCr: a rapid realization of UTC, *Metrologia*, **51,** 2014, 33-39.
12. Solve S., Chayramy R., Picard A., Kiss A., Fang H., Robertsson L, de Mirandés E., Stock M., A bias source for the voltage reference of the BIPM watt balance. *IEEE Trans. Instrum. Meas*., 2013, 1594-1599.
13. Zucco M., Robertsson L. and Wallerand J.-P., Laser-induced fluorescence as a tool to verify the reproducibility of iodine-based laser standards: a study of 96 iodine cells. *Metrologia* **50**, 2013, 402–408.

BIPM publications

14. *BIPM Annual Report on Time Activities for 2012*, 7, 121 pp., available only at http://www.bipm.org/en/publications/time_activities.html.
15. *Circular T* (monthly), 8 pp.
16. *Rapid UTC* (*UTCr*) (weekly), 1 pp.
17. Panfilo G., Harmegnies A., Tisserand L., A new weighting procedure for UTC. Report to the CCTF Working Group on TAI and to the CCTF working group on Time Scale Algorithms, December 2013.

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).

W. Lewandowski 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) since June 2013.

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 the Commission 31 (Time) and co-chairs 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 associated 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 the Study Group 7 of the International Telecommunication Union – Radiocommunication Sector (ITU-R).

W. Lewandowski is the BIPM representative to the Civil GPS Service Interface Committee and chairman of its Timing Sub-Committee. He is a member of the Scientific Council of the Space Research Centre of the Polish Academy of Sciences. He is also a member of a consultative Group on the Reform of Metrology at the Polish Ministry of Economy, an adviser to a Parliamentary Group on Space, and a member of the Committee on Research on Space Techniques of the Polish Academy of Sciences. He is member of European Commission Advisory Group on Galileo Time Infrastructure. Together with E.F. Arias, he is the BIPM representative to Working Party 7A of the Study Group 7 of the ITU-R, and to the ICG.

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 Working Group 1 (WG1) on the Expression of uncertainty in Measurement (GUM) of the Joint Committee for Guides in Metrology (JCGM) to provide an example for the new version of the GUM.

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

E.F. Arias to:

- Tokyo (Japan), 5-8 February 2013, for the NICT workshop on optical frequency standards (invited as a lecturer) and for a visit to the NMIJ;
- Geneva (Switzerland), 10-18 September 2013, for meetings of Study Group 7 and Working Party 7A of the International Telecommunication Union (ITU-R);
- Geneva (Switzerland), 19-20 September 2013, for the ITU/BIPM Workshop on the future of the international time scale at the International Telecommunication Union; charged with its organization and for giving presentations;
- Dubai (United Arab Emirates), 10-15 October 2013, for the 8th meeting of the International Committee on GNSS (ICG), with presentations and chairmanship of task group meetings;
- Bellevue (Washington, USA), 2-6 December 2013, for the PTTI2013 meeting with oral presentations, a panel discussion and two CCTF WG meetings;
- San Francisco (California, USA), 8 December 2013, for the IGS Governing Board meeting.

A. Harmegnies to:

- Prague (Czech Republic), 22-25 July 2013, to attend the IFCS-EFTF 2013 meeting and to give an oral presentation;
- Besançon (France), 26-30 August 2013, for training at the European Frequency and Time Seminar.

Z. Jiang to:

- Wuhan (China), 4-7 May 2013, for the China Satellite Navigation Conference 2013;
- Prague (Czech Republic), 22-25 July 2013, to attend the IFCS-EFTF 2013 meeting;
- Zdiby (Czech Republic), 26 July 2013, for a visit to the Research Institute of Geodesy, Topography and Cartography (VÚGTK/RIGTC);
- Taipei (Chinese Taipei), 4-9 September 2013, for the 21st meeting of the CCTF Working Group on TWSTFT, the AP-RASC'13 and the ATF Workshop;
- Bellevue (Washington, USA), 2-6 December 2013, for the PTTI 2013 meeting with oral presentations, a panel discussion and two CCTF WG meetings.

W. Lewandowski to:

- Vienna (Austria), 17-18 February 2013, for the preparatory meeting of the 8th ICG;
- Warsaw (Poland), 5-12 February and 18-23 April 2013, to the Space Research Centre and Space Commission;
- Brussels (Belgium), 4-5 June 2013, for GNSS Program Board;
- Warsaw-Poznan (Poland), 11-16 July 2013, for a GNSS calibration trip and experiment with fibre links;
- Taipei (Chinese Taipei), 4-9 September 2013, for the 21st meeting of the CCTF Working Group on TWSTFT, the AP-RASC'13 and the ATF Workshop;
- Geneva (Switzerland), 18-21 September 2013, for the ITU/BIPM Workshop on the future of the international time scale at the International Telecommunication Union;
- Dubai (United Arab Emirates), 10-15 October 2013, for the 8th meeting of the International Committee on GNSS (ICG), with presentations and task group meetings;

- Warsaw (Poland), 25-28 November 2013, for the Metrology Working Group and the Conference "Metrology - the engine of innovation";
- Bellevue (Washington, USA), 2-6 December 2013, for the PTTI2013 meeting with oral presentations.

G. Petit to:

- New Delhi (India), 20-23 February 2013, to attend the 8th International Conference of Advances in Metrology, with an invited talk, and to visit the NPLI time laboratory;
- Toulouse (France), 26 March 2013, to visit the CNES time laboratory for collaboration in GNSS analysis and calibration;
- Paris (France), 10-11 April 2013, to attend the GRAMAP workshop and to give an oral presentation;
- Paris (France), 23-24 May 2013, to participate in the IERS Retreat;
- Toulouse (France), 3-7 June 2013, for training on GNSS processing and to visit the CNES time laboratory with a travelling GNSS receiver;
- Ottawa (Canada), 12-14 June 2013, to attend the GNSS Precise Point Positioning Workshop, to give an oral presentation and to visit the NRC time laboratory;
- Brussels (Belgium), 26 June 2013, to visit the ORB time laboratory for collaboration in GNSS analysis;
- Prague (Czech Republic), 22-25 July 2013, to attend the IFCS-EFTF 2013 meeting, to give oral presentations, a CCTF WG meeting and a CCL-CCTF WG meeting;
- Besançon (France), 27-29 August 2013, to give two lectures at the European Frequency and Time Seminar;
- Paris (France), 16-17 September 2013, to attend the Journées 2013 SRST and to give an oral presentation;
- Bellevue (Washington, USA), 2-6 December 2013, for the PTTI2013 Meeting with oral presentations and two CCTF WG meetings.

L. Robertsson to:

- Walferdange (Luxembourg), 10-14 November 2013 for the ICAG 2013, being a member of the steering committee.

15. Visitors

- P. Nogaś from the Polish Space Research Centre (SRC) for a cooperation on the improvement of GNSS time transfer, 23 April – 1 May 2013;
- T. Bartholomew (NIST, ITU) for a cooperation on ITU-R activities, 15-19 July 2013;
- Ł. Śliwczyński and P. Krehlik from the AGH University of Science and Technology, Krakow, Poland for discussions on the use of optical fibres for time transfer, 20 November 2013;
- M. Khalid Al-Dawood, Supervisor of Time and Frequency Laboratory (SASO) and R. Hamid, Head of the Time, Frequency and Wavelength Laboratory (TÜBİTAK - UME), and Chair of the EURAMET Technical Committee for Time and Frequency, for discussions on the participation of SASO in the key comparison CCTF-K001.UTC, 3 October 2013.

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/scientific/tai/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
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
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
Values of the differences between TAI and UTC and the respective local scales, evaluated for two-month periods until the end of 1997	TAIXYZ
[*UTC*(*lab1*) - *UTC*(*lab2*)] obtained by the TWSTFT link	lab1 - lab2.tw
BIPM Two-Way Satellite Time and Frequency Transfer Reports (until February 2003)	twstftXX.pdf
Most recent schedules for common-view observations of GPS and	schgps.XX
GLONASS satellites (until April 2008)	schglo.XX

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

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
Starting 1993:	
Difference between the normalized frequencies of EAL and TAI	EALTAIXY.ar
TAI frequency	FTAIXY.ar (for 1993,1994)
Measurements of the duration of the TAI scale interval	UTAIXY.ar (starting 1995)
Mean duration of TAI scale interval	SITAIXY.ar (1993-1999)
Mean fractional deviation of the TAI scale interval from that of TT duration of TAI scale interval	SITAIXY.ar (starting 2000)
[*TAI - GPS time*] and [*UTC - GPS time*] (until March 2003)	UTCGPSXY.ar
[*TAI - GLONASS time*] and [*UTC - GLONASS time*] (until March 2003)	UTCGLOXY.ar
Relations of UTC and TAI with GPS and GLONASS system times (from April 2003 until December 2010), and also with the predictions of UTC(*k*) disseminated by GNSS (starting January 2011)	UTCGPSGLOXY.ar
Local representations of UTC: Values of [*UTC - UTC*(*lab*)]	UTCXY.ar (1993-1998)
Independent local atomic time scales: values of [*TAI - TA*(*lab*)]	TAIXY.ar (1993-1998)
Until 1992:	
Local representations of UTC: Values of [*UTC - UTC*(*lab*)]	UTC.XY
Local values of [*TAI - TA*(*lab*)]	TA.XY

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

Rapid UTC - Results of Rapid UTC
Pilot Project since February 2012 until June 2013, official starting on July 2013

UTCr	UTCr_XYWW
Daily values of the differences between UTCr and its local presentation by the given laboratory.	UTCr - lab

Starting with the BIPM Time Section Annual Report for 1999, some tables traditionally included in the printed version are only available in electronic form. From the BIPM Annual Report on Time Activities for 2009, only electronic files are available.

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 [1] and [2]. The weighting procedure and clock frequency prediction [3] 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*)] [4].

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

After the successful closure of the Pilot Experiment, the rapid solution *UTCr* became an official BIPM publication from July 2013. Regular publication of the values [*UTCr* - *UTC*(*k*)] allows weekly access to a prediction of UTC [5] 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 geodetic-type receivers are regularly used in the calculation of time links, in addition to that acquired by a few single-frequency (single- or multi-channel) GPS time receivers. For those links realized using more than one technique, one of them is considered official for TAI 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” [6], with a network of time links that uses the PTB as a unique pivot laboratory for all the GPS links. Since September 2009, links equipped with geodetic-type receivers are computed with the “Precise Point Positioning” method GPS PPP [7].

Clock comparisons using GLONASS C/A (L1C frequency) satellite observations with multi-channel receivers have been introduced since October 2009 [8]. These links are computed using the “common-view” [9] 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 were introduced in January 2011 and are currently used in the calculation of TAI [10, 11].

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. The BIPM publishes in *Circular T* 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.

International GPS tracking schedules have been published by the BIPM about every six months.

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 [12, 13, 14]. 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 and 9 of this report give the rates relative to TAI and the weights of the clocks contributing to TAI in 2013.

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 2013 is extracted from the *Director's Report on the Activity and Management of the BIPM (1 January − 31 December 2013)*. All the publications mentioned in this report are available on request from the BIPM.

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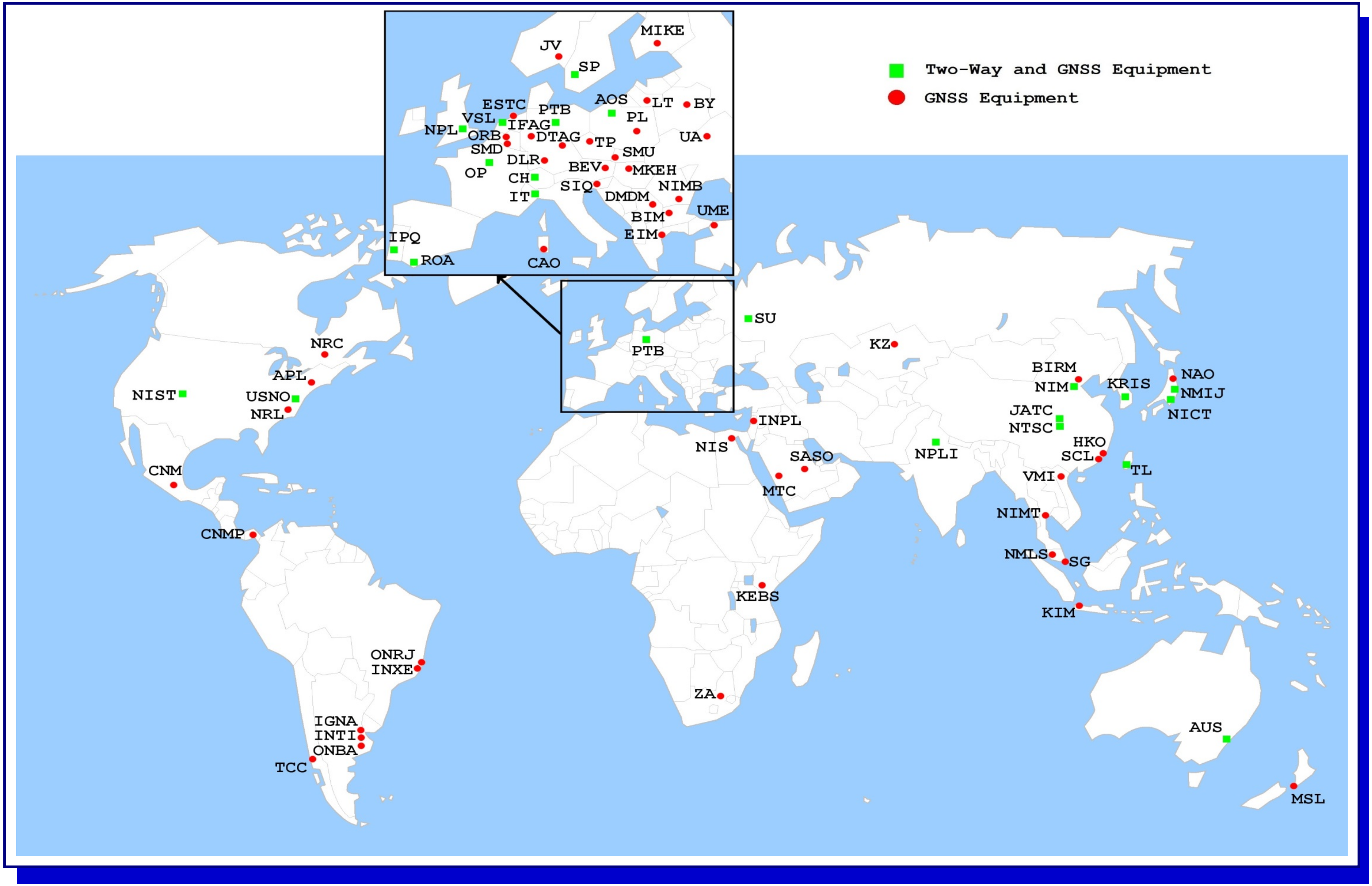

Geographical distribution of the laboratories that contribute to TAI and time transfer equipment (March 2014)

Table 1. Relative frequency offsets and step adjustments of UTC, up to 31 December 2014

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

Table 2. Relationship between TAI and UTC, up to 31 December 2014

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 –	35

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	Center for Metrology and Accreditation (MIKES), 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
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

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.)

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 space-temps, 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 (1)	Saudi Standards, Metrology and Quality Organization, Riyadh, Kingdom of 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	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) First participation since November 2013

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 2013

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	2 Ind. Cs 3 H-masers	1 Cs + microphase-stepper			*	*		
BY	6 H-masers	3-4 H-masers + microphase-stepper			*		*	
CAO (a)	2 Ind. Cs	1 Cs		*	*	*	*	
CH	4 Ind. Cs (3) 1 H-maser	all the Cs 1 H-maser	*	*		*		*
CNM	2 Ind. Cs 1 H-maser	2 Ind. Cs 1 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 2013 (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 4 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 1 H-maser	1 H-maser + microphase-stepper				*		
HKO	2 Ind. Cs	1 Cs				*	*	
IFAG (a)	5 Ind. Cs 2 H-masers	1 Cs + microphase-stepper		*	*	*		
IGNA	2 Ind. Cs	1 Cs		*	*			
INPL	2 Ind. Cs	1 Cs				*	*	
INTI	1 Ind. Cs	1 Cs		*	*			
INXE	2 Ind. Cs 1 Ind. Rb	1 Cs			*	*		

Table 4. Equipment and source of UTC(*k*) of the laboratories contributing to TAI in 2013 (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 3 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 (a)	3 Ind. Cs	1 Cs + reference generator				*	*	
KIM	2 Ind. Cs	1 Cs				*	*	
KRIS	5 Ind. Cs 3 H-masers	1 H-maser + microphase-stepper	*	*	*	*	*	*
KZ	5 Ind. Cs (5)	1 Cs + microphase-stepper				*	*	
LT	2 Ind. Cs	1 Cs		*	*			
MIKE	2 Ind. Cs 3 H-masers	1 H-maser + microphase-stepper			*	*		
MKEH	1 Ind. Cs	1 Cs			*			

Table 4. Equipment and source of UTC(*k*) of the laboratories contributing to TAI in 2013 (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		
MSL	2 Ind. Cs	1 Cs + microphase-stepper		*		*		
MTC	5 Ind. Cs	1 Cs (6)			*			
NAO	4 Ind. Cs 1 H-maser	1 Cs + microphase-stepper		*	*			
NICT	29 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 7 Ind. Cs 7 H-masers	4 Cs 5 H-masers + microphase-stepper	*	*	*	*		*
NMIJ	4 Ind. Cs 1 Lab. Cs 4 H-masers	1 H-maser + microphase-stepper		*	*	*		*
NMLS	2 Ind. Cs	1 Cs		*		*		

Table 4. Equipment and source of UTC(*k*) of the laboratories contributing to TAI in 2013 (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		
NPL	3 Ind. Cs 4 H-masers	1 H-maser			*	*		*
NPLI	5 Ind. Cs 1 H-maser	1 H-maser + microphase-stepper		*	*	*		*
NRC	6 Ind. Cs 2 Lab. Cs 4 H-masers	1 Cs + microphase-stepper	*	*		*		
NRL	7 Ind. Cs 4 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	8 Ind. Cs 3 Lab. Cs 1 Lab. Rb 5 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 4 H-masers	1 Cs (12) + microphase-stepper	* (13)	*	*	*		
PTB	3 Ind. Cs 4 Lab. Cs (14) 4 H-masers	1 H-maser (15) + microphase-stepper	* (16)	*	*	*	*	*

Table 4. Equipment and source of UTC(*k*) of the laboratories contributing to TAI in 2013 (Cont.)

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

Lab k	Equipment	Source of UTC(*k*) (1)	TA(*k*)	UTCr	Time Links GPS SF	Time Links GPS DF	Time Links GLONASS	Time Links Two-Way
ROA	6 Ind. Cs (17) 1 H-maser	1 H-maser (18) + frequency synthesizer steered to UTC(ROA)		*	*	*	*	*
SASO	5 Ind. Cs	1 Cs		*		*	*	
SCL	2 Ind. Cs	1 Cs + microphase-stepper		*	*			
SG	4 Ind. Cs 1 H-maser	1 H-maser + microphase-stepper	*	*	*	*	*	
SIQ	1 Ind. Cs	1 Cs			*			
SMD	3 Ind. Cs 1 H-maser	1 Cs + microphase-stepper			*	*	*	
SMU	1 Ind. Cs	1 Cs + output frequency steering			*	*	*	
SP	18 Ind. Cs (19) 7 H-masers	1 H-maser + microphase-stepper		*		*	*	*
SU	2 Lab. Cs (20) 8-9 H-masers	5-7 H-masers (21)	* (22)	*		*	*	* (23)
TCC (a)	3 Ind. Cs 3 H-masers	1 Cs			*	*		
TL	13 Ind. Cs 2 H-masers	1 H-maser + microphase-stepper	* (24)	*		*		*

Table 4. Equipment and source of UTC(*k*) of the laboratories contributing to TAI in 2013 (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		
TP	4 Ind. Cs	1 Cs + output frequency steering				*		
UA (a)	1 Ind. Cs 3 H-masers	3 H-masers + microphase-stepper			*	*	*	
UME	5 Ind. Cs	1 Cs		*		*	*	
USNO	82 Ind. Cs 31 H-masers 5 Lab. Rb	1 H-maser + frequency synthesizer steered to UTC(USNO) (25)	* (25)	*	*	*		*
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 2012, not confirmed by the laboratory.
(b)		Information not confirmed by the laboratory.
(1)		When several clocks are indicated as source of UTC(*k*), laboratory k computes a software clock, steered to UTC. Often a physical realization of UTC(*k*) is obtained using a Cs clock and a micro-phase-stepper.
(2)	AOS	The UTC(AOS) is formed technically using 1 hydrogen maser and microstepper, it is steered using TA(PL) data as a reference. TA(PL) laboratories are linked via MC GPS-CV, except for two clocks of TPSA, two clocks of NIT and four clocks of AOS linked via a two-directional optical fibre connection to GUM
(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(MT) 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 — 19 Cs, 7 H-masers * Ohtakadoya-yama LF station — 4 Cs * Hagane-yama LF station — 5 Cs * Advanced ICT Research Institute in Kobe — 2 Cs
(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 25 industrial caesium clocks located as follows (at the end of 2013) :

* Centre Electronique de l'Armement (CELAR, Rennes)	2 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)	8 Cs
* Observatoire de Besançon (OB, Besançon)	2 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) is 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 2013): * SP Technical Research Institute of Sweden (SP, Borås) — 4 Cs, 2 H-masers * SP Technical Research Institute of Sweden (SP, Stockholm) — 5 Cs * 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. Both are intermittently operated as frequency standards. During 2013 both CsFO1 and CsFO2 were under experimental operation and there was no contribution 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 closely 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 the SU Time Service Bulletin.
(23)	SU	Starting MJD 56564 0:00 UTC time link to contribute to TAI have been shifted from GLO/GPS to Two-way. Two-way measurements are referred to MC(SU). Difference UTC(SU) – MC(SU) for the referred period have been regularly evaluated by the SU Time Service.
(24)	TL	TA(TL) is generated from a 13-caesium-clock ensemble.
(25)	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 March 2014

(File containing values since the beginning of the steering is available at ftp://62.161.69.5/pub/tai/scale/ealtai13.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 - 2014 MAR 28	56199 - 56744	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 http://www.bipm.org under the name UTAI13.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) NIST-F1, NPL-CSF2, PTB-CS1, PTB-CS2, PTB-CSF1, PTB-CSF2, SYRTE-FO1 and SYRTE-FO2 for the year 2013.
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 7.
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 for the year 2013.

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 over 2013 are indicated below. Reports of individual evaluations may be found at http://www.bipm.org in the subdirectory named 'data'. Ref(u_B) is a reference giving information on the value of u_B as stated in the 2013 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.
NIST-F1	Fountain	0.31	0.35	[1]	H maser	4 / 15 d to 45 d
NPL-CSF2	Fountain	0.23	0.23	[2]	H maser	12 / 15 d to 35 d
PTB-CS1	Beam / Mag.	8	8.	[3]	TAI	12 / 30 d
PTB-CS2	Beam / Mag.	12	12.	[4]	TAI	12 / 30 d
PTB-CSF1	Fountain	(0.70 to 0.72)	1.4	[5]	H maser	4 / 15 d to 30 d
PTB-CSF2	Fountain	(0.29 to 0.38)	0.41	[6]	H maser	9 / 15 d to 30 d
SYRTE-FO1	Fountain	(0.35 to 0.41)	0.37	[7]	H maser	5 / 10 d to 30 d
SYRTE-FO2	Fountain	(0.23 to 0.31)	0.23	[7]	H maser	13 / 10 d to 35 d

Secondary Standard	Type	Type B std. uncertainty/ 10^{-15}	u_B(Ref) / 10^{-15}	Ref(u_B)	Comparison with	Number / typical duration of comp.
SYRTE-FORb	Fountain	(0.28 to 0.34)	0.33	[7]	H maser	14 / 10 d to 35 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	$d/10^{-15}$	$u_A/10^{-15}$	$u_B/10^{-15}$	$u_{link/lab}/10^{-15}$	$u_{link/TAI}/10^{-15}$	$u/10^{-15}$	Notes
NIST-F1	56304 56329	0.59	0.27	0.31	0.15	0.23	0.49	
NIST-F1	56389 56414	-1.56	0.36	0.31	0.06	0.23	0.53	
NIST-F1	56489 56534	-0.82	0.24	0.31	0.14	0.14	0.44	
NIST-F1	56609 56624	-0.96	0.46	0.31	0.15	0.37	0.68	
NPL-CsF2	56289 56309	0.00	0.24	0.23	0.02	0.28	0.44	
NPL-CsF2	56319 56349	0.39	0.21	0.23	0.08	0.20	0.38	
NPL-CsF2	56349 56374	0.97	0.25	0.23	0.07	0.23	0.42	
NPL-CsF2	56389 56409	-0.13	0.26	0.23	0.03	0.28	0.45	
NPL-CsF2	56409 56439	-0.47	0.21	0.23	0.05	0.20	0.37	
NPL-CsF2	56439 56469	0.24	0.23	0.23	0.11	0.20	0.40	
NPL-CsF2	56469 56494	0.02	0.23	0.23	0.06	0.23	0.40	
NPL-CsF2	56519 56534	-0.61	0.32	0.23	0.11	0.37	0.55	
NPL-CsF2	56534 56564	0.72	0.22	0.23	0.07	0.20	0.38	
NPL-CsF2	56564 56594	-0.11	0.22	0.23	0.11	0.20	0.39	
NPL-CsF2	56594 56619	-0.08	0.25	0.23	0.10	0.23	0.42	
NPL-CsF2	56624 56654	-0.44	0.25	0.23	0.15	0.20	0.42	
PTB-CS1	56289 56319	-11.13	6.00	8.00	0.00	0.07	10.00	(1)
PTB-CS1	56319 56349	-8.58	6.00	8.00	0.00	0.07	10.00	
PTB-CS1	56349 56379	-14.56	6.00	8.00	0.00	0.07	10.00	
PTB-CS1	56379 56409	-8.04	6.00	8.00	0.00	0.07	10.00	
PTB-CS1	56409 56439	-16.18	6.00	8.00	0.00	0.07	10.00	
PTB-CS1	56439 56469	-16.88	6.00	8.00	0.00	0.07	10.00	
PTB-CS1	56469 56504	-17.14	6.00	8.00	0.00	0.06	10.00	
PTB-CS1	56504 56534	-10.43	6.00	8.00	0.00	0.07	10.00	
PTB-CS1	56534 56564	-9.66	6.00	8.00	0.00	0.07	10.00	
PTB-CS1	56564 56594	-12.55	6.00	8.00	0.00	0.07	10.00	
PTB-CS1	56594 56624	-9.66	6.00	8.00	0.00	0.07	10.00	
PTB-CS1	56624 56654	-7.77	6.00	8.00	0.00	0.07	10.00	
PTB-CS2	56289 56319	-13.75	3.00	12.00	0.00	0.07	12.37	(1)
PTB-CS2	56319 56349	-7.31	3.00	12.00	0.00	0.07	12.37	
PTB-CS2	56349 56379	-10.39	3.00	12.00	0.00	0.07	12.37	
PTB-CS2	56379 56409	-0.60	3.00	12.00	0.00	0.07	12.37	
PTB-CS2	56409 56439	4.73	3.00	12.00	0.00	0.07	12.37	
PTB-CS2	56439 56469	0.06	3.00	12.00	0.00	0.07	12.37	
PTB-CS2	56469 56504	5.68	3.00	12.00	0.00	0.06	12.37	
PTB-CS2	56504 56534	1.14	3.00	12.00	0.00	0.07	12.37	
PTB-CS2	56534 56564	-3.49	3.00	12.00	0.00	0.07	12.37	
PTB-CS2	56564 56594	-4.80	3.00	12.00	0.00	0.07	12.37	
PTB-CS2	56594 56624	-7.66	3.00	12.00	0.00	0.07	12.37	
PTB-CS2	56624 56654	-7.96	3.00	12.00	0.00	0.07	12.37	
PTB-CSF1	56409 56439	-0.06	0.11	0.72	0.02	0.07	0.73	
PTB-CSF1	56474 56499	0.17	0.12	0.70	0.02	0.08	0.71	
PTB-CSF1	56549 56564	1.05	0.14	0.70	0.02	0.12	0.72	
PTB-CSF1	56564 56594	1.55	0.10	0.72	0.03	0.07	0.73	
PTB-CSF2	56284 56304	-0.26	0.17	0.34	0.02	0.09	0.39	
PTB-CSF2	56304 56324	-0.21	0.17	0.34	0.02	0.09	0.39	
PTB-CSF2	56354 56369	0.83	0.20	0.37	0.02	0.12	0.44	
PTB-CSF2	56374 56394	-0.10	0.17	0.37	0.02	0.09	0.42	
PTB-CSF2	56414 56439	0.03	0.16	0.33	0.01	0.08	0.37	
PTB-CSF2	56484 56514	-1.07	0.15	0.29	0.01	0.07	0.33	
PTB-CSF2	56564 56584	0.40	0.15	0.38	0.02	0.09	0.42	
PTB-CSF2	56599 56614	0.85	0.18	0.31	0.02	0.12	0.38	
PTB-CSF2	56624 56639	-0.37	0.18	0.31	0.04	0.12	0.38	

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-FO1	56309 56319	-0.54	0.21	0.37	0.11	0.53	0.69
SYRTE-FO1	56319 56344	-0.28	0.20	0.36	0.12	0.23	0.49
SYRTE-FO1	56349 56364	0.07	0.40	0.37	0.11	0.37	0.67
SYRTE-FO1	56544 56559	-0.46	0.30	0.41	0.11	0.37	0.64
SYRTE-FO1	56564 56594	0.08	0.35	0.35	0.11	0.20	0.54
SYRTE-FO2	56289 56304	-0.35	0.28	0.31	0.12	0.37	0.57
SYRTE-FO2	56309 56319	0.29	0.21	0.31	0.11	0.53	0.66
SYRTE-FO2	56319 56349	-0.05	0.25	0.24	0.12	0.20	0.42
SYRTE-FO2	56349 56379	0.69	0.20	0.25	0.11	0.20	0.39
SYRTE-FO2	56379 56409	0.08	0.20	0.23	0.11	0.20	0.38
SYRTE-FO2	56409 56439	-0.47	0.20	0.23	0.10	0.20	0.38
SYRTE-FO2	56439 56469	-0.13	0.20	0.25	0.10	0.20	0.39
SYRTE-FO2	56469 56504	-0.51	0.25	0.25	0.10	0.17	0.41
SYRTE-FO2	56504 56534	-0.21	0.40	0.25	0.10	0.20	0.52
SYRTE-FO2	56544 56564	0.10	0.20	0.26	0.10	0.28	0.44
SYRTE-FO2	56564 56594	0.44	0.35	0.26	0.10	0.20	0.49
SYRTE-FO2	56594 56614	1.03	0.30	0.26	0.10	0.28	0.50
SYRTE-FO2	56614 56624	1.21	0.30	0.26	0.11	0.53	0.67

Notes:
(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	56289 56304	-1.84	0.14	0.34	0.11	0.37	0.53	3.00	[8]
SYRTE-FORb	56309 56319	-1.16	0.30	0.34	0.11	0.53	0.70	3.00	[8]
SYRTE-FORb	56319 56349	-1.78	0.20	0.31	0.10	0.20	0.43	3.00	[8]
SYRTE-FORb	56349 56379	0.63	0.30	0.33	0.10	0.20	0.50	1.30	[9]
SYRTE-FORb	56379 56409	0.16	0.25	0.33	0.12	0.20	0.47	1.30	[9]
SYRTE-FORb	56409 56439	-0.15	0.27	0.33	0.11	0.20	0.48	1.30	[9]
SYRTE-FORb	56439 56469	-0.22	0.20	0.30	0.15	0.20	0.44	1.30	[9]
SYRTE-FORb	56469 56504	-0.59	0.40	0.30	0.11	0.17	0.54	1.30	[9]
SYRTE-FORb	56554 56564	0.19	0.40	0.34	0.12	0.53	0.75	1.30	[9]
SYRTE-FORb	56564 56594	0.40	0.30	0.34	0.10	0.20	0.50	1.30	[9]
SYRTE-FORb	56594 56614	0.89	0.40	0.31	0.10	0.28	0.59	1.30	[9]
SYRTE-FORb	56614 56624	1.42	0.20	0.31	0.10	0.53	0.65	1.30	[9]
SYRTE-FORb	56624 56639	-0.27	0.20	0.28	0.10	0.37	0.51	1.30	[9]
SYRTE-FORb	56639 56654	-0.79	0.30	0.28	0.11	0.37	0.56	1.30	[9]

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Operation of NIST-F1 and NIST-F2 in 2013

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. For NIST-F1, these improvements now tend to be aimed more at increasing the fountain run time and reliability, rather than decreasing the uncertainty. 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.

Four formal NIST-F1 evaluations were carried out in 2013. All were made with a range of atom densities to determine the spin exchange shift. NIST-F1 has also been used in comparisons to NIST-F2. In all nine comparisons have been made since 2010 between the two fountains in order to provide a direct evaluation of the blackbody shift. Results from these comparisons are presented in [5] along with six measurements from the INRIM cryogenic fountain. The comparisons provide an uncertainty five times smaller than the previous best direct measurement of the blackbody shift.

The Type B uncertainties in NIST-F1 for the four runs in 2013 are substantially the same as those given in Table 1 of [2], and are dominated by the blackbody and microwave amplitude shifts. Reference 2 is the source for u_B(Ref) given in Circular T. The density shift uncertainty is included in the Type A uncertainty. The total Type B uncertainty for all of the runs in 2013 was $3.1x10^{-16}$, dominated by the blackbody shift with an uncertainty of $2.8x10^{-16}$. The Type A uncertainties ranged from $2.4x10^{-16}$ to $4.6x10^{-16}$ for the four runs. The uncertainties due to the spin exchange shift ranged from $2.1x10^{-16}$ to $3.9x10^{-16}$. Total uncertainties, including frequency transfer and dead time uncertainties, ranged from $4.4x10^{-16}$ to $6.8x10^{-16}$.

For NIST-F2 only one formal evaluation was submitted. The Type B uncertainty for NIST-F2 was $1.5x10^{-16}$ and was dominated by the microwave power shift of $1.3x10^{-16}$. Reference 4 is the source for u_B(Ref) given in Circular T. The density shift uncertainty is included in the Type A uncertainty. The Type A uncertainty was $4.4x10^{-16}$ including a spin exchange uncertainty of $3.7x10^{-16}$. The total uncertainty, including frequency transfer and dead time uncertainties, was $5.1x10^{-16}$.

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Operation of the NPL-CsF2 primary frequency standard in 2013

At National Physical Laboratory one caesium fountain, NPL-CsF2, is operated as primary frequency standard and a second one, NPL-CsF3, is being built for redundancy and comparisons.

NPL-CsF2 was made operational and characterised for the first time in 2009. In 2011 a major reassessment of the uncertainty budget was performed [1]. Last year, a new evaluation of the frequency shift due to collisions with background gas was performed [2] based on a recently published model [3]. The table below summarises the new accuracy evaluation.

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[a]
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
Type A uncertainty evaluation	
u_A (1σ for 25-day measurement campaign)	2.0[b]
Total uncertainty	2.9

[a] An exemplary value of the type B contribution to the uncertainty.
[b] A value quoted for a typical 25 day measurement campaign including dead time.

During the calendar year 2013, the NPL-CsF2 primary frequency standard was used 12 times (every month) 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.

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Operation of the SYRTE fountain clocks in 2013

FO1, FO2Cs and FOM primary frequency standards

In 2013 we have sent to BIPM 5 and 13 calibrations performed by the SYRTE cesium fountains FO1, FO2-Cs. The mobile FOM, currently in operation at CNES, in Toulouse, for tests of the PHARAO flight model space clock, was not connected to the reference maser in Observatoire de Paris.

The nominal operation of the FO1, FO2Cs fountains is the same as in 2012. The microwave synthesizers are referenced to the signal provided by a cryogenic sapphire oscillator (CSO) phase locked to a hydrogen Maser, to take the benefit of the ultra-low phase noise of the CSO. The relative frequency instabilities are routinely $\sigma_y(\tau) \sim 5 \times 10^{-14}\ \tau^{-1/2}$ for the FO1 and FO2Cs fountains. 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 of the clocks.

Table 1 gives the typical uncertainty budgets for the three SYRTE fountain clocks in 2013. The value and the uncertainty 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	-1218.4	0.2	-1917.4	0.3	-305.6	1.2
Blackbody Radiation	172.6	0.6	169.0	0.6	165.6	0.6
Cold Collisions + cavity pulling	123.0	1.0	89.2	1.0	28.6	5.0
Distributed cavity phase shift	-1.0	2.7	-0.9	0.93	-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		**3.5**		**2.3**		**6.0**

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

FO2-Rb secondary frequency standard

The operation of FO2-Rb is similar to that of the Cs fountains at LNE-SYRTE. It also uses 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 (typically 1 - 2 x 10^{-16}), type B (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 (3.0 x 10^{-15} with the previous recommended value and 1.3 x 10^{-15} with the current recommended value) is accounted for. Table 2 gives the typical accuracy budget of FO2-Rb.

Physical origin	Correction	Uncertainty
2nd order Zeeman	-3466.1	0.7
Blackbody Radiation	125.5	1.4
Cold Collisions + cavity pulling	6.4	1.34
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		**2.8**

Table 2: Typical accuracy budget for the SYRTE FO2Rb fountain [2].
(Values given in units of 10^{-16})

Based on comparisons of FO2-Rb against FO2Cs and FOM, performed between January and August 2012, a new value for the secondary representation of the second based on the rubidium hyperfine splitting frequency has been proposed at the last CCTF held in September 2012 [3]. This new value was adopted by the CIPM at its 102nd meeting in June 2013 [4].

FO2-Rb calibration reports were regularly sent to BIPM in 2013 and included in Circular T: 14 calibration values were transmitted. The first 3 ones were referenced to the previous definition of the secondary representation of the second and the following calibrations, to the new definition. Initially 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.

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Operation of the PTB primary clocks in 2013

PTB's primary clocks with a thermal beam

During 2013 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 -8.4×10^{-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.

CS1

Based on continuous comparison with an active hydrogen maser, the CS1 relative frequency instability was found to vary between 80×10^{-15} and 91×10^{-15} for an averaging time of 1 hour, in 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 $u_A(\tau = 30\text{ d, CS1}) = 6\times10^{-15}$ stated in Circular T. CS1 got the maximum statistical weight in the ALGOS computation throughout 2013. During the year, three 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 $\sigma_y(\tau = 1\text{ hour})$ was measured between 65×10^{-15} and 75×10^{-15} during 2013. This range of values would justify the estimate of the uncertainty contributions u_A as $u_A(\tau = 30\text{ d, CS2}) = 3\times10^{-15}$. The standard deviation of the 12 *d*- values reported in Circular T of 2013 amounted, however, to 5.3×10^{-15}. In comparison with UTC(PTB) one can identify two epochs at which significant rate changes (a few parts in 10^{15}) happened. The first one cannot be related to any documented activity done on the clock or its environment. The second one is close in time to one of the two beam reversals that were performed during 2013. The beam reversal frequency shift values (due to end-to-end cavity phase difference) deviated in both cases from its long-term mean value by less than the 1-σ statistical uncertainty. For 2014 we plan to do beam reversals more frequently. 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 2013 both caesium fountain clocks, CSF1 and CSF2, were operated regularly with a high duty cycle. The strategy of the generation of UTC(PTB) [3] has been modified to make use of the data of both fountains for the steering of a hydrogen maser output frequency. The steering data is selected based on the availability of the respective fountain data and the chosen priority.

CSF1

A detailed description of the PTB fountain CSF1 is given in Refs. [4] and [5]. Formerly CSF1 was operated in an autonomous mode by steering a quartz oscillator to the atomic resonance frequency and measuring the frequency difference between the quartz oscillator and the hydrogen maser with a commercial phase comparator [4]. Since the beginning of 2013 CSF1 is operated in a non-autonomous mode: As in CSF2 and other fountains, for this purpose the quartz oscillator is locked to the hydrogen maser. The microwave signal for the fountain is synthesized based on the quartz oscillator and a DDS synthesizer locked to the quartz oscillator. The output frequency of the DDS synthesizer is digitally steered to the atomic resonance frequency by evaluating the caesium transition probability measured by the fountain. The frequency difference between CSF1 and the hydrogen maser is thus obtained from the monitored synthesizer frequency settings. The quadratic Zeeman shift is regularly evaluated every few hours by measuring the (F=3, m_F=1) – (F=4, m_F=1) transition frequency. Moreover, the employed new microwave frequency synthesis setup [6] provides a better suppression of sidebands compared to the previously employed synthesis. The dominating 50 Hz sidebands are 65 dB below the carrier with an asymmetry of much less than 10%. Therefore the current estimate of the uncertainty due to the electronics amounts to less than 0.1×10^{-15}.

In autumn 2013 the magnetic field strength in the interaction region of CSF1 was increased by a factor of 1.5 to obtain a better separation of the individual Zeeman components (F=3, m_F) – (F=4, m_F). This enables at the same time the utilization of newly developed techniques to determine the atom cloud position in the Ramsey cavity [7] for improved distributed cavity phase evaluations [8] and reduces frequency shifts due to Rabi and Ramsey pulling [9].

In 2013 CSF1 provided steering data for the hydrogen maser during 360 days of the year. Four measurements of the TAI scale unit of 15 (1×), 25 (1×) and 30 (2×) days duration were performed in 2013 and reported to the BIPM. Due to the performance and reliability of the laser systems, dead times are routinely kept below 2% (in one case 5%) of the nominal measurement duration. The resulting clock link uncertainty $u_{l/lab}$ was at or below 0.03×10^{-15}. The statistical uncertainty of CSF1 measurements was calculated with the assumption of white frequency noise during the measurement intervals. For the four TAI contributions in 2013 statistical uncertainties $u_A \leq 0.2\times10^{-15}$ 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	107.88	0.10
Black body radiation shift	- 16.53	0.10
Cold collisions	- 1.04	0.25
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		0.72

Table 1: Typical frequency biases and type B uncertainties of PTB-CSF1 in 2013

CSF2

A detailed description of the PTB fountain CSF2 is given in Refs. [8] and [10]. In 2013 CSF2 provided steering data for the hydrogen maser during 352 days of the year. Nine measurements of the TAI scale unit of 15 (3×), 20 (4×), 25 (1×) and 30 (1×) days duration were performed and reported to the BIPM. The dead times of these measurements were in most cases below 2% (in one case 4%), so that the resulting clock link uncertainty $u_{l/lab}$ was at or below 0.02×10^{-15} (in one case 0.04×10^{-15}).

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 eight TAI contributions in 2013 we arrived at statistical uncertainties $u_A \leq 0.2{\times}10^{-15}$.

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	99.906	0.010
Black body radiation shift	- 16.583	0.057
Cold collisions	- 0.59	0.23
Gravitational red shift	8.567	0.006
Cavity phase	0.044	0.133
Microwave lensing	0.083	0.042
Majorana transitions		0.0001
Rabi pulling		0.0002
Ramsey pulling		0.001
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 2013.

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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/SITAI/sitai13.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, KRISS-1, NICT-CSF1, NIST-F1, NMIJ-F1, NPL-CSF1, NPL-CSF2, PTB-CS1, PTB-CS2, PTB-CSF1, PTB-CSF2, SYRTE-FO1, SYRTE-FO2, SYRTE-FOM, SYRTE-JPO and secondary frequency standard (SFS) SYRTE-FORb consistently corrected for the black-body radiation shift.
In this computation, the uncertainty of the link to TAI has been computed using the standard uncertainty of [UTC-UTC(*k*)], following the recommendation of the CCTF working group on PFS. The model for the instability of EAL has been expressed as the quadratic sum of three components: a white frequency noise $1.7 \times 10^{-15}/\sqrt{(\tau)}$, a flicker frequency noise 0.35×10^{-15} and a random walk frequency noise $0.4 \times 10^{-16} \times \sqrt{(\tau)}$, with τ in days. The relation between EAL and TAI is given in Table 5.

Month	Interval	$d/10^{-15}$	uncertainty/10^{-15}
Jan. 2011	55559-55589	+6.54	0.38
Feb. 2011	55589-55619	+6.24	0.45
Mar. 2011	55619-55649	+5.83	0.33
Apr. 2011	55649-55679	+5.97	0.31
May 2011	55679-55709	+5.72	0.31
Jun. 2011	55709-55739	+6.16	0.32
Jul. 2011	55739-55769	+5.90	0.36
Aug. 2011	55769-55804	+5.41	0.27
Sep. 2011	55804-55834	+5.03	0.28
Oct. 2011	55834-55864	+4.62	0.37
Nov. 2011	55864-55894	+3.93	0.24
Dec. 2011	55894-55924	+2.99	0.26
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	+2.47	0.21
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	-0.18	0.25
Nov. 2012	56229-56259	-0.26	0.24
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	0.22
May 2013	56409-56439	-0.33	0.19
Jun. 2013	56439-56469	-0.01	0.25
Jul. 2013	56469-56504	-0.41	0.22
Aug. 2013	56504-56534	-0.52	0.29
Sep. 2013	56534-56564	+0.31	0.25
Oct. 2013	56564-56594	+0.29	0.21
Nov. 2013	56594-56624	+0.42	0.21
Dec. 2013	56624-56654	-0.34	0.29

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 60 File SCHGPS.60	implemented on MJD = 56412 (2013 April 30) at 0 h UTC	Reference date MJD = 50722 (1997 October 1)
GPS Schedule no 61 File SCHGPS.61	implemented on MJD = 56596 (2013 October 31) at 0 h UTC	Reference date MJD = 50722 (1997 October 1)

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/utcgpsglo13.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

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

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 further notice:

$$[UTC - GPS\ time] = -16\ \text{s} + C_0,$$

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 further notice, $[TAI – UTC(USNO)\_GPS] = 35\ \text{s} + C_0'$

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 $[UTC– UTC(USNO)\_GPS] = 0\ \text{s} + C_0'$

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/utcgpsglo13.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 further notice, $[TAI - GLONASS\ time] = 35\ \text{s} + C_1$.

Here C_1 is given at 0 h UTC every day.

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

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

+1285 ns from 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 further notice, $[TAI – UTC(SU)\_GLONASS] = 35\ \text{s} + C_1'$

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

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

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

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

Table 8. Rates relative to TAI of contributing clocks in 2013

(File is available at ftp://62.161.69.5/pub/tai/scale/RTAI/rtai13.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 2013. 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 upon request. Unit is ns/day, "   -" denotes that the clock was not used, "*" denotes that the related rate was influenced by a frequency jump.

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

12 HEWLETT-PACKARD 5061A
13 EBAUCHES, OSCILLATOM B5000
14 HEWLETT-PACKARD 5061A OPT. 4
16 OSCILLOQUARTZ 3200
17 OSCILLOQUARTZ 3000
15 DATUM/SYMMETRICOM Cs III
18 DATUM/SYMMETRICOM Cs 4000
19 RHODES AND SCHWARZ XSC
4x HYDROGEN MASERS
9x PRIMARY CLOCKS AND PROTOTYPES
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 5071A High perf.
36 H-P/AGILENT/SYMMETRICOM 5071A Low perf.
50 FREQ. AND TIME SYSTEMS INC. 4065A
51 DATUM/SYMMETRICOM 4065 B
52 DATUM/SYMMETRICOM 4065 C
53 DATUM/SYMMETRICOM 4310 B

Lab.	Clock	56319	56349	56379	56409	56439	56469	56504	56534	56564	56594	56624	56654
APL	35 904	30.73	31.10	30.53	30.38	30.51	31.04	29.79	30.33	29.47	-	30.41	30.12
APL	35 1264	19.87	19.44	18.87	18.29	18.97	17.98	18.47	18.55	20.49	-	20.89	21.30
APL	35 1791	-	-	-	-	-	-	-	-	-	-	1.15	0.61
APL	40 3107	29.09	29.19	29.28	29.52	29.68	29.83	30.06	30.30	30.18	-	-	-
APL	40 3108	415.88	419.12	422.35	425.64	428.79	431.99	435.41	438.79	441.61	-	447.81	450.51
APL	40 3109	43.34	42.99	42.65	42.16	41.47	41.07	40.60	40.01	39.25	-	38.23	37.51
AUS	35 2269	-0.83	-0.32	0.29	-0.79	-1.26	-0.77	-1.35	-1.10	-0.81	-0.81	-0.16	-1.34
AUS	36 299	12.64	12.98	13.16	16.67	15.37	13.76	12.47	14.00	14.79	13.96	13.24	12.39
AUS	36 340	1.17	2.45	0.79	0.44	3.41	2.93	2.99	0.63	2.29	3.66	1.21	1.59
AUS	36 654	-11.89	-11.95	-13.34	-13.23	-13.56	-13.37	-13.35	-13.13	-12.81	-13.17	-11.59	-13.28

Table 8. (Cont.)

Lab.	Clock	56319	56349	56379	56409	56439	56469	56504	56534	56564	56594	56624	56654
AUS	36 1141	11.81	10.92	12.73	9.51	11.74	8.19	12.13	10.87	9.83	12.79	13.18	11.66
AUS	40 5401	-	-	-4.51	-3.26	-5.69	-4.14	-	-	-	-	-	-
AUS	40 5402	43.44	-	17.86	17.94	-	27.63	27.93	41.57	-	-	-	-
BEV	35 1065	1.31	1.29	1.08	1.35	1.49	1.64	3.37	9.93	13.40	7.88	9.15	10.15
BEV	35 1793	1.19*	-3.29*	-2.61*	-1.37*	-1.15*	-1.97*	-1.38*	1.53*	0.79*	-1.73*	-1.34*	-1.33
BEV	40 3452	-63.06*	-56.19*	-49.67*	-42.72*	-36.93*	-30.27	-23.43	-16.18	-10.32	-3.85	-	-
BIM	18 8058	2.00	2.12	1.78	3.01	1.44	1.55	1.21	1.28	-0.04	1.70	3.14	3.09
BY	40 4222	-0.01*	0.06	-	-	-	-	-	-	-	-6.42	-5.07	-4.18
BY	40 4227	-	-	-	-	-	-	-	-	-	3.48*	1.64	0.58
BY	40 4229	-	-	-	-	-	-	-	-	-	9.68	10.67	9.41
BY	40 4260	-13.91	-14.37	-	-	-	-	-	-	-	-	-	-
BY	40 4278	3.99	5.28	-	-	-	-	-	-	-	4.13	3.90	-
CH	22 112	17.24	21.17	26.51	30.64	30.03	34.31	39.68	43.13	50.53	53.48	52.75	58.34
CH	35 2117	2.30	1.85	2.37	1.51	1.41	2.49	1.91	2.28	1.21	3.54	1.79	1.68
CH	35 2743	-2.41	-2.94	-2.12	-2.41	-2.19	-2.18	-2.70	-2.50	-2.38	-2.41	-1.80	-2.60
CH	36 354	41.33	43.25	43.01	43.95	41.34	40.66	43.41	42.18	43.66	-	-	-
CH	40 5701	-15.44	-17.21	-18.62	-19.82	-20.73	-21.61	-22.17	-22.78	-23.22	-23.86	-24.86	-25.14
CNM	35 2708	-0.57	0.30	-0.21	0.22	-0.19	0.92	-0.53	-0.40	0.68	-	-0.54	0.86
CNM	35 2709	6.10	7.03	5.83	6.50	5.55	7.43	4.90	6.26	6.35	-	-	-
CNM	40 7301	-6.50	-5.07	-6.49	-6.30	-7.69	-6.44	-8.61	-8.23	-7.83	-	-	-
CNMP	36 1752	8.45	7.37	7.55	5.98	7.63	7.00	6.12	5.78	8.16	6.36	7.08	7.98
CNMP	36 1806	0.23	0.71	1.41	1.10	0.36	0.83	-0.23	0.28	-1.90	0.51	-2.03	1.78
CNMP	36 2873	-	-	-	-	0.59	-0.34	0.54	2.00	0.72	-0.82	0.41	-0.48
DLR	35 1714	0.44	-1.28	1.01	-1.37	-0.64	1.57	-1.05	0.36	1.62	-	-	-
DMDM	35 2191	21.34	20.93	20.71	21.40	20.88	20.88	21.38	20.72	20.95	20.65	20.92	20.26
DMDM	36 2033	-1.35*	1.15*	11.73*	-28.00*	-9.06*	-17.05*	-2.02	8.88	7.32	6.39	8.21	8.09
DTAG	35 2635	-1.70*	-2.89*	-2.33*	-1.92*	-0.44*	-0.93*	-2.51*	-2.95*	-0.10	-	-	-
DTAG	35 2805	-	-	-	-	1.81	1.69	1.87	2.52	2.64	3.11	2.42	2.33
DTAG	35 2865	-1.72	-1.93	-3.45	-	-	-	-	-	-	-	-	-
DTAG	35 2941	-	-	-	-	-	-	-	-	-	-	-1.48	-1.80
DTAG	36 2794	0.16	0.02	0.05	-	-	0.71	0.58	1.68	1.53	-0.40	-0.86	-0.34
EIM	35 716	-	-	-	-	-	-	-	-	-	16.21	14.85	17.87
EIM	35 2060	-	-	-	-	-	-	-0.12	-0.24	0.20	-0.03	-0.15	0.04
ESTC	22 132	-74.12*	-72.40*	-71.03*	-71.37	-	-	-87.99	-89.57	-93.94	-96.36	-97.89	-101.48
ESTC	35 1615	13.29	13.51	12.94	13.46	-	-	-8.64	-8.78	-8.43	-9.19	-9.42	-9.06

Table 8. (Cont.)

Lab.	Clock	56319	56349	56379	56409	56439	56469	56504	56534	56564	56594	56624	56654
ESTC	35 2025	3.85	3.40	3.42	4.02	-	-	-	-	-	-	-	-
ESTC	35 2353	-12.51	-11.77	-12.68	-12.14	-	-	-0.31	-0.53	-0.96	-0.52	-0.25	-0.23
ESTC	40 2551	-4.29	-6.22	-8.00	-8.69	-	-	-5.29	-8.11	-10.66	-13.63	-16.43	-18.77
F	35 124	8.71	7.34	7.57	7.34	7.27	6.99	7.91	7.97	7.37	7.32	7.46	7.89
F	35 157	12.91	12.66	12.68	12.17	12.65	12.25	12.86	13.13	13.45	13.64	12.90	13.02
F	35 158	10.33	9.75	10.04	10.45	9.87	9.47	9.20	8.75	8.14	8.99	11.27	11.19
F	35 355	2.34	1.21	1.16	1.07	1.42	1.14	0.67	0.12	-0.05	1.17	0.55	0.58
F	35 385	20.83	21.72	22.26	19.17	19.09	18.90	21.02	21.46	20.26	21.23	20.62	21.32
F	35 396	-0.94	-1.11	-1.22	-0.92	-0.65	-0.44	0.89	1.06	1.47	1.60	0.77	1.23
F	35 469	-1.26	-1.88	0.43	-0.07	-1.18	-	-	-	-	-	-	-
F	35 520	14.73	14.51	14.31	12.56	13.65	12.33	11.75	11.44	12.67	11.39	9.80	11.93
F	35 609	-24.96	-24.18	-23.24	-23.80	-23.38	-23.68	-23.39	-22.70	-23.34	-24.34	-25.81	-26.51
F	35 700	-19.68	-19.93	-20.72	-21.17	-21.15	-22.24	-18.28	-15.46	-14.73	-12.44	-11.56	-10.98
F	35 770	-6.41	-7.25	-7.49	-6.99	-7.09	-6.86	-7.21	-7.21	-6.53	-9.22	-9.63	-7.80
F	35 774	27.44	26.47	27.07	27.59	27.06	26.43	27.01	25.88	26.38	26.32	25.97	26.01
F	35 781	9.76	9.94	9.93	9.77	9.46	8.48	8.85	7.48	7.49	8.26	8.92	8.47
F	35 819	8.99	11.10	11.30	10.97	10.70	8.69	7.31	7.91	7.79	9.56	-	-
F	35 859	-	5.56	-	-	5.94	-	-	4.03	3.27	3.89	2.84	3.29
F	35 1177	-2.44	-2.42	-2.06	-3.37	-2.60	-3.76	-2.57	-3.42	-2.50	-3.62	-3.00	-2.88
F	35 1222	-	-	-0.13	0.68	0.03	0.84	0.65	0.88	1.06	1.39	1.33	1.50
F	35 1321	3.86	4.45	5.50	6.31	4.13	3.32	4.47	4.22	3.47	3.59	4.09	5.06
F	35 1556	-4.12	-3.60	-3.17	-2.68	-2.60	-2.45	-2.65	-1.98	-1.84	-1.53	-2.76	-2.23
F	35 1644	10.00	10.94	10.75	10.94	10.26	10.76	10.85	10.72	10.80	10.65	10.35	9.84
F	35 2027	3.52	3.47	2.84	3.14	3.32	2.73	3.07	2.77	3.21	-	-	-
F	35 2388	0.76	1.08	0.98	0.09	-0.11	0.27	-0.45	0.70	-0.03	-0.52	0.03	-0.60
F	35 2609	7.55	6.55	7.28	6.91	6.48	7.14	7.08	6.93	6.26	6.67	6.90	6.37
F	35 2647	14.66	14.33	14.97	16.12	15.58	-	-	-	-	-	-	-
F	35 2804	0.48	0.74	1.15	0.70	1.14	1.52	1.39	2.29	2.52	2.51	2.59	2.68
F	40 809	10.65	11.18	11.75	-	-	-	-	15.99	16.91	17.72	18.41	19.16
F	40 810	14.67	15.24	16.09	17.00	18.00	19.00	19.79	20.38	21.32	22.00	22.67	23.62
F	40 889	15.01	15.29	15.49	15.85	16.10	16.42	16.71	17.06	17.33	17.61	17.95	18.47
F	40 890	12.34	12.58	12.74	13.03	13.23	13.43	13.75	13.88	14.10	14.23	14.45	14.76
HKO	35 1893	3.72	3.22	3.90	3.88	-	-	4.27	-	-	-	-	-
HKO	35 2425	-1.05	-0.77	-0.98	-0.54	-	-	-1.31	-0.91	-1.64	-1.90	-1.98	-1.53
HKO	35 2884	-	-	-	-	-	-	-	-	-0.24	0.11	0.60	0.82

Table 8. (Cont.)

Lab.	Clock	56319	56349	56379	56409	56439	56469	56504	56534	56564	56594	56624	56654
IFAG	36 1167	-1.23	-2.28	-4.23	-1.73	-2.13	-0.91	-0.45	-0.92	-0.19	-1.11	-0.95	-2.14
IFAG	36 1173	12.89	10.99	11.23	10.98	14.77	15.50	14.64	13.35	17.65	18.29	16.81	13.83
IFAG	36 1629	13.10	13.06	12.59	12.24	12.36	13.81	14.85	14.95	14.21	11.01	10.43	11.34
IFAG	36 1732	14.97	14.52	14.99	15.56	15.45	14.23	14.11	13.64	13.64	13.31	13.36	14.04
IFAG	36 1798	-2.74	-2.87	-2.79	-2.40	-2.41	-2.99	-2.25	-3.21	-2.23	-2.59	-2.64	-2.35
IFAG	40 4418	1.61	1.93	2.32	2.68	2.57	2.50	2.81	2.93	3.56	3.90	4.34	4.95
IFAG	40 4439	0.25	-0.54	-	-	-3.27	-4.63	-6.32	-7.97	-8.75	-8.58	-8.59	-9.05
IGNA	35 1196	13.69	12.50	13.14	-	-	-	19.00	19.85	20.23	18.99	18.76	18.65
INPL	35 2480	-1.60	-1.45	-1.36	-1.14	-0.48	-1.12	-0.31	-0.31	-0.18	0.54	-0.95	-0.80
INPL	35 2481	1.12	0.65	1.23	1.49	0.94	0.93	0.17	0.05	0.04	-0.14	-0.08	-0.45
INTI	35 2377	-2.50	-1.65	0.03	-	1.20	-0.26	-1.18	-0.56	1.81	-0.07	-2.36	2.49
INXE	35 2393	-	0.70	0.16	0.04	-0.39	0.51	-0.04	-0.03	0.46	-0.85	0.20	0.37
IT	35 219	0.91	0.92	0.38	0.93	0.80	1.56	1.31	0.55	1.59	1.32	0.29	1.88
IT	35 505	-25.40	-24.36	-24.54	-24.33	-24.22	-24.59	-24.66	-24.60	-24.35	-23.89	-23.37	-23.89
IT	35 1115	20.17	20.27	19.74	19.89	19.69	20.91	19.47	20.18	19.54	19.98	18.06	9.58
IT	35 1373	-6.21	-6.26	-6.17	-6.14	-5.89	-6.92	-6.77	-5.94	-5.81	-5.84	-5.90	-6.68
IT	35 2118	-	-	-	14.87	14.76	15.15	16.11	14.84	15.34	15.48	14.83	15.25
IT	35 2487	-8.72	-9.45	-9.12	-9.40	-8.04	-8.63	-7.78	-7.55	-7.39	-7.42	-7.76	-7.69
IT	40 1101	-72.02*	-66.28*	-60.90*	-55.54*	-49.96*	-43.71	-37.30	-31.42	-26.01	-20.76	-15.58	-10.37
IT	40 1102	-75.23*	-69.57*	-64.07*	-58.03*	-51.79*	-44.95	-38.03	-31.96	-25.99	-20.48	-14.83	-9.17
IT	40 1103	19.53*	20.98*	22.46*	24.32*	25.56*	26.97	27.95	28.53	29.41	30.24	31.23	32.33
JV	21 216	76.42	81.62	79.61	76.30	77.73	78.63	84.19	81.36	86.25	84.76	87.11	90.15
JV	36 1277	-16.23	-16.47	-14.20	-15.82	-15.54	-16.80	-15.78	-15.65	-15.02	-13.72	-16.20	-14.13
JV	36 2617	-	14.41	14.52	12.71	12.75	12.98	14.40	13.72	14.75	13.39	12.56	13.40
JV	36 2629	-4.72	-4.71	-4.80	-5.58	-6.14	-4.60	-4.64	-5.84	-4.69	-3.11	-5.23	-6.27
KEBS	35 2518	19.03	20.38	22.72	22.82	-	-	-	-	-	-	-	-
KIM	36 618	1.39	-	-	0.46	2.56	-0.82	2.04	4.00	3.12	1.56	-0.75	1.56
KRIS	35 321	12.47	12.44	12.63	12.18	12.89	12.63	-	-	12.36	11.46	12.12	11.74
KRIS	35 739	-0.09	-0.44	-1.32	-0.27	-0.67	-0.87	-	-	0.42	-0.16	0.32	1.03
KRIS	35 1135	23.95	25.01	24.81	25.40	24.88	24.98	-	-	25.98	26.35	26.71	27.36
KRIS	35 1693	8.75	8.99	8.44	8.76	8.30	8.12	-	-	8.69	7.71	8.81	8.31
KRIS	35 1783	21.21	21.48	21.10	22.23	22.37	20.30	-	-	21.48	21.76	21.77	21.12
KRIS	40 5624	-47.24	-47.11	-47.07	-46.91	-46.76	-46.65	-	-	-46.26	-46.23	-46.08	-
KRIS	40 5625	0.34	0.39	0.36	0.46	0.63	0.72	-	-	-	-	-	1.39
KRIS	40 5626	-8.71	-8.44	-8.23	-7.93	-7.68	-7.45	-	-	-6.53	-6.38	-6.15	-5.82

Table 8. (Cont.)

Lab.	Clock	56319	56349	56379	56409	56439	56469	56504	56534	56564	56594	56624	56654
KZ	35 2202	-	-	-	-	-7.93	-10.57	-9.72	-10.73	-9.90	-10.51	-9.66	-10.90
KZ	35 2665	-	-	-	-	-10.20	5.16	3.32	5.42	4.71	5.76	6.28	5.16
KZ	35 2667	-	-	-	-	-10.24	4.33	4.41	4.22	4.10	4.47	5.05	4.57
LT	35 1362	1.45	0.50	0.64	1.06	0.79	-	2.30	-0.20	-0.84	-0.51	1.40	-0.83
LT	35 1868	-2.06	-1.80	-0.69	-0.16	-0.56	-	-1.15	-0.70	-0.37	-1.20	-1.81	-0.76
MIKE	35 1171	-1.09	-0.02	0.38	-0.65	-1.16	0.78	-	-	-	-	-	-
MIKE	36 986	0.40	1.02	1.03	2.25	1.21	0.22	0.58	0.46	1.26	3.13	3.35	1.46
MIKE	40 4108	9.50*	10.05*	10.58*	11.20*	11.77*	1.16	-4.23	-3.63	-3.04	-2.49	-1.91	-0.64
MIKE	40 4113	-	-	-	-	-	-	-	-	-2.81*	-2.79	-2.21	-1.71
MIKE	40 4180	-	-1.11*	-0.48*	1.97*	2.98*	2.77	-	-	-	3.20	3.16	3.42
MKEH	36 849	-40.03	-40.08	-40.01	-40.56	-40.62	-40.35	-42.02	-42.85	-40.84	-41.04	-41.51	-40.80
MSL	12 933	-	-	-	-37.27	-36.40	-	-	-	-	-	-	-
MSL	36 274	-	-	-	-4.76	-5.42	-7.56	-10.78	-	-	-	-	-
MSL	36 2869	-	-	-	0.94	4.46	1.91	-2.50	-	-	-	-	-
NAO	35 779	2.69	1.94	1.36	2.54	2.55	1.23	-	-	3.60	2.68	4.29	4.20
NAO	35 1206	-0.08	-0.25	-0.37	0.00	1.28	0.54	0.56	0.05	-0.94	-1.41	0.46	-0.18
NAO	35 1214	-4.62	-5.46	-4.52	-4.50	-4.95	-4.25	-4.25	-3.83	-4.59	-4.96	-4.97	-2.94
NAO	35 1689	3.90	3.81	5.45	4.47	4.58	4.17	3.01	2.75	1.92	2.14	2.80	1.50
NAO	40 1301	5.21	11.68	11.87	5.13	8.81	4.10	4.60	2.52	2.54	0.12	-0.12	1.93
NICT	35 112	-10.12	-8.67	-9.68	-8.49	-7.99	-8.36	-9.51	-9.16	-9.06	-10.57	-11.41	-11.29
NICT	35 332	7.83	8.01	7.65	8.06	7.41	7.86	7.21	6.81	7.82	6.44	5.99	6.27
NICT	35 342	50.27	50.55	49.84	49.64	48.55	-	-	-	-	-	-	-
NICT	35 343	8.34	7.91	7.51	7.68	7.43	8.15	7.55	8.12	8.00	7.27	7.56	7.85
NICT	35 715	10.97	10.58	10.57	10.41	10.26	10.10	10.42	10.22	10.45	10.09	9.98	9.75
NICT	35 732	-6.10	-5.95	-5.89	-5.74	-6.20	-6.28	-5.64	-6.21	-6.57	-6.61	-6.79	-6.52
NICT	35 907	20.74	20.68	21.28	20.86	21.15	21.10	20.66	21.08	21.20	21.25	21.09	20.98
NICT	35 913	-14.01	-14.07	-13.66	-14.39	-15.16	-16.06	-16.15	-16.89	-16.83	-16.32	-13.16	-14.02
NICT	35 916	-0.31	-0.33	0.53	-0.56	0.13	-0.27	-0.87	-1.43	-0.39	-1.37	-1.76	-1.54
NICT	35 1225	5.51	5.50	4.17	5.56	6.24	4.87	5.27	5.25	6.39	5.38	5.91	4.88
NICT	35 1226	12.16	10.91	11.36	10.27	11.02	10.50	11.15	11.49	10.25	7.91	8.72	8.57
NICT	35 1611	18.46	18.36	19.26	17.32	15.12	13.97	14.03	-1.42	5.43	12.78	10.18	6.98
NICT	35 1778	-23.17	-24.06	-23.17	-23.85	-23.39	-24.02	-24.65	-24.64	-24.60	-24.24	-24.40	-24.09
NICT	35 1789	-7.29	-7.62	-7.31	-8.15	-7.14	-7.78	-7.83	-7.82	-7.59	-8.00	-7.73	-8.45
NICT	35 1790	10.63	10.54	10.45	9.70	10.05	9.69	10.49	9.73	9.52	9.91	8.51	8.83
NICT	35 1866	2.81	3.29	3.55	2.93	3.60	3.16	4.01	2.63	3.22	3.38	3.07	2.75

Table 8. (Cont.)

Lab.	Clock	56319	56349	56379	56409	56439	56469	56504	56534	56564	56594	56624	56654
NICT	35 1882	0.13	0.07	0.14	0.41	-0.34	0.39	-0.08	0.04	-0.23	-1.22	-0.68	-0.60
NICT	35 1887	-2.46	-1.93	-7.51	-9.44	-21.94	-28.22	-31.31	-34.63	-34.12	-38.26	-40.40	-41.65
NICT	35 1944	2.02	-	-	5.83	6.00	6.22	6.16	6.15	6.45	6.26	5.88	6.49
NICT	35 2010	6.17	-	-	-	-	-	-	-0.61	-0.34	-1.29	-1.60	-1.06
NICT	35 2011	-0.73	-0.35	0.71	-0.36	0.22	0.31	0.16	0.15	0.58	1.39	1.49	2.12
NICT	35 2056	-23.42	-23.54	-23.59	-23.87	-24.03	-23.56	-23.42	-22.42	-22.61	-21.30	-21.70	-22.04
NICT	35 2113	-	-	-	1.29	0.96	1.86	1.65	1.59	1.95	2.42	2.07	2.70
NICT	35 2116	14.12	13.60	-	-	-	-	-	-	-	-	-	-
NICT	35 2570	9.33	9.19	9.62	8.74	9.35	9.61	9.16	9.88	12.04	11.57	11.49	10.56
NICT	35 2574	-1.77	-1.91	-2.23	-2.07	-1.82	-1.52	-1.09	-0.76	-0.71	0.11	-0.05	-0.05
NICT	35 2627	1.03	0.95	0.69	0.93	1.26	1.58	2.24	2.67	2.58	2.44	1.91	2.32
NICT	35 2628	5.47	6.18	6.58	6.18	6.30	6.29	6.24	6.52	5.92	4.36	3.20	2.87
NICT	35 2784	3.97	4.16	3.34	3.69	3.96	4.64	3.77	5.10	4.99	5.23	5.76	5.93
NICT	35 2903	-	-	-	-	-	-	-	-	-9.10	-9.06	-9.00	-9.06
NICT	36 1217	8.03	7.28	6.84	7.39	5.57	4.20	7.37	4.75	6.10	7.66	7.23	8.47
NICT	40 2003	-21.41	-25.42	-27.47	-28.70	-29.79	-31.02	-32.15	-32.86	-33.34	-33.76	-33.99	-33.88
NICT	40 2004	6.06	7.44	8.83	10.59	12.35	14.08	15.89	17.70	19.34	21.04	22.73	24.71
NICT	40 2005	78.13	79.98	81.71	83.51	85.27	86.82	88.36	89.91	90.49	92.39	94.46	96.61
NICT	40 2006	12.60	14.23	15.93	17.33	19.07	21.12	23.46	25.76	27.20	28.38	29.89	31.49
NIM	35 1235	11.42	12.93	13.01	11.96	11.86	15.68	14.24	13.03	14.00	14.73	16.05	14.91
NIM	35 2239	3.15	2.03	2.02	2.04	2.64	2.92	2.43	2.05	2.09	1.89	2.34	2.53
NIM	35 2256	12.08	12.60	12.31	12.09	12.86	12.74	12.37	13.01	12.43	12.85	12.03	13.27
NIM	35 2483	1.41	2.00	1.60	1.97	2.55	2.59	2.49	2.41	2.59	2.88	2.79	3.28
NIM	35 2643	-7.81	-7.94	-7.70	-7.51	-6.87	-6.55	-6.98	-6.79	-6.44	-5.73	-5.90	-5.72
NIM	35 2744	-12.17	-10.14	-10.47	-9.43	-8.54	-8.29	-7.14	-6.31	-5.79	-4.97	-4.56	-4.12
NIM	35 2767	-30.23	-30.69	-30.67	-30.55	-30.07	-28.76	-28.91	-29.16	-28.21	-28.74	-28.40	-29.50
NIM	40 4832	101.42	104.40	107.92	111.97	115.31	119.00	122.93	-	-	130.83	133.20	136.11
NIM	40 4835	197.68	200.59	202.11	205.29	207.13	211.14	212.58	214.05	217.31	-	-	214.85
NIM	40 4871	133.51	137.74	141.81	146.37	150.51	154.88	159.64	-	-	172.61	176.63	181.06
NIM	40 4878	22.67	27.43	32.11	37.11	41.69	46.06	50.72	-	-	63.12	67.01	71.16
NIM	40 4879	41.01	50.07	60.03	70.10	78.01	86.11	96.06	-	-	113.42	119.56	124.92
NIM	40 4880	32.91	40.13	47.39	55.18	62.81	70.64	79.17	-	-	102.59	110.17	117.71
NIMB	35 600	2.97	3.03	-0.59	-0.35	-2.34	-0.97	-1.03	-2.01	2.41	-0.89	-	0.80
NIMT	35 2246	7.72	5.56	5.97	6.43	5.96	6.28	-	-	6.39	5.97	-	5.18
NIMT	35 2247	-0.69	0.33	0.30	-1.79	0.30	0.70	-	-0.28	0.01	0.33	-	-0.17

Table 8. (Cont.)

Lab.	Clock	56319	56349	56379	56409	56439	56469	56504	56534	56564	56594	56624	56654
NIS	35 1126	-	13.45	-	14.11	-	-	-	-	-	-8.86	-	-
NIST	35 282	9.11	8.61	8.81	8.74	9.24	9.55	9.70	9.25	9.35	10.27	10.34	-
NIST	35 408	-21.01	-21.65	-21.66	-21.10	-21.29	-20.98	-21.12	-20.16	-20.55	-20.95	-21.03	-20.21
NIST	35 1074	-19.22	-19.08	-20.47	-20.23	-20.11	-20.63	-22.15	-21.67	-20.51	-20.91	-21.97	-23.47
NIST	35 1519	-	-	-12.22	-11.74	-11.30	-10.72	-10.54	-9.18	-9.09	-8.10	-6.91	-6.56
NIST	35 2031	-8.45	-9.19	-9.57	-8.57	-8.54	-8.09	-8.89	-8.03	-9.72	-10.58	-9.61	-10.14
NIST	35 2032	-	-	-	-	-	-	-	-	-	-3.26	-3.00	-2.31
NIST	35 2034	-8.90	-9.45	-9.66	-9.37	-9.57	-10.29	-10.31	-10.32	-10.45	-10.00	-9.70	-10.74
NIST	35 2579	-1.13	-1.28	-1.05	-0.98	-0.69	-0.41	-0.92	-0.61	-1.02	-0.96	-2.24	-2.52
NIST	35 2672	-0.31	0.13	0.88	0.74	1.48	1.18	1.26	0.83	1.55	1.55	1.98	1.47
NIST	40 203	179.31	180.23	181.36	182.54	-	-	-	-	-	-	-	-
NIST	40 204	36.50	36.86	37.03	37.32	37.57	37.81	38.06	38.35	38.55	38.85	39.03	39.38
NIST	40 205	-25.17	-25.14	-25.18	-25.05	-25.06	-25.26	-25.20	-25.19	-25.11	-25.13	-25.19	-25.02
NIST	40 206	-47.34	-46.81	-46.35	-46.12	-45.71	-45.29	-44.69	-43.99	-43.44	-42.97	-42.38	-41.54
NIST	40 222	32.38	32.46	32.48	32.62	32.69	32.82	32.87	32.96	33.01	33.07	33.14	33.41
NMIJ	35 224	-10.98	-12.04	-10.58	-11.76	-12.49	-12.84	-12.44	-12.78	-13.17	-13.62	-13.70	-14.10
NMIJ	35 523	14.48	14.81	14.99	15.61	15.10	15.27	14.88	14.95	14.91	15.29	15.90	16.33
NMIJ	35 1273	20.31	20.99	20.49	20.63	-	-	-	-	-	-	-	-
NMIJ	40 5002	4.13	-	3.76	3.35	-	-	-	-	-	-	-	-
NMIJ	40 5003	0.75	0.62	0.67	0.82	0.82	0.66	0.53	0.49	0.57	0.52	0.50	0.49
NMIJ	40 5015	59.96	63.75	67.35	71.21	74.80	78.20	81.91	85.50	88.79	92.02	95.35	98.53
NMLS	35 328	2.51	3.96	2.87	3.62	4.56	6.60	6.89	5.60	7.00	5.20	-17.05	-16.20
NPL	35 1275	4.17	4.45	4.18	4.01	4.68	6.02	6.91	7.32	4.79	3.86	4.29	4.25
NPL	36 784	5.38	5.55	-	-	-	-	-	-	-	-	-	-
NPL	40 1701	17.85	17.82	17.78	18.10	18.84	18.88	18.85	18.88	19.28	19.57	19.70	20.25
NPL	40 1708	-0.75*	-1.03*	-0.89*	-0.64*	-0.48*	-0.28*	-1.44*	-1.09*	-0.53	-0.20	-0.27	0.05
NPLI	35 57	91.26	90.98	91.15	91.83	93.27	93.68	94.69	94.33	92.28	92.75	92.44	92.26
NPLI	35 140	15.38	15.27	13.86	14.54	14.69	18.27	18.08	18.19	18.11	16.58	13.26	13.50
NPLI	35 1324	-1.84	-1.18	-3.18	-2.41	-3.01	-4.06	-1.98	-1.99	-3.40	-2.73	-2.90	-3.06
NPLI	35 2245	-2.41	-2.53	-1.88	-1.27	-0.82	-0.34	-0.92	0.04	-0.15	-0.26	-0.54	-0.71
NPLI	35 2796	-26.46	-26.90	-26.17	-26.89	-26.23	-25.87	-25.40	-25.99	-25.59	-25.67	-25.20	-25.00
NPLI	40 5201	-2.00	-7.20	0.25	7.30	-0.48	8.26	-6.44	-3.16	7.35	5.71	-6.67	1.95
NRC	35 2148	9.89	10.53	9.89	-	-	-	-	-	-	-	-	-
NRC	35 2150	-3.28	-2.69	-2.93	-2.48	-3.83	-2.62	-2.45	-3.06	-2.15	-2.08	-3.33	-2.99
NRC	35 2152	-3.03*	-4.27*	-2.59*	-3.94	-3.67	-3.66	-4.26	-4.45	-3.88	-4.19	-4.78	-3.89

Table 8. (Cont.)

Lab.	Clock	56319	56349	56379	56409	56439	56469	56504	56534	56564	56594	56624	56654
NRC	36 2219	-	-	-	-	1.89	2.76	2.81	3.14	2.04	3.93	3.87	3.02
NRC	40 304	-	-	-	-	-	-	-	-	-	-	6.69	7.40
NRC	40 306	-	-	-	-	-	-	-	-	-	-	63.89	70.71
NRL	35 714	-	24.40	24.10	24.68	24.83	25.45	-	27.44	27.60	26.89	-	-
NRL	35 719	-	28.49	28.25	28.52	29.25	29.03	-	29.40	28.89	27.31	-	-
NRL	35 1245	-	21.29	25.62	24.55	20.00	20.95	-	19.89	15.65	5.30	-	-
NRL	36 387	-	23.68	23.05	23.57	22.18	23.12	-	22.56	22.47	20.55	-	-
NRL	40 1001	-	167.41	165.72	164.81	163.69	163.15	-	159.55	158.13	157.33	-	-
NTSC	35 1007	5.36	5.10	4.54	6.97	4.24	-	-	-	-	-	-	-
NTSC	35 1008	4.06	3.53	3.51	3.21	3.76	3.52	6.26	6.85	7.16	4.62	3.39	1.92
NTSC	35 1011	5.38	5.64	7.11	6.06	8.45	7.88	8.59	9.37	8.03	10.11	11.21	11.74
NTSC	35 1016	12.81	13.24	13.39	11.77	14.36	12.59	13.12	13.90	14.42	14.07	13.06	12.03
NTSC	35 1018	-8.91	-10.12	-10.26	-8.46	-9.58	-10.29	-8.66	-10.27	-9.85	-9.31	-10.03	-8.64
NTSC	35 1818	-17.47	-17.07	-17.92	-18.96	-16.50	-19.81	-18.33	-20.24	-19.92	-19.79	-21.39	-19.83
NTSC	35 1820	12.01	13.63	13.33	14.08	12.84	15.79	15.03	15.60	15.23	15.83	16.64	16.80
NTSC	35 1823	15.43	15.16	16.59	15.33	15.96	16.28	16.55	16.48	16.23	16.51	16.96	16.75
NTSC	35 2096	-5.58	-4.79	-5.35	-4.58	-4.97	-4.45	-4.85	-5.04	-4.96	-5.60	-6.09	-5.02
NTSC	35 2098	7.41	8.42	7.36	8.05	6.58	6.45	7.59	6.67	6.83	6.41	7.74	6.40
NTSC	35 2131	11.50	12.27	11.65	11.77	11.78	11.13	11.63	12.09	11.07	10.80	10.57	11.49
NTSC	35 2141	18.79	9.64	10.54	8.56	16.66	20.46	11.46	11.19	8.35	15.11	15.23	1.00
NTSC	35 2142	-13.28	-13.10	-13.16	-13.74	-12.88	-13.60	-13.39	-13.09	-13.40	-12.86	-13.13	-13.37
NTSC	35 2143	7.63	8.67	7.97	6.93	8.68	7.13	8.82	8.64	8.33	7.91	7.67	9.53
NTSC	35 2144	-3.85	-2.28	-4.22	-4.80	-2.29	-3.54	-1.15	-2.77	-3.67	-4.90	-3.68	-4.65
NTSC	35 2145	-1.30	-1.42	-1.47	-1.50	-1.96	-1.82	-1.75	-1.40	-1.46	-1.62	-1.84	-2.29
NTSC	35 2147	8.48	8.05	7.38	6.72	7.11	7.45	7.26	6.86	7.15	6.83	7.37	7.45
NTSC	35 2573	5.54	5.58	5.61	5.74	5.58	5.37	5.86	5.50	5.20	5.30	6.15	6.49
NTSC	35 2831	4.67	5.25	4.96	5.74	6.46	6.85	7.85	7.14	8.20	7.59	9.85	8.75
NTSC	35 2852	-	17.04	17.20	16.66	17.76	17.57	18.12	17.97	17.94	18.14	18.21	18.28
NTSC	35 2855	14.82	15.26	15.09	14.93	15.08	15.62	15.73	15.30	15.19	16.29	15.81	16.97
NTSC	35 2921	-	-	-	-	-	-	-	1.67	1.31	1.60	1.60	1.37
NTSC	35 2922	-	-	-	-	-	-	0.58	0.67	0.75	0.55	0.26	0.34
NTSC	35 2924	-	-	-	-	-	-	-	0.04	1.13	1.26	0.80	0.99
NTSC	35 2926	-	-	-	-	-	-	-3.64	-3.04	-3.16	-3.68	-2.84	-2.21
NTSC	35 2928	-	-	-	-	-	-	-	0.08	0.93	1.02	0.61	0.99
NTSC	35 2933	-	-	-	-	-	-	-3.53	-3.85	-4.17	-4.05	-3.68	-4.31

Table 8. (Cont.)

Lab.	Clock	56319	56349	56379	56409	56439	56469	56504	56534	56564	56594	56624	56654
NTSC	40 4926	557.66	565.74	573.36	579.89	586.32	592.25	598.42	604.12	610.73	617.34	623.41	629.78
NTSC	40 4927	528.26	532.58	537.56	541.14	544.46	547.50	551.24	553.92	556.37	559.25	562.28	-
NTSC	40 4943	-	-	-	-	-	-	-	-	-	-	-	0.25
NTSC	40 4945	-	-	-	-	-	-	-	-	-	-	-	609.18
NTSC	40 4946	-	-	-	-	-	-	-	-	-	-	-	554.23
ONBA	36 2228	-1.32	-2.54	-3.98	-2.13	-2.05	-2.48	-2.71	-2.10	-2.46	-2.83	-2.49	-
ONRJ	35 102	-3.18	-3.58	-4.00	-3.84	-5.02	-4.65	-3.76	-3.99	-4.06	-4.15	-3.51	-2.30
ONRJ	35 103	2.88	2.91	2.60	2.73	2.66	2.53	3.63	2.06	1.97	1.86	2.66	1.52
ONRJ	35 123	32.41	32.67	32.58	33.39	31.55	33.12	32.77	31.83	33.60	33.12	34.38	34.18
ONRJ	35 129	7.87	7.35	7.51	7.20	7.45	-	9.97	9.84	10.03	9.53	8.73	9.30
ONRJ	35 147	4.60	4.76	4.86	4.43	5.26	4.51	5.29	5.06	5.38	5.98	5.61	4.86
ONRJ	35 1153	2.14	2.58	2.22	2.56	2.47	2.63	2.73	3.25	2.94	2.68	3.10	2.81
ONRJ	35 1942	10.88	10.19	9.43	10.35	9.59	8.52	8.21	7.96	7.86	7.42	7.25	7.15
ONRJ	40 1950	28.26	17.00	10.43	0.46	-10.84	-22.93	-36.92	-53.82	-71.86	-79.52	-77.43	-71.20
ONRJ	40 1958	34.27	33.85	33.22	32.95	32.66	32.70	33.72	35.35	36.77	34.91	33.96	35.52
ORB	35 2722	0.08	0.45	0.75	0.76	1.36	0.83	0.82	0.91	1.25	0.74	1.21	1.80
ORB	35 2723	7.39	6.73	6.55	6.33	7.13	6.16	6.04	5.44	5.98	6.34	5.63	6.43
ORB	35 2724	-	-	-	-	-	-	-	-	-	-	1.12	1.40
ORB	36 593	82.67	78.84	79.55	79.81	81.49	78.81	80.38	79.73	78.24	78.72	78.38	79.51
ORB	40 2602	8.71	9.46	10.19	10.99	11.81	12.29	-	-	-	-	-	-
PL	25 124	-	-	-	1.74	-8.26	-12.85	-11.08	-11.70	-12.35	-13.46	-12.38	-7.75
PL	25 125	2.24	4.47	3.92	-	-	0.44	0.17	-2.17	-4.80	-6.78	-6.83	-9.06
PL	35 441	1.16	1.80	1.73	2.12	2.25	2.17	2.52	1.88	2.43	2.41	2.01	1.55
PL	35 502	6.39	5.68	6.16	6.40	6.21	6.23	6.37	5.71	5.64	6.01	6.60	6.33
PL	35 745	-6.35	-5.64	-5.75	-5.74	-6.23	-6.17	-5.71	-6.22	-5.69	-4.80	-4.83	-6.50
PL	35 761	2.47	4.46	1.83	1.89	1.62	1.52	3.60	-0.20	2.95	1.23	0.96	1.60
PL	35 1120	-3.24	-1.31	-1.72	-1.03	-1.52	-1.82	-1.05	-0.90	-1.11	-1.47	-0.73	-1.20
PL	35 1746	-10.20	-9.25	-9.54	-8.91	-9.83	-10.21	-9.35	-10.60	-9.99	-8.32	-8.25	-12.14
PL	35 1934	5.24	4.96	-	-	-	-	-	-	-	-	-	2.36
PL	35 2175	-7.56	-7.03	-6.97	-7.70	-7.27	-7.08	-6.48	-6.52	-7.31	-6.86	-7.58	-7.86
PL	35 2394	4.67	4.87	5.46	4.79	5.29	5.60	5.43	5.07	5.55	4.67	5.44	5.67
PL	35 2891	-	-	-	-30.60*	-31.21*	-31.90*	4.08*	3.98	3.32	-	-	-
PL	40 4002	4.71*	3.77*	4.76*	8.26*	6.36*	13.18*	11.94	-	-	-	-	-
PL	40 4004	-	560.35*	463.73*	395.81*	334.83*	257.46*	201.76*	140.56*	94.78*	53.47*	24.96	7.66
PL	40 4601	8.24	9.16	9.87	10.66	11.36	12.10	13.04	13.77	14.52	15.26	15.90	16.70

Table 8. (Cont.)

Lab.	Clock		56319	56349	56379	56409	56439	56469	56504	56534	56564	56594	56624	56654
PL	40	4602	502.04	508.25	517.85	528.35	537.65	547.20	557.11	565.52	574.90	584.19	591.44	599.48
PTB	35	128	5.67	5.08	5.47	6.18	6.75	6.17	6.84	6.27	6.06	6.29	6.46	5.61
PTB	35	415	2.67	2.07	2.75	3.19	2.21	2.25	0.99	-0.08	0.35	0.09	-3.02	-3.63
PTB	35	1072	10.64	9.99	10.14	11.52	10.25	10.74	11.66	10.96	10.95	11.04	10.91	10.15
PTB	40	506	-3.12	-0.96	2.33	5.76	7.59	6.89	7.35	8.79	10.27	11.69	13.01	14.61
PTB	40	508	3.22	6.35	9.92	14.38	21.72	23.58	27.03	5.81	-10.25	-6.48	-2.77	0.64
PTB	40	509	-	-	-	-	-	-	-	-0.86	-1.35	-1.10	-0.82	-0.34
PTB	40	590	-9.09	-8.37	-7.96	-7.71	-7.18	-6.68	-5.82	-5.23	-4.90	-4.62	-4.20	-3.66
PTB	92	1	2.43	2.21	2.73	2.16	2.87	2.93	2.95	2.37	2.30	2.55	2.30	2.14
PTB	92	2	2.66	2.10	2.37	1.52	1.06	1.46	0.98	1.37	1.77	1.88	2.13	2.16
ROA	35	583	5.07	5.96	6.24	5.32	5.62	5.86	6.21	6.62	7.20	7.00	7.28	6.43
ROA	35	718	7.61	7.37	7.62	7.68	6.91	7.38	7.63	7.81	7.50	8.56	7.65	6.61
ROA	35	1699	9.35	9.72	9.01	9.13	10.27	9.46	9.71	9.34	8.73	9.17	8.62	9.38
ROA	35	2270	-5.96	-6.56	-5.32	-5.25	-6.42	-5.92	-6.68	-6.46	-6.78	-6.35	-6.89	-6.96
ROA	36	1488	10.69	9.90	9.48	9.98	10.70	9.04	10.99	11.46	10.76	10.58	11.28	11.51
ROA	36	1490	12.32	10.40	9.38	11.74	10.32	11.14	10.47	11.08	11.17	11.00	11.47	10.71
ROA	40	1436	169.81	173.22	177.04	179.58	182.76	185.51	188.79	192.31	195.58	198.95	201.41	204.10
SASO	35	221	-	-	-	-	-	-	-	-	-	-	-	-2.21
SASO	35	1628	-	-	-	-	-	-	-	-	-	-	-	0.08
SASO	35	2923	-	-	-	-	-	-	-	-	-	-	-	0.37
SASO	35	2932	-	-	-	-	-	-	-	-	-	-	-	1.07
SCL	35	2178	4.39	4.36	4.18	4.70	4.97	5.15	5.11	3.57	3.80	3.33	3.22	3.99
SCL	35	2525	0.30	0.26	-0.65	-0.64	-0.68	-0.20	1.01	1.25	0.57	1.41	1.71	1.16
SG	35	475	-2.23	-2.85	-1.76	-1.73	-2.56	-2.43	-2.17	-1.05	-1.93	-1.91	-2.17	-1.43
SG	35	476	10.80	10.52	8.81	8.13	6.49	5.49	4.39	6.49	5.91	5.03	-	-
SG	35	1889	19.22	18.58	19.48	18.77	19.53	19.30	18.18	18.03	19.10	19.76	20.63	18.79
SG	36	522	2.58	2.60	2.53	3.81	1.91	2.44	3.98	2.23	2.69	2.61	3.25	3.05
SG	40	7701	-	-	-	-	12.35	12.36	12.82	15.39	17.72	21.18	24.83	29.83
SIQ	36	1268	-0.30	-2.05	-2.83	0.11	-2.70	-3.46	-4.91	-5.18	-2.87	-3.65	-2.71	-0.73
SMD	35	1766	-	-	-	-	-	-	9.52	9.90	10.07	9.99	9.91	10.01
SMD	35	2003	-	-	-	-	-	-	7.68	8.88	7.14	7.67	6.42	6.98
SMD	35	2543	-	-	-	-	-	-	9.44	8.41	9.26	9.54	9.12	9.09
SMD	40	7909	-	-	-	-	-	-	-9.07	-25.83	-33.24	-34.72	-38.40	-44.77
SMU	36	1193	1.11	2.19	2.35	0.53	-0.11	-	-	-0.81	-0.32	-	-	2.49
SP	35	572	18.98	19.38	18.73	19.11	18.76	19.64	18.94	18.15	18.43	18.49	19.00	18.59

Table 8. (Cont.)

Lab.	Clock	56319	56349	56379	56409	56439	56469	56504	56534	56564	56594	56624	56654
SP	35 641	3.55	2.66	3.49	1.98	2.11	2.26	1.71	1.96	1.58	1.55	1.04	1.33
SP	35 767	-	-	-	-	-	-	-	-	-	-	14.23	13.98
SP	35 1188	13.89	11.57	10.05	9.71	9.61	10.30	10.39	9.55	8.23	8.83	-	-
SP	35 1642	-1.08	-0.34	-0.81	-1.31	-1.18	-0.86	-1.05	-0.70	-1.10	-1.98	-0.95	-1.21
SP	35 2166	7.67	7.49	6.89	6.65	6.99	6.76	6.51	6.27	6.57	6.25	7.24	6.42
SP	35 2745	-	-	-	-	-	-	-	-	-	-	-2.33	-1.38
SP	35 2746	-	-	-	-	-	-	-	-	-	-	25.91	26.33
SP	35 2749	-	-	-	-	-	-	-	-	-	-	6.42	6.08
SP	35 2758	-	-	-	-	-	-	-	-	-	-	18.50	18.45
SP	36 223	9.95	9.81	10.83	10.29	12.83	11.59	10.93	13.40	9.00	9.41	9.06	9.40
SP	36 1175	1.82	2.35	2.48	2.59	3.07	2.86	3.59	3.97	2.51	4.39	2.17	3.61
SP	36 1187	-56.66	-57.95	-57.74	-56.39	-57.08	-57.26	-57.07	-55.29	-54.74	-53.85	-52.86	-52.74
SP	36 1531	73.93	74.37	75.90	74.03	74.11	74.89	74.67	75.18	75.81	75.49	76.81	75.16
SP	36 2068	3.89	3.38	4.11	4.36	2.53	4.31	5.98	4.06	3.63	4.76	4.17	5.00
SP	36 2218	23.45	24.48	24.22	23.31	24.03	24.15	24.18	23.89	24.59	24.94	24.49	24.65
SP	36 2295	10.66	9.70	10.94	9.58	9.37	11.39	9.74	11.24	10.30	11.16	12.39	11.71
SP	36 2297	-6.94	-6.41	-6.70	-6.83	-7.28	-6.65	-6.39	-5.95	-5.56	-5.26	-6.52	-5.84
SP	40 7201	176.45	179.04	181.67	184.65	187.42	190.30	193.22	195.82	198.74	199.62	203.01	205.73
SP	40 7203	31.49	32.40	33.22	34.08	34.94	35.70	36.62	37.49	38.23	38.88	39.65	40.55
SP	40 7210	186.21	188.20	190.70	193.37	196.11	198.90	201.72	205.22	207.90	209.32	211.49	214.56
SP	40 7211	57.50	58.95	60.39	61.91	63.35	64.80	66.47	67.99	69.28	70.66	72.06	74.05
SP	40 7212	23.33	23.80	24.31	24.83	25.27	25.69	26.22	26.70	27.05	27.47	27.80	28.31
SP	40 7218	-44.20	-44.25	-44.20	-	-	-	-	-	-	-	-	-
SP	40 7221	-40.44	-40.31	-40.14	-39.90	-39.72	-	-39.36	-39.16	-39.05	-38.92	-38.77	-38.49
SP	40 7223	-	-	-	-	-	-	-	-	-	-	-22.44	-
SU	40 3809	-	-8.74	-8.55	-8.39	-8.19	-8.06	-7.84	-7.54	-7.37	-6.70	-6.98	-6.61
SU	40 3810	0.22	0.37	0.62	0.78	0.98	1.09	1.29	1.55	1.74	2.38	2.09	2.42
SU	40 3812	4.83	5.05	5.34	5.60	5.86	6.08	6.40	6.75	6.92	7.59	7.32	7.71
SU	40 3814	27.39	28.20	29.09	29.93	30.75	31.55	32.49	33.45	34.19	35.42	35.76	36.72
SU	40 3815	-43.08	-42.51	-41.88	-41.33	-40.74	-40.21	-39.57	-38.91	-38.40	-37.47	-37.45	-36.76
SU	40 3816	41.87	42.44	43.12	43.69	44.32	45.00	45.70	46.43	46.99	48.03	48.28	49.12
SU	40 3817	-	-	-	-	-	-	48.80*	50.55*	51.60	53.08	54.16	54.36
SU	40 3818	-	-	-	-	-	-	-	-	-	-	-1.68	-0.66
TCC	35 768	7.31	6.65	6.42	6.24	10.20	9.34	-	-	9.49	8.01	9.11	9.52
TCC	35 1881	3.44	3.46	3.36	3.49	3.32	3.78	-	-	3.75	3.49	2.83	3.29

Table 8. (Cont.)

Lab.	Clock	56319	56349	56379	56409	56439	56469	56504	56534	56564	56594	56624	56654
TCC	40 8620	11.24	11.74	12.01	12.54	13.48	14.05	-	-	15.01	27.35	30.20	15.46
TCC	40 8624	-9.52	-9.82	-9.74	-9.27	-9.82	-11.77	-	-	-14.32	-14.51	-14.89	-15.38
TCC	40 8650	-17.10	-17.68	-18.26	-18.23	-17.69	-17.59	-	-	-19.40	-23.65	-23.61	-
TL	35 1012	3.13	3.29	3.41	3.67	2.82	3.94	2.13	3.50	2.66	2.59	2.12	2.77
TL	35 1132	-0.38	-0.75	-1.32	-0.69	-1.57	0.10	-1.97	-	-	-	-	-
TL	35 1498	0.57	1.95	1.98	2.09	2.36	2.20	2.10	2.89	2.56	2.60	2.30	3.08
TL	35 1500	16.15	15.42	14.53	15.51	15.73	14.54	14.74	14.39	14.30	13.53	15.08	15.00
TL	35 1712	-	-	-	-17.39	-17.10	-17.75	-17.18	-16.97	-17.53	-16.86	-16.94	-16.87
TL	35 2365	5.10	5.17	4.62	4.81	4.47	4.89	4.19	4.11	4.21	3.74	4.00	3.13
TL	35 2366	-5.57	-5.78	-5.41	-6.02	-5.89	-6.11	-6.15	-5.88	-6.96	-5.99	-6.02	-8.43
TL	35 2367	9.95	10.07	9.92	10.00	10.83	9.62	11.20	10.71	10.45	10.25	10.57	10.27
TL	35 2368	-1.45	-1.79	-1.97	-2.00	-0.35	0.40	1.72	1.90	2.06	2.95	2.92	2.89
TL	35 2630	-14.08	-14.13	-13.58	-13.94	-13.59	-13.64	-13.54	-14.04	-14.68	-14.27	-14.85	-13.72
TL	35 2634	10.39	11.08	13.32	13.39	10.50	10.61	12.38	11.33	10.44	12.21	13.64	10.58
TL	35 2636	12.53	12.58	12.60	12.68	13.12	12.17	13.28	13.28	12.93	10.22	11.34	13.05
TL	35 2853	-3.00	-3.43	-3.21	-3.54	-2.66	-2.67	-2.83	-3.13	-2.89	-2.41	-2.64	-2.21
TL	35 2910	-	-	-	1.13	1.93	1.92	1.36	1.59	1.51	1.71	1.58	1.52
TL	40 57	-28.80	-31.21	-32.69	-35.24	-37.27	-39.81	-42.16	-43.87	-46.76	-48.61	-52.39	-53.80
TL	40 3052	64.93	64.50	64.73	-	-	-	-	-	0.24	-	-	-5.20
TP	35 163	2.95	3.42	2.52	3.86	4.81	6.69	6.04	6.58	6.26	7.56	9.38	9.13
TP	35 1227	13.77	13.58	13.41	13.67	13.59	12.47	12.83	13.40	13.24	13.62	13.26	13.79
TP	35 2476	5.43	6.03	5.76	7.32	8.12	7.59	8.14	8.03	7.82	7.49	7.16	7.79
TP	36 154	10.80	8.89	10.38	11.96	8.54	10.73	8.92	8.95	10.03	10.78	-	-
UA	35 2465	-2.39	-1.55	-5.05	-5.76	-0.38	-4.36	-3.60	-2.71	-	-	-4.39	-5.73
UA	40 7854	-0.36	-0.62	-1.01	0.31	2.89	-0.36	-0.50	-0.19	-	-	-0.25	-0.09
UA	40 7881	0.48	0.03	0.11	0.55	0.58	1.18	2.05	2.48	-	-	2.81	2.86
UA	40 7882	1.06	0.09	0.60	0.96	1.11	1.00	0.73	1.55	-	-	2.42	2.68
UME	35 251	1.96	-	2.08	2.27	2.49	2.41	1.73	1.28	1.25	1.43	0.45	0.37
UME	35 252	0.78	-	1.23	0.72	0.70	1.43	0.95	1.35	1.57	2.07	1.97	1.93
UME	35 710	2.89	-	1.98	2.02	2.21	2.05	1.33	0.66	1.06	0.04	-0.13	0.08
UME	35 2703	2.85	-	2.88	2.75	3.31	3.70	3.34	2.92	3.28	2.91	4.08	3.75
USNO	35 101	6.07	1.31	1.05	0.98	1.21	3.14	4.28	4.93	4.81	4.40	4.89	5.65
USNO	35 104	18.70	19.56	20.36	20.66	19.52	20.03	19.67	19.60	19.18	19.81	20.51	19.61
USNO	35 106	-1.12	-0.16	0.28	0.61	1.61	1.49	1.79	1.05	1.07	1.24	1.50	1.40
USNO	35 108	2.68	1.45	1.84	2.46	2.95	1.93	2.08	2.26	2.25	1.92	2.18	1.95

Table 8. (Cont.)

Lab.	Clock		56319	56349	56379	56409	56439	56469	56504	56534	56564	56594	56624	56654
USNO	35	114	-	-	-	-	2.03	0.29	1.76	1.42	0.99	0.55	1.37	1.11
USNO	35	120	24.77	24.78	24.29	24.31	24.34	23.72	22.50	23.18	22.74	21.79	22.57	23.34
USNO	35	142	-10.91	-9.96	-11.09	-11.20	-11.24	-10.11	-9.75	-11.00	-11.08	-11.84	-12.40	-11.99
USNO	35	145	22.55	21.91	19.85	19.89	20.48	20.66	20.77	21.10	22.20	22.50	22.09	22.45
USNO	35	146	-	-	-	-	11.18	11.96	12.04	12.10	12.78	13.41	13.69	13.99
USNO	35	148	12.73	12.93	13.37	13.26	12.82	12.59	-	-	-	-	-	-
USNO	35	150	-2.96	-3.36	-3.48	-3.12	-3.57	-2.69	-1.64	-2.64	-1.81	-0.87	-1.44	-2.76
USNO	35	152	3.53	3.28	3.05	2.05	2.27	0.89	1.35	3.24	2.38	3.55	2.53	3.95
USNO	35	153	3.04	3.60	3.21	4.32	3.87	3.85	4.84	5.53	4.80	5.67	6.00	5.64
USNO	35	156	10.54	10.37	10.46	10.21	10.99	10.85	11.18	11.55	11.12	11.33	11.35	10.14
USNO	35	161	9.08	9.13	9.29	9.49	8.65	6.97	-	-	-	-	-	21.73
USNO	35	164	-	-	-	-	-	-	-	-	-	-	-	2.00
USNO	35	165	10.11	10.06	11.05	8.42	8.10	8.37	7.95	7.57	7.69	8.27	7.94	7.91
USNO	35	166	54.21	54.65	53.25	47.29	47.31	46.05	46.90	52.10	51.97	53.34	52.14	51.47
USNO	35	167	-	-	-	-	-	-	20.96	22.00	21.37	22.21	-	-
USNO	35	169	-16.84	-16.58	-16.00	-15.01	-14.89	-15.30	-14.81	-15.88	-14.83	-14.77	-14.80	-14.51
USNO	35	173	-6.17	-5.59	-5.04	-5.34	-5.97	-5.69	-5.57	-5.73	-6.44	-7.43	-6.73	-6.25
USNO	35	213	10.56	11.68	11.95	11.22	11.43	11.79	11.36	10.89	10.39	12.14	11.10	12.39
USNO	35	226	8.94	9.00	9.20	9.65	10.07	10.29	8.15	7.49	7.62	7.79	8.20	9.07
USNO	35	227	29.84	30.30	30.10	30.37	29.99	29.93	30.13	30.67	30.09	28.13	27.94	28.10
USNO	35	231	-1.64	-1.75	-1.97	-2.32	-2.00	-1.72	-3.49	-3.16	-2.09	-2.75	-3.37	-3.35
USNO	35	233	13.25	12.47	12.64	12.71	12.31	16.47	17.37	17.77	16.73	16.17	16.42	16.00
USNO	35	242	15.05	13.75	14.49	15.31	14.87	13.70	13.69	12.97	-	-	-	-
USNO	35	244	7.76	7.34	7.13	7.25	8.19	7.97	7.89	7.63	7.25	6.96	6.05	7.03
USNO	35	253	-23.02	-23.17	-24.44	-24.73	-24.89	-25.48	-24.79	-25.36	-26.31	-25.62	-26.20	-26.97
USNO	35	254	8.56	8.48	8.27	7.69	8.07	7.77	7.58	8.71	8.23	8.61	8.82	8.95
USNO	35	255	26.16	-	-	-	-	-	-	-	-	-	-	-
USNO	35	256	21.17	20.87	21.38	21.02	20.80	21.10	20.52	20.69	20.01	21.17	20.66	20.80
USNO	35	260	13.29	14.04	13.55	14.49	15.75	35.46	36.50	28.52	31.76	28.20	28.03	29.33
USNO	35	266	23.99	24.37	23.94	23.72	23.43	23.81	24.56	24.10	23.79	23.24	23.23	-
USNO	35	268	-4.46	-5.69	-7.37	-7.19	-6.92	-5.65	-4.95	-4.15	-5.35	-5.43	-5.26	-5.01
USNO	35	270	17.72	17.48	17.40	16.91	17.83	15.12	15.00	15.76	15.92	16.46	15.98	16.33
USNO	35	279	26.62	25.94	25.77	26.14	25.65	25.75	25.55	26.37	26.75	26.37	26.64	27.52
USNO	35	389	-22.32	-21.51	-21.67	-21.44	-21.21	-20.61	-21.39	-20.86	-20.16	-19.32	-19.40	-20.00
USNO	35	394	-36.19	-36.16	-35.68	-35.40	-35.05	-35.14	-36.12	-36.98	-36.80	-38.01	-38.06	-39.34

Table 8. (Cont.)

Lab.	Clock	56319	56349	56379	56409	56439	56469	56504	56534	56564	56594	56624	56654
USNO	35 416	-2.68	-3.40	-2.30	-2.70	-3.30	-2.34	-2.43	-2.95	-1.91	-2.57	-3.22	-3.04
USNO	35 417	-6.21	-5.86	-6.30	-6.82	-6.85	-6.29	-6.34	-7.36	-7.27	-6.15	-6.19	-6.50
USNO	35 703	0.32	0.67	0.64	1.32	0.56	1.81	2.20	1.12	0.44	0.87	1.21	1.06
USNO	35 717	-13.38	-13.37	-12.84	-13.07	-11.81	-12.16	-11.07	-11.89	-11.19	-11.24	-11.05	-10.23
USNO	35 762	1.21	1.74	1.48	0.98	1.41	1.89	2.19	2.29	1.70	1.86	1.45	1.51
USNO	35 763	-12.95	-13.18	-14.24	-14.25	-14.42	-13.84	-14.47	-14.33	-14.10	-14.73	-14.18	-13.98
USNO	35 765	-40.58	-40.63	-40.68	-40.53	-40.84	-40.09	-40.29	-39.89	-39.59	-39.73	-39.70	-38.90
USNO	35 1096	16.31	16.25	15.76	16.17	15.41	15.65	15.31	16.12	14.81	15.49	15.36	14.27
USNO	35 1097	7.43	7.35	6.74	7.04	6.55	6.71	6.75	6.68	6.11	5.70	6.04	7.72
USNO	35 1125	0.25	-0.18	-0.88	-0.69	-0.68	-1.74	-4.68	-4.49	-4.75	-6.30	-6.10	-5.45
USNO	35 1327	-5.25	-6.14	-6.40	-7.81	-8.73	-9.37	-8.83	-9.79	-9.86	-8.83	-9.62	-9.54
USNO	35 1328	4.25	4.35	4.00	4.20	4.89	3.96	2.83	3.98	2.57	3.08	3.65	3.69
USNO	35 1331	-40.87	-39.87	-40.02	-39.07	-39.89	-37.88	-39.80	-39.82	-39.60	-39.02	-39.07	-37.81
USNO	35 1438	-4.66	-4.73	-4.11	-4.10	-5.12	-4.49	-5.21	-3.96	-3.78	-3.29	-3.01	-1.85
USNO	35 1459	-3.76	-3.94	-3.27	-3.21	-2.88	-5.55	-5.11	-6.07	-5.71	-6.66	-5.97	-7.14
USNO	35 1462	-1.67	-1.46	-1.09	-1.20	-0.45	-1.77	-0.75	-1.54	-0.95	-1.24	-0.91	-0.90
USNO	35 1463	12.52	13.07	12.25	12.37	12.32	11.26	13.00	12.65	12.78	13.01	12.94	12.16
USNO	35 1468	-	-	-	-	-	-	-	-	-	-	5.22	4.46
USNO	35 1481	-22.01	-22.18	-21.68	-22.52	-23.29	-23.28	-23.97	-23.70	-24.14	-24.14	-24.49	-24.45
USNO	35 1543	5.27	4.15	4.31	4.89	4.41	4.96	5.57	6.31	6.52	6.29	4.97	5.84
USNO	35 1573	14.93	15.21	14.97	13.50	14.25	15.43	15.06	14.31	13.83	14.08	14.15	14.01
USNO	35 1575	-3.58	-3.77	-3.33	-3.58	-2.71	-4.04	-4.27	-4.08	-2.99	-3.59	-3.10	-2.84
USNO	35 1580	-19.02	-19.04	-18.79	-18.52	-17.36	-18.23	-19.65	-18.41	-18.64	-19.49	-18.66	-18.26
USNO	35 1585	26.41	27.43	25.60	26.49	26.82	26.34	27.23	26.66	26.30	26.61	25.86	25.13
USNO	35 1598	-10.42	-10.95	-10.59	-10.39	-9.97	-9.19	-7.89	-7.84	-8.40	-8.47	-8.06	-9.34
USNO	35 1658	21.68	21.90	21.80	22.24	22.34	22.55	22.88	22.46	23.00	22.24	21.80	21.68
USNO	35 1692	-3.01	-2.84	-2.41	-2.82	-2.55	-3.28	-3.38	-3.27	-3.63	-3.70	-3.28	-3.60
USNO	35 1694	21.12	21.83	20.95	21.47	20.74	20.82	21.15	21.12	20.81	21.05	20.92	20.74
USNO	35 1696	8.74	8.04	9.53	10.59	10.73	11.16	11.18	11.03	10.49	10.90	10.64	11.53
USNO	35 1697	24.63	24.01	24.98	25.41	24.55	24.36	24.91	25.02	24.64	25.16	24.96	25.11
USNO	40 701	-	-	-	-	-	29.58	28.55	27.73	27.13	27.31	27.62	28.06
USNO	40 702	-9.27	-9.22	-9.33	-9.18	-9.06	-9.17	-9.13	-9.02	-8.99	-9.00	-9.00	-8.87
USNO	40 704	33.73	33.80	33.90	34.04	33.97	33.64	33.52	-	-	33.79	33.83	34.11
USNO	40 705	-74.01	-73.86	-73.83	-73.81	-73.71	-74.13	-74.02	-73.48	-73.36	-73.22	-73.18	-72.90
USNO	40 708	-	-	-	-	-	-	86.33	86.64	86.89	87.08	87.30	87.66

Table 8. (Cont.)

Lab.	Clock		56319	56349	56379	56409	56439	56469	56504	56534	56564	56594	56624	56654
USNO	40	710	-480.85	-471.67	-462.53	-453.29	-444.17	-435.44	-	-	-543.48	-543.29	-543.06	-542.69
USNO	40	711	380.71	382.37	385.53	388.40	390.95	-	-	-	-	365.91	367.55	369.05
USNO	40	712	50.46	50.68	50.60	50.65	-	-	-	-	-	-	60.15	60.33
USNO	40	713	32.25	33.03	33.41	33.89	34.34	34.88	35.39	35.95	36.31	36.53	37.45	38.20
USNO	40	714	-5.32	-5.05	-4.83	-4.57	-4.31	-4.00	-3.69	-3.51	-3.87	-3.18	-3.31	-2.80
USNO	40	715	107.08	107.55	108.03	108.49	109.00	108.54	109.04	109.55	109.96	110.33	110.64	103.52
USNO	40	716	215.48	215.65	215.77	215.88	215.97	216.30	216.39	216.53	216.63	216.64	216.68	217.00
USNO	40	717	-	-	-	-	-	-	-	-	-	66.38	68.07	69.82
USNO	40	718	194.51	196.01	197.57	199.17	200.88	202.45	204.43	206.36	208.11	209.79	211.50	213.11
USNO	40	719	87.40	88.50	89.65	90.64	91.61	92.66	93.79	94.87	95.79	96.72	97.72	98.76
USNO	40	720	-	-	-	-	-	-	-	-	197.19	199.18	201.51	204.00
USNO	40	721	210.71	216.42	222.63	228.70	233.92	240.51	246.90	252.44	-	-	-	-
USNO	40	722	466.71	469.67	472.78	475.63	-	-	-	-	-	-	499.00	502.24
USNO	40	723	-69.14	-68.98	-68.95	-68.70	-68.41	-68.15	-68.03	-67.84	-67.75	-67.67	-67.51	-67.23
USNO	40	724	-101.62	-100.49	-102.31	-102.93	-102.99	-103.03	-103.03	-103.00	-103.00	-102.98	-101.22	-101.15
USNO	40	725	-40.15	-39.89	-39.79	-39.53	-39.29	-39.36	-39.24	-39.06	-38.95	-38.77	-38.64	-38.29
USNO	40	728	315.57	318.66	321.87	325.03	328.17	332.12	336.15	339.15	342.02	344.93	347.95	351.17
USNO	40	729	-	-	-	-	-	153.12	158.47	163.95	168.88	173.73	178.62	183.58
USNO	40	730	201.56	204.96	208.32	211.64	215.01	218.44	222.10	225.90	229.24	232.49	235.83	239.25
USNO	40	731	-170.26	-170.49	-171.00	-171.33	-171.63	-171.93	-172.26	-172.58	-172.86	-173.19	-173.40	-173.42
USNO	40	732	-52.34	-49.66	-47.02	-44.24	-41.60	-38.88	-35.85	-32.78	-29.95	-27.25	-24.30	-21.49
USNO	40	734	435.13	432.70	428.77	424.17	418.93	413.17	406.01	398.64	391.42	384.03	376.96	370.19
USNO	40	735	90.06	92.64	95.71	99.15	102.93	106.77	111.07	115.60	120.06	124.64	129.54	134.71
USNO	40	736	-	-	-	-	-	-	-	-	-	-	46.29	46.00
USNO	40	737	-	-	-	-	-	-	-	-	-	-	68.20	75.68
USNO	93	2	-5.91	-5.92	-5.97	-5.93	-5.93	-5.95	-5.93	-5.91	-5.95	-6.00	-6.06	-5.89
USNO	93	3	-5.90	-5.90	-5.92	-5.88	-5.88	-5.88	-5.94	-5.90	-5.94	-6.01	-6.03	-5.85
USNO	93	4	-5.81	-5.79	-5.81	-5.77	-5.77	-5.77	-5.79	-5.72	-5.76	-5.85	-5.86	-5.74
USNO	93	5	-5.86	-5.83	-5.87	-5.82	-5.82	-5.83	-5.81	-5.81	-5.83	-5.91	-5.98	-5.84
VMI	35	2230	-	-22.13	-23.72	-22.34	-	-24.27	-21.39	-22.08	-21.62	-21.92	-21.37	-
VMI	36	1233	-	-1.73	-4.67	-4.01	-	-6.94	-3.33	-4.14	-4.68	-4.14	-3.66	-
VMI	36	2314	-	22.49	21.31	21.51	-	19.49	22.47	21.17	22.03	21.24	21.63	-
VSL	35	179	-27.07	-27.19	-26.87	-26.83	-27.33	-27.04	-27.42	-28.00	-27.77	-28.63	-28.57	-27.94
VSL	35	456	-1.86	-2.00	-1.79	-2.30	-2.63	-1.92	-1.98	-1.88	-1.81	-3.21	-4.23	-3.79
VSL	35	548	20.98	21.37	20.90	21.31	20.36	19.86	20.12	-	-	-	-	-

Table 8. (Cont.)

Lab.	Clock	56319	56349	56379	56409	56439	56469	56504	56534	56564	56594	56624	56654
VSL	35 731	-7.81	-7.46	-8.14	-8.45	-7.94	-8.15	-8.36	-7.86	-7.17	-8.38	-7.34	-8.64
ZA	35 2233	-	-14.74	-15.00	-14.32	-15.08	-14.35	-15.10	-14.06	-14.07	-14.32	-14.44	-
ZA	36 1034	-	-14.60	-17.39	-16.71	-18.25	-20.19	-18.24	-13.10	-14.45	-17.93	-13.28	-
ZA	36 1821	-	-7.83	-8.77	-6.91	-7.25	-9.46	-7.33	-7.71	-7.78	-6.86	-7.97	-
ZA	36 2232	-	9.95	9.85	8.50	10.05	8.08	8.21	10.10	8.83	8.96	10.01	-

Table 9A. Relative weights (in percent) of contributing clocks in 2013

(File is available at ftp://62.161.69.5/pub/tai/scale/WTAI/wtai13.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
13 EBAUCHES, OSCILLATOM B5000
14 HEWLETT-PACKARD 5061A OPT. 4
16 OSCILLOQUARTZ 3200
17 OSCILLOQUARTZ 3000
15 DATUM/SYMMETRICOM Cs III
18 DATUM/SYMMETRICOM Cs 4000
19 RHODES AND SCHWARZ XSC
4x HYDROGEN MASERS
9x PRIMARY CLOCKS AND PROTOTYPES
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 5071A High perf.
36 H-P/AGILENT/SYMMETRICOM 5071A Low perf.
50 FREQ. AND TIME SYSTEMS INC. 4065A
51 DATUM/SYMMETRICOM 4065 B
52 DATUM/SYMMETRICOM 4065 C
53 DATUM/SYMMETRICOM 4310 B

Lab.	Clock	56319	56349	56379	56409	56439	56469	56504	56534	56564	56594	56624	56654
APL	35 904	0.000	0.000	0.000	0.649	0.663	0.654	0.502	0.607	0.404	-	0.000	0.000
APL	35 1264	0.000	0.000	0.000	0.022	0.032	0.035	0.046	0.057	0.064	-	0.000	0.000
APL	35 1791	-	-	-	-	-	-	-	-	-	-	0.000	0.000
APL	40 3107	0.000	0.000	0.000	0.649	0.663	0.639	0.544	0.433	0.446	-	-	-
APL	40 3108	0.000	0.000	0.000	0.000	0.002	0.002	0.002	0.001	0.001	-	0.000	0.000
APL	40 3109	0.000	0.000	0.000	0.126	0.089	0.071	0.065	0.055	0.046	-	0.000	0.000
AUS	35 2269	0.308	0.286	0.311	0.316	0.390	0.365	0.332	0.310	0.318	0.392	0.366	0.538
AUS	36 299	0.070	0.088	0.103	0.000	0.045	0.051	0.055	0.059	0.055	0.084	0.088	0.081
AUS	36 340	0.153	0.176	0.225	0.215	0.143	0.119	0.112	0.100	0.098	0.097	0.100	0.105
AUS	36 654	0.194	0.161	0.102	0.090	0.075	0.063	0.075	0.078	0.092	0.108	0.185	0.290

Table 9A. (Cont.)

Lab.	Clock	56319	56349	56379	56409	56439	56469	56504	56534	56564	56594	56624	56654
AUS	36 1141	0.025	0.025	0.024	0.031	0.031	0.027	0.032	0.040	0.045	0.049	0.056	0.060
AUS	40 5401	-	-	0.000	0.000	0.000	0.000	-	-	-	-	-	-
AUS	40 5402	0.000	-	0.000	0.000	-	0.000	0.000	0.000	-	-	-	-
BEV	35 1065	0.066	0.089	0.518	0.551	0.607	0.580	0.000	0.000	0.000	0.008	0.007	0.006
BEV	35 1793	0.674	0.681	0.660	0.649	0.663	0.654	0.693	0.694	0.600	0.472	0.380	0.453
BEV	40 3452	0.000	0.000	0.001	0.001	0.001	0.001	0.001	0.001	0.000	0.000	-	-
BIM	18 8058	0.245	0.230	0.217	0.000	0.454	0.518	0.481	0.459	0.000	0.284	0.188	0.160
BY	40 4222	0.005	0.004	-	-	-	-	-	-	-	0.000	0.000	0.000
BY	40 4227	-	-	-	-	-	-	-	-	-	0.000	0.000	0.000
BY	40 4229	-	-	-	-	-	-	-	-	-	0.000	0.000	0.000
BY	40 4260	0.003	0.002	-	-	-	-	-	-	-	-	-	-
BY	40 4278	0.028	0.029	-	-	-	-	-	-	-	0.000	0.000	-
CH	22 112	0.000	0.002	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
CH	35 2117	0.499	0.512	0.474	0.438	0.497	0.654	0.693	0.694	0.625	0.000	0.326	0.342
CH	35 2743	0.289	0.326	0.285	0.348	0.345	0.360	0.396	0.393	0.540	0.698	0.672	0.679
CH	36 354	0.259	0.221	0.219	0.160	0.146	0.111	0.114	0.113	0.101	-	-	-
CH	40 5701	0.005	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.005	0.008	0.010	0.015
CNM	35 2708	0.000	0.000	0.000	0.288	0.442	0.240	0.301	0.366	0.357	-	0.000	0.000
CNM	35 2709	0.000	0.000	0.000	0.201	0.218	0.146	0.128	0.162	0.201	-	-	-
CNM	40 7301	0.000	0.000	0.000	0.145	0.088	0.117	0.074	0.074	0.085	-	-	-
CNMP	36 1752	0.276	0.319	0.297	0.228	0.232	0.217	0.196	0.151	0.137	0.149	0.178	0.168
CNMP	36 1806	0.611	0.681	0.620	0.538	0.577	0.582	0.530	0.520	0.000	0.212	0.115	0.098
CNMP	36 2873	-	-	-	-	0.000	0.000	0.000	0.000	0.074	0.077	0.097	0.114
DLR	35 1714	0.094	0.082	0.080	0.074	0.091	0.092	0.093	0.100	0.113	-	-	-
DMDM	35 2191	0.489	0.478	0.508	0.394	0.457	0.435	0.563	0.694	0.685	0.698	0.672	0.679
DMDM	36 2033	0.674	0.000	0.009	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
DTAG	35 2635	0.151	0.073	0.074	0.090	0.107	0.123	0.132	0.149	0.000	-	-	-
DTAG	35 2805	-	-	-	-	0.000	0.000	0.000	0.000	0.270	0.224	0.281	0.381
DTAG	35 2865	0.000	0.000	0.000	-	-	-	-	-	-	-	-	-
DTAG	35 2941	-	-	-	-	-	-	-	-	-	-	0.000	0.000
DTAG	36 2794	0.199	0.257	0.309	-	-	0.000	0.000	0.000	0.000	0.087	0.064	0.081
EIM	35 716	-	-	-	-	-	-	-	-	-	0.000	0.000	0.000
EIM	35 2060	-	-	-	-	-	-	0.000	0.000	0.000	0.000	0.672	0.679
ESTC	22 132	0.000	0.000	0.000	0.004	-	-	0.000	0.000	0.000	0.000	0.003	0.003
ESTC	35 1615	0.000	0.000	0.000	0.083	-	-	0.000	0.000	0.000	0.000	0.334	0.491

Table 9A. (Cont.)

Lab.	Clock	56319	56349	56379	56409	56439	56469	56504	56534	56564	56594	56624	56654
ESTC	35 2025	0.000	0.000	0.000	0.000	-	-	-	-	-	-	-	-
ESTC	35 2353	0.000	0.000	0.000	0.116	-	-	0.000	0.000	0.000	0.000	0.672	0.679
ESTC	40 2551	0.000	0.000	0.000	0.012	-	-	0.000	0.000	0.000	0.000	0.003	0.003
F	35 124	0.292	0.203	0.281	0.287	0.244	0.220	0.263	0.260	0.385	0.462	0.532	0.636
F	35 157	0.000	0.000	0.301	0.359	0.511	0.587	0.693	0.694	0.582	0.574	0.523	0.679
F	35 158	0.316	0.299	0.327	0.472	0.421	0.308	0.303	0.307	0.195	0.260	0.171	0.150
F	35 355	0.178	0.150	0.144	0.151	0.183	0.193	0.202	0.183	0.238	0.292	0.289	0.331
F	35 385	0.226	0.209	0.156	0.121	0.109	0.089	0.094	0.091	0.092	0.107	0.114	0.112
F	35 396	0.457	0.442	0.431	0.430	0.560	0.591	0.000	0.135	0.096	0.095	0.096	0.108
F	35 469	0.032	0.053	0.032	0.027	0.028	-	-	-	-	-	-	-
F	35 520	0.024	0.025	0.034	0.059	0.081	0.071	0.084	0.083	0.081	0.086	0.056	0.061
F	35 609	0.257	0.299	0.369	0.396	0.449	0.431	0.435	0.329	0.340	0.373	0.000	0.105
F	35 700	0.000	0.020	0.013	0.011	0.010	0.009	0.011	0.013	0.015	0.015	0.010	0.008
F	35 770	0.606	0.565	0.477	0.579	0.600	0.654	0.693	0.694	0.685	0.000	0.000	0.137
F	35 774	0.509	0.370	0.385	0.511	0.528	0.439	0.601	0.355	0.441	0.517	0.398	0.396
F	35 781	0.047	0.040	0.035	0.033	0.040	0.044	0.098	0.120	0.122	0.134	0.122	0.169
F	35 819	0.161	0.198	0.169	0.177	0.182	0.133	0.081	0.077	0.067	0.077	-	-
F	35 859	-	0.000	-	-	0.000	-	-	0.000	0.000	0.000	0.000	0.232
F	35 1177	0.396	0.448	0.445	0.307	0.334	0.212	0.229	0.200	0.200	0.316	0.442	0.452
F	35 1222	-	-	0.000	0.000	0.000	0.000	0.286	0.341	0.366	0.380	0.364	0.376
F	35 1321	0.543	0.517	0.311	0.000	0.191	0.157	0.172	0.175	0.169	0.199	0.181	0.174
F	35 1556	0.368	0.521	0.517	0.567	0.557	0.435	0.415	0.286	0.221	0.229	0.221	0.248
F	35 1644	0.192	0.247	0.243	0.273	0.410	0.359	0.449	0.455	0.685	0.698	0.672	0.679
F	35 2027	0.581	0.484	0.455	0.448	0.574	0.630	0.693	0.694	0.685	-	-	-
F	35 2388	0.165	0.161	0.156	0.193	0.399	0.376	0.429	0.431	0.404	0.396	0.358	0.396
F	35 2609	0.379	0.575	0.583	0.611	0.663	0.642	0.693	0.694	0.667	0.698	0.672	0.679
F	35 2647	0.030	0.036	0.045	0.054	0.071	-	-	-	-	-	-	-
F	35 2804	0.674	0.681	0.660	0.649	0.663	0.654	0.629	0.000	0.212	0.212	0.184	0.195
F	40 809	0.140	0.101	0.074	-	-	-	-	0.000	0.000	0.000	0.000	0.036
F	40 810	0.037	0.030	0.024	0.020	0.017	0.014	0.014	0.013	0.013	0.016	0.015	0.015
F	40 889	0.026	0.034	0.042	0.054	0.070	0.085	0.106	0.112	0.117	0.135	0.119	0.110
F	40 890	0.258	0.230	0.205	0.188	0.195	0.197	0.206	0.199	0.201	0.240	0.223	0.222
HKO	35 1893	0.152	0.164	0.133	0.133	-	-	0.000	-	-	-	-	-
HKO	35 2425	0.674	0.681	0.660	0.649	-	-	0.000	0.000	0.000	0.000	0.282	0.429
HKO	35 2884	-	-	-	-	-	-	-	-	0.000	0.000	0.000	0.000

Table 9A. (Cont.)

Lab.	Clock	56319	56349	56379	56409	56439	56469	56504	56534	56564	56594	56624	56654
IFAG	36 1167	0.055	0.054	0.036	0.037	0.042	0.041	0.043	0.061	0.070	0.096	0.107	0.114
IFAG	36 1173	0.021	0.030	0.030	0.028	0.028	0.026	0.028	0.028	0.024	0.024	0.021	0.021
IFAG	36 1629	0.094	0.099	0.089	0.080	0.076	0.073	0.135	0.132	0.154	0.112	0.067	0.063
IFAG	36 1732	0.564	0.470	0.473	0.541	0.558	0.359	0.278	0.212	0.191	0.227	0.186	0.219
IFAG	36 1798	0.667	0.647	0.586	0.593	0.663	0.654	0.693	0.694	0.685	0.698	0.672	0.679
IFAG	40 4418	0.004	0.004	0.004	0.005	0.008	0.016	0.105	0.135	0.142	0.175	0.159	0.136
IFAG	40 4439	0.020	0.022	-	-	0.000	0.000	0.000	0.000	0.010	0.014	0.016	0.019
IGNA	35 1196	0.147	0.154	0.175	-	-	-	0.000	0.000	0.000	0.000	0.135	0.163
INPL	35 2480	0.235	0.330	0.414	0.477	0.353	0.407	0.360	0.338	0.275	0.214	0.248	0.336
INPL	35 2481	0.289	0.393	0.452	0.458	0.602	0.654	0.633	0.553	0.449	0.515	0.408	0.330
INTI	35 2377	0.012	0.013	0.013	-	0.000	0.000	0.000	0.000	0.033	0.057	0.039	0.035
INXE	35 2393	-	0.000	0.000	0.000	0.000	0.274	0.408	0.542	0.649	0.476	0.532	0.636
IT	35 219	0.674	0.681	0.660	0.649	0.663	0.654	0.693	0.694	0.685	0.698	0.672	0.534
IT	35 505	0.378	0.252	0.198	0.182	0.159	0.169	0.217	0.420	0.685	0.698	0.525	0.536
IT	35 1115	0.206	0.262	0.242	0.261	0.366	0.381	0.351	0.349	0.344	0.500	0.000	0.000
IT	35 1373	0.118	0.105	0.100	0.104	0.171	0.184	0.309	0.615	0.665	0.698	0.672	0.679
IT	35 2118	-	-	-	0.000	0.000	0.000	0.000	0.167	0.245	0.374	0.412	0.537
IT	35 2487	0.527	0.510	0.474	0.480	0.329	0.296	0.229	0.191	0.214	0.233	0.230	0.223
IT	40 1101	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
IT	40 1102	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
IT	40 1103	0.003	0.003	0.003	0.003	0.003	0.003	0.004	0.005	0.005	0.007	0.007	0.008
JV	21 216	0.004	0.003	0.003	0.003	0.003	0.004	0.005	0.007	0.007	0.014	0.009	0.007
JV	36 1277	0.108	0.110	0.097	0.097	0.106	0.091	0.117	0.117	0.120	0.113	0.119	0.137
JV	36 2617	-	0.000	0.000	0.000	0.000	0.060	0.079	0.109	0.114	0.166	0.152	0.188
JV	36 2629	0.157	0.195	0.346	0.521	0.314	0.358	0.373	0.305	0.368	0.000	0.209	0.181
KEBS	35 2518	0.000	0.000	0.000	0.017	-	-	-	-	-	-	-	-
KIM	36 618	0.092	-	-	0.000	0.000	0.000	0.000	0.015	0.020	0.032	0.028	0.037
KRIS	35 321	0.076	0.077	0.072	0.090	0.108	0.130	-	-	0.000	0.000	0.000	0.000
KRIS	35 739	0.161	0.148	0.154	0.216	0.263	0.394	-	-	0.000	0.000	0.000	0.000
KRIS	35 1135	0.035	0.030	0.027	0.028	0.033	0.039	-	-	0.000	0.000	0.000	0.000
KRIS	35 1693	0.674	0.681	0.660	0.649	0.663	0.654	-	-	0.000	0.000	0.000	0.000
KRIS	35 1783	0.352	0.342	0.353	0.322	0.303	0.251	-	-	0.000	0.000	0.000	0.000
KRIS	40 5624	0.674	0.623	0.579	0.548	0.558	0.556	-	-	0.000	0.000	0.000	-
KRIS	40 5625	0.674	0.681	0.660	0.649	0.663	0.654	-	-	-	-	-	0.000
KRIS	40 5626	0.042	0.031	0.025	0.023	0.024	0.023	-	-	0.000	0.000	0.000	0.000

Table 9A. (Cont.)

Lab.	Clock	56319	56349	56379	56409	56439	56469	56504	56534	56564	56594	56624	56654
KZ	35 2202	-	-	-	-	0.000	0.000	0.000	0.000	0.042	0.067	0.084	0.098
KZ	35 2665	-	-	-	-	0.000	0.000	0.000	0.000	0.001	0.002	0.002	0.003
KZ	35 2667	-	-	-	-	0.000	0.000	0.000	0.000	0.001	0.002	0.002	0.003
LT	35 1362	0.026	0.037	0.048	0.064	0.084	-	0.000	0.000	0.000	0.000	0.030	0.039
LT	35 1868	0.095	0.109	0.137	0.150	0.192	-	0.000	0.000	0.000	0.000	0.184	0.266
MIKE	35 1171	0.000	0.086	0.092	0.127	0.154	0.134	-	-	-	-	-	-
MIKE	36 986	0.000	0.081	0.112	0.119	0.161	0.149	0.182	0.202	0.242	0.000	0.122	0.125
MIKE	40 4108	0.000	0.081	0.064	0.053	0.047	0.000	0.000	0.003	0.003	0.003	0.003	0.003
MIKE	40 4113	-	-	-	-	-	-	-	-	0.000	0.000	0.000	0.000
MIKE	40 4180	-	0.000	0.000	0.000	0.000	0.027	-	-	-	0.000	0.000	0.000
MKEH	36 849	0.092	0.086	0.076	0.075	0.076	0.075	0.107	0.122	0.173	0.201	0.172	0.180
MSL	12 933	-	-	-	0.000	0.000	-	-	-	-	-	-	-
MSL	36 274	-	-	-	0.000	0.000	0.000	0.000	-	-	-	-	-
MSL	36 2869	-	-	-	0.000	0.000	0.000	0.000	-	-	-	-	-
NAO	35 779	0.398	0.470	0.503	0.472	0.440	0.374	-	-	0.000	0.000	0.000	0.000
NAO	35 1206	0.045	0.044	0.042	0.045	0.049	0.049	0.050	0.050	0.050	0.056	0.252	0.266
NAO	35 1214	0.012	0.009	0.007	0.007	0.007	0.007	0.008	0.010	0.013	0.474	0.672	0.000
NAO	35 1689	0.112	0.085	0.053	0.052	0.054	0.051	0.064	0.095	0.107	0.112	0.115	0.092
NAO	40 1301	0.000	0.000	0.000	0.000	0.005	0.005	0.006	0.007	0.007	0.008	0.007	0.008
NICT	35 112	0.052	0.198	0.415	0.263	0.167	0.136	0.163	0.187	0.217	0.247	0.137	0.105
NICT	35 332	0.278	0.247	0.241	0.227	0.267	0.245	0.259	0.249	0.302	0.306	0.303	0.252
NICT	35 342	0.674	0.681	0.660	0.649	0.000	-	-	-	-	-	-	-
NICT	35 343	0.674	0.681	0.660	0.649	0.663	0.636	0.603	0.694	0.685	0.698	0.672	0.679
NICT	35 715	0.674	0.681	0.660	0.649	0.663	0.654	0.693	0.694	0.685	0.698	0.672	0.679
NICT	35 732	0.422	0.345	0.301	0.287	0.318	0.402	0.522	0.636	0.685	0.698	0.672	0.679
NICT	35 907	0.579	0.592	0.581	0.649	0.663	0.654	0.693	0.694	0.685	0.698	0.672	0.679
NICT	35 913	0.088	0.069	0.053	0.051	0.054	0.060	0.067	0.062	0.070	0.103	0.074	0.076
NICT	35 916	0.674	0.681	0.660	0.649	0.663	0.654	0.596	0.376	0.441	0.414	0.283	0.262
NICT	35 1225	0.674	0.681	0.000	0.453	0.422	0.355	0.407	0.398	0.329	0.404	0.358	0.360
NICT	35 1226	0.129	0.206	0.211	0.142	0.138	0.129	0.162	0.207	0.296	0.000	0.080	0.078
NICT	35 1611	0.012	0.011	0.014	0.017	0.016	0.016	0.018	0.000	0.003	0.003	0.003	0.003
NICT	35 1778	0.078	0.079	0.072	0.072	0.077	0.080	0.114	0.202	0.203	0.232	0.230	0.463
NICT	35 1789	0.674	0.681	0.660	0.649	0.663	0.654	0.693	0.694	0.685	0.698	0.672	0.679
NICT	35 1790	0.411	0.441	0.442	0.417	0.521	0.606	0.693	0.694	0.565	0.667	0.000	0.301
NICT	35 1866	0.674	0.681	0.660	0.649	0.663	0.654	0.693	0.626	0.685	0.698	0.672	0.679

Table 9A. (Cont.)

Lab.	Clock	56319	56349	56379	56409	56439	56469	56504	56534	56564	56594	56624	56654
NICT	35 1882	0.674	0.681	0.660	0.649	0.663	0.654	0.693	0.694	0.685	0.698	0.591	0.582
NICT	35 1887	0.000	0.047	0.000	0.000	0.000	0.000	0.001	0.001	0.001	0.001	0.001	0.001
NICT	35 1944	0.281	-	-	0.000	0.000	0.000	0.000	0.694	0.685	0.698	0.672	0.679
NICT	35 2010	0.109	-	-	-	-	-	-	0.000	0.000	0.000	0.000	0.216
NICT	35 2011	0.275	0.273	0.171	0.195	0.238	0.264	0.339	0.465	0.445	0.328	0.238	0.190
NICT	35 2056	0.430	0.460	0.488	0.649	0.663	0.654	0.693	0.694	0.556	0.000	0.169	0.162
NICT	35 2113	-	-	-	0.000	0.000	0.000	0.000	0.425	0.456	0.381	0.416	0.346
NICT	35 2116	0.512	0.426	-	-	-	-	-	-	-	-	-	-
NICT	35 2570	0.248	0.314	0.445	0.489	0.663	0.654	0.693	0.694	0.000	0.143	0.106	0.111
NICT	35 2574	0.674	0.681	0.660	0.649	0.663	0.654	0.648	0.444	0.326	0.239	0.175	0.186
NICT	35 2627	0.674	0.681	0.660	0.649	0.663	0.654	0.686	0.380	0.285	0.286	0.266	0.253
NICT	35 2628	0.674	0.681	0.660	0.649	0.663	0.654	0.693	0.694	0.685	0.000	0.000	0.079
NICT	35 2784	0.081	0.081	0.089	0.117	0.184	0.251	0.400	0.357	0.311	0.314	0.196	0.185
NICT	35 2903	-	-	-	-	-	-	-	-	0.000	0.000	0.000	0.000
NICT	36 1217	0.075	0.172	0.236	0.244	0.194	0.000	0.095	0.082	0.096	0.102	0.091	0.078
NICT	40 2003	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.004	0.005	0.009
NICT	40 2004	0.035	0.020	0.013	0.009	0.007	0.005	0.005	0.004	0.004	0.004	0.004	0.004
NICT	40 2005	0.000	0.000	0.005	0.005	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004
NICT	40 2006	0.013	0.010	0.007	0.006	0.006	0.005	0.004	0.004	0.003	0.004	0.003	0.003
NIM	35 1235	0.056	0.046	0.043	0.055	0.168	0.000	0.066	0.075	0.083	0.086	0.061	0.058
NIM	35 2239	0.674	0.595	0.470	0.441	0.522	0.520	0.551	0.521	0.508	0.688	0.672	0.679
NIM	35 2256	0.000	0.000	0.660	0.649	0.663	0.654	0.693	0.694	0.685	0.698	0.672	0.679
NIM	35 2483	0.000	0.000	0.250	0.280	0.214	0.196	0.229	0.260	0.284	0.331	0.409	0.458
NIM	35 2643	0.000	0.000	0.660	0.649	0.403	0.250	0.301	0.317	0.300	0.258	0.227	0.211
NIM	35 2744	0.000	0.000	0.000	0.024	0.023	0.023	0.022	0.020	0.019	0.020	0.018	0.020
NIM	35 2767	0.000	0.000	0.411	0.579	0.500	0.000	0.131	0.137	0.113	0.139	0.130	0.160
NIM	40 4832	0.000	0.000	0.003	0.002	0.002	0.001	0.001	-	-	0.000	0.000	0.000
NIM	40 4835	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	-	-	0.000
NIM	40 4871	0.000	0.000	0.001	0.001	0.001	0.001	0.001	-	-	0.000	0.000	0.000
NIM	40 4878	0.000	0.000	0.001	0.001	0.001	0.001	0.001	-	-	0.000	0.000	0.000
NIM	40 4879	0.000	0.000	0.000	0.000	0.000	0.000	0.000	-	-	0.000	0.000	0.000
NIM	40 4880	0.000	0.000	0.000	0.000	0.000	0.000	0.000	-	-	0.000	0.000	0.000
NIMB	35 600	0.265	0.355	0.000	0.034	0.023	0.023	0.027	0.026	0.027	0.035	-	0.000
NIMT	35 2246	0.000	0.277	0.263	0.252	0.287	0.350	-	-	0.000	0.000	-	0.000
NIMT	35 2247	0.003	0.003	0.004	0.004	0.004	0.009	-	0.000	0.000	0.000	-	0.000

Table 9A. (Cont.)

Lab.	Clock	56319	56349	56379	56409	56439	56469	56504	56534	56564	56594	56624	56654
NIS	35 1126	-	0.000	-	0.000	-	-	-	-	-	0.000	-	-
NIST	35 282	0.076	0.096	0.101	0.106	0.186	0.221	0.238	0.334	0.364	0.424	0.301	-
NIST	35 408	0.292	0.255	0.230	0.277	0.420	0.538	0.693	0.694	0.614	0.698	0.672	0.589
NIST	35 1074	0.024	0.025	0.025	0.036	0.095	0.098	0.094	0.100	0.124	0.165	0.121	0.084
NIST	35 1519	-	-	0.000	0.000	0.000	0.000	0.109	0.055	0.051	0.047	0.031	0.028
NIST	35 2031	0.000	0.428	0.407	0.313	0.270	0.249	0.262	0.225	0.256	0.221	0.213	0.199
NIST	35 2032	-	-	-	-	-	-	-	-	-	0.000	0.000	0.000
NIST	35 2034	0.674	0.681	0.660	0.649	0.663	0.654	0.693	0.677	0.536	0.632	0.587	0.460
NIST	35 2579	0.674	0.681	0.660	0.649	0.663	0.654	0.693	0.694	0.685	0.698	0.000	0.000
NIST	35 2672	0.082	0.084	0.084	0.110	0.099	0.120	0.119	0.155	0.192	0.230	0.287	0.318
NIST	40 203	0.008	0.008	0.007	0.007	-	-	-	-	-	-	-	-
NIST	40 204	0.170	0.154	0.146	0.147	0.149	0.139	0.151	0.147	0.151	0.180	0.162	0.160
NIST	40 205	0.674	0.681	0.660	0.649	0.663	0.654	0.693	0.694	0.685	0.698	0.672	0.679
NIST	40 206	0.028	0.026	0.026	0.028	0.032	0.036	0.044	0.044	0.044	0.049	0.042	0.039
NIST	40 222	0.000	0.000	0.660	0.649	0.663	0.654	0.693	0.694	0.685	0.698	0.672	0.679
NMIJ	35 224	0.168	0.113	0.106	0.117	0.114	0.087	0.102	0.099	0.100	0.117	0.099	0.117
NMIJ	35 523	0.142	0.146	0.201	0.179	0.185	0.253	0.344	0.379	0.478	0.698	0.672	0.502
NMIJ	35 1273	0.625	0.391	0.349	0.444	-	-	-	-	-	-	-	-
NMIJ	40 5002	0.091	-	0.000	0.000	-	-	-	-	-	-	-	-
NMIJ	40 5003	0.027	0.026	0.026	0.030	0.041	0.066	0.516	0.694	0.685	0.698	0.672	0.679
NMIJ	40 5015	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
NMLS	35 328	0.014	0.013	0.012	0.014	0.023	0.042	0.067	0.063	0.048	0.055	0.000	0.002
NPL	35 1275	0.083	0.071	0.063	0.069	0.074	0.075	0.095	0.088	0.101	0.108	0.096	0.098
NPL	36 784	0.054	0.058	-	-	-	-	-	-	-	-	-	-
NPL	40 1701	0.160	0.154	0.150	0.145	0.125	0.111	0.135	0.164	0.190	0.222	0.211	0.207
NPL	40 1708	0.165	0.153	0.145	0.145	0.155	0.155	0.174	0.173	0.156	0.161	0.150	0.151
NPLI	35 57	0.039	0.032	0.031	0.036	0.045	0.051	0.052	0.063	0.074	0.095	0.089	0.090
NPLI	35 140	0.046	0.055	0.047	0.054	0.064	0.054	0.059	0.054	0.045	0.053	0.038	0.035
NPLI	35 1324	0.232	0.157	0.169	0.209	0.250	0.198	0.196	0.203	0.184	0.228	0.204	0.211
NPLI	35 2245	0.387	0.382	0.459	0.452	0.377	0.264	0.273	0.184	0.162	0.183	0.165	0.178
NPLI	35 2796	0.384	0.470	0.351	0.433	0.432	0.354	0.325	0.371	0.347	0.379	0.336	0.354
NPLI	40 5201	0.002	0.002	0.002	0.002	0.003	0.003	0.003	0.003	0.004	0.004	0.003	0.004
NRC	35 2148	0.576	0.553	0.660	-	-	-	-	-	-	-	-	-
NRC	35 2150	0.674	0.681	0.660	0.649	0.663	0.654	0.693	0.694	0.566	0.596	0.500	0.508
NRC	35 2152	0.368	0.294	0.334	0.291	0.326	0.359	0.320	0.410	0.431	0.477	0.355	0.367

Table 9A. (Cont.)

Lab.	Clock		56319	56349	56379	56409	56439	56469	56504	56534	56564	56594	56624	56654
NRC	36	2219	-	-	-	-	0.000	0.000	0.000	0.000	0.182	0.131	0.120	0.163
NRC	40	304	-	-	-	-	-	-	-	-	-	-	0.000	0.000
NRC	40	306	-	-	-	-	-	-	-	-	-	-	0.000	0.000
NRL	35	714	-	0.000	0.000	0.000	0.000	0.195	-	0.000	0.000	0.000	-	-
NRL	35	719	-	0.000	0.000	0.000	0.000	0.292	-	0.000	0.000	0.000	-	-
NRL	35	1245	-	0.000	0.000	0.000	0.000	0.008	-	0.000	0.000	0.000	-	-
NRL	36	387	-	0.000	0.000	0.000	0.000	0.143	-	0.000	0.000	0.000	-	-
NRL	40	1001	-	0.000	0.000	0.000	0.000	0.017	-	0.000	0.000	0.000	-	-
NTSC	35	1007	0.053	0.047	0.040	0.053	0.049	-	-	-	-	-	-	-
NTSC	35	1008	0.504	0.485	0.524	0.486	0.507	0.497	0.000	0.000	0.054	0.063	0.056	0.052
NTSC	35	1011	0.019	0.020	0.019	0.022	0.024	0.028	0.035	0.041	0.048	0.052	0.037	0.031
NTSC	35	1016	0.674	0.681	0.660	0.000	0.314	0.275	0.290	0.266	0.217	0.236	0.220	0.182
NTSC	35	1018	0.000	0.334	0.399	0.236	0.240	0.225	0.205	0.216	0.231	0.355	0.310	0.268
NTSC	35	1818	0.047	0.065	0.098	0.094	0.098	0.066	0.077	0.060	0.055	0.057	0.041	0.062
NTSC	35	1820	0.133	0.000	0.045	0.036	0.042	0.032	0.033	0.033	0.035	0.045	0.043	0.057
NTSC	35	1823	0.201	0.210	0.144	0.166	0.187	0.213	0.244	0.222	0.287	0.361	0.383	0.387
NTSC	35	2096	0.433	0.435	0.382	0.403	0.419	0.410	0.459	0.672	0.671	0.654	0.558	0.610
NTSC	35	2098	0.457	0.380	0.382	0.554	0.426	0.333	0.349	0.314	0.347	0.354	0.307	0.277
NTSC	35	2131	0.317	0.264	0.346	0.451	0.585	0.584	0.693	0.694	0.685	0.698	0.502	0.526
NTSC	35	2141	0.002	0.002	0.003	0.004	0.004	0.004	0.005	0.006	0.006	0.008	0.008	0.005
NTSC	35	2142	0.589	0.660	0.552	0.444	0.461	0.434	0.604	0.631	0.665	0.698	0.672	0.679
NTSC	35	2143	0.674	0.641	0.600	0.356	0.366	0.295	0.281	0.266	0.274	0.374	0.341	0.235
NTSC	35	2144	0.396	0.325	0.241	0.181	0.169	0.160	0.110	0.108	0.112	0.114	0.102	0.101
NTSC	35	2145	0.350	0.368	0.428	0.628	0.663	0.654	0.645	0.653	0.685	0.698	0.672	0.679
NTSC	35	2147	0.313	0.279	0.187	0.175	0.147	0.133	0.131	0.122	0.183	0.222	0.311	0.528
NTSC	35	2573	0.338	0.401	0.598	0.552	0.603	0.654	0.693	0.694	0.685	0.698	0.672	0.679
NTSC	35	2831	0.059	0.056	0.064	0.062	0.057	0.050	0.043	0.045	0.042	0.062	0.051	0.052
NTSC	35	2852	-	0.000	0.000	0.000	0.000	0.263	0.227	0.262	0.313	0.397	0.389	0.427
NTSC	35	2855	0.323	0.211	0.221	0.271	0.321	0.276	0.278	0.313	0.402	0.466	0.549	0.000
NTSC	35	2921	-	-	-	-	-	-	-	0.000	0.000	0.000	0.000	0.679
NTSC	35	2922	-	-	-	-	-	-	0.000	0.000	0.000	0.000	0.672	0.679
NTSC	35	2924	-	-	-	-	-	-	-	0.000	0.000	0.000	0.000	0.243
NTSC	35	2926	-	-	-	-	-	-	0.000	0.000	0.000	0.000	0.396	0.225
NTSC	35	2928	-	-	-	-	-	-	-	0.000	0.000	0.000	0.000	0.360
NTSC	35	2933	-	-	-	-	-	-	0.000	0.000	0.000	0.000	0.672	0.679

Table 9A. (Cont.)

Lab.	Clock	56319	56349	56379	56409	56439	56469	56504	56534	56564	56594	56624	56654
PL	40 4602	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
PTB	35 128	0.230	0.206	0.224	0.193	0.158	0.146	0.140	0.195	0.194	0.286	0.385	0.488
PTB	35 415	0.674	0.681	0.660	0.596	0.580	0.549	0.000	0.000	0.103	0.100	0.000	0.027
PTB	35 1072	0.303	0.183	0.143	0.145	0.130	0.121	0.127	0.125	0.150	0.219	0.317	0.463
PTB	40 506	0.001	0.001	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.003	0.004	0.005
PTB	40 508	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
PTB	40 509	-	-	-	-	-	-	-	0.000	0.000	0.000	0.000	0.400
PTB	40 590	0.030	0.027	0.025	0.025	0.028	0.030	0.033	0.032	0.033	0.042	0.041	0.042
PTB	92 1	0.674	0.681	0.660	0.649	0.663	0.654	0.693	0.687	0.683	0.698	0.672	0.679
PTB	92 2	0.674	0.681	0.660	0.649	0.530	0.484	0.418	0.407	0.406	0.521	0.481	0.493
ROA	35 583	0.000	0.307	0.395	0.330	0.315	0.402	0.440	0.467	0.358	0.360	0.261	0.264
ROA	35 718	0.674	0.681	0.660	0.649	0.663	0.654	0.693	0.694	0.685	0.698	0.672	0.592
ROA	35 1699	0.553	0.432	0.633	0.613	0.000	0.345	0.347	0.393	0.405	0.627	0.599	0.659
ROA	35 2270	0.225	0.242	0.253	0.247	0.250	0.342	0.300	0.293	0.271	0.373	0.462	0.410
ROA	36 1488	0.069	0.069	0.065	0.065	0.073	0.068	0.069	0.073	0.182	0.236	0.192	0.219
ROA	36 1490	0.108	0.109	0.106	0.104	0.107	0.098	0.107	0.103	0.103	0.135	0.230	0.233
ROA	40 1436	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
SASO	35 221	-	-	-	-	-	-	-	-	-	-	-	0.000
SASO	35 1628	-	-	-	-	-	-	-	-	-	-	-	0.000
SASO	35 2923	-	-	-	-	-	-	-	-	-	-	-	0.000
SASO	35 2932	-	-	-	-	-	-	-	-	-	-	-	0.000
SCL	35 2178	0.244	0.309	0.335	0.442	0.540	0.556	0.659	0.456	0.385	0.329	0.273	0.298
SCL	35 2525	0.144	0.160	0.105	0.103	0.110	0.126	0.153	0.166	0.231	0.257	0.188	0.180
SG	35 475	0.534	0.571	0.416	0.403	0.510	0.603	0.693	0.000	0.540	0.618	0.558	0.547
SG	35 476	0.279	0.403	0.132	0.079	0.042	0.027	0.021	0.023	0.022	0.024	-	-
SG	35 1889	0.240	0.338	0.227	0.297	0.281	0.300	0.350	0.367	0.425	0.409	0.235	0.261
SG	36 522	0.101	0.145	0.190	0.151	0.176	0.208	0.189	0.218	0.225	0.262	0.351	0.356
SG	40 7701	-	-	-	-	0.000	0.000	0.000	0.000	0.009	0.006	0.003	0.002
SIQ	36 1268	0.085	0.070	0.070	0.073	0.065	0.055	0.050	0.043	0.049	0.058	0.054	0.048
SMD	35 1766	-	-	-	-	-	-	0.000	0.000	0.000	0.000	0.672	0.679
SMD	35 2003	-	-	-	-	-	-	0.000	0.000	0.000	0.000	0.068	0.095
SMD	35 2543	-	-	-	-	-	-	0.000	0.000	0.000	0.000	0.277	0.421
SMD	40 7909	-	-	-	-	-	-	0.000	0.000	0.000	0.000	0.000	0.000
SMU	36 1193	0.114	0.094	0.122	0.123	0.122	-	-	0.000	0.000	-	-	0.000
SP	35 572	0.674	0.681	0.660	0.649	0.663	0.654	0.693	0.584	0.685	0.698	0.672	0.679

Table 9A. (Cont.)

Lab.	Clock	56319	56349	56379	56409	56439	56469	56504	56534	56564	56594	56624	56654
SP	35 641	0.211	0.219	0.255	0.149	0.118	0.096	0.087	0.090	0.089	0.108	0.107	0.216
SP	35 767	-	-	-	-	-	-	-	-	-	-	0.000	0.000
SP	35 1188	0.021	0.023	0.022	0.025	0.029	0.031	0.034	0.035	0.031	0.038	-	-
SP	35 1642	0.674	0.681	0.660	0.649	0.663	0.654	0.693	0.694	0.685	0.698	0.672	0.679
SP	35 2166	0.000	0.000	0.000	0.000	0.287	0.351	0.395	0.372	0.449	0.542	0.551	0.626
SP	35 2745	-	-	-	-	-	-	-	-	-	-	0.000	0.000
SP	35 2746	-	-	-	-	-	-	-	-	-	-	0.000	0.000
SP	35 2749	-	-	-	-	-	-	-	-	-	-	0.000	0.000
SP	35 2758	-	-	-	-	-	-	-	-	-	-	0.000	0.000
SP	36 223	0.262	0.265	0.230	0.231	0.000	0.111	0.117	0.076	0.068	0.073	0.068	0.065
SP	36 1175	0.168	0.164	0.154	0.153	0.151	0.196	0.205	0.230	0.236	0.206	0.186	0.218
SP	36 1187	0.027	0.030	0.032	0.030	0.038	0.044	0.081	0.151	0.130	0.091	0.051	0.039
SP	36 1531	0.252	0.287	0.182	0.189	0.225	0.215	0.245	0.240	0.265	0.314	0.166	0.175
SP	36 2068	0.114	0.112	0.109	0.124	0.101	0.099	0.103	0.104	0.105	0.155	0.177	0.183
SP	36 2218	0.372	0.385	0.364	0.331	0.367	0.353	0.373	0.403	0.543	0.487	0.531	0.578
SP	36 2295	0.114	0.123	0.103	0.111	0.158	0.115	0.158	0.166	0.268	0.279	0.153	0.147
SP	36 2297	0.613	0.643	0.660	0.649	0.663	0.654	0.693	0.694	0.619	0.441	0.399	0.377
SP	40 7201	0.002	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.002	0.001	0.001
SP	40 7203	0.013	0.012	0.011	0.012	0.012	0.012	0.013	0.013	0.013	0.016	0.015	0.015
SP	40 7210	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.002	0.001	0.001
SP	40 7211	0.005	0.005	0.004	0.004	0.005	0.004	0.005	0.004	0.004	0.005	0.005	0.005
SP	40 7212	0.040	0.038	0.036	0.036	0.038	0.038	0.042	0.041	0.042	0.051	0.049	0.051
SP	40 7218	0.120	0.133	0.152	-	-	-	-	-	-	-	-	-
SP	40 7221	0.285	0.263	0.252	0.248	0.261	-	0.000	0.000	0.000	0.000	0.672	0.679
SP	40 7223	-	-	-	-	-	-	-	-	-	-	0.000	-
SU	40 3809	-	0.000	0.000	0.000	0.000	0.654	0.590	0.430	0.365	0.264	0.240	0.224
SU	40 3810	0.492	0.415	0.333	0.303	0.311	0.309	0.342	0.315	0.308	0.276	0.245	0.238
SU	40 3812	0.282	0.255	0.214	0.191	0.178	0.156	0.151	0.143	0.145	0.147	0.137	0.138
SU	40 3814	0.014	0.014	0.014	0.014	0.014	0.013	0.014	0.014	0.014	0.015	0.014	0.014
SU	40 3815	0.025	0.025	0.025	0.026	0.028	0.028	0.031	0.029	0.029	0.032	0.029	0.030
SU	40 3816	0.025	0.024	0.023	0.024	0.026	0.025	0.026	0.025	0.024	0.027	0.024	0.023
SU	40 3817	-	-	-	-	-	-	0.000	0.000	0.000	0.000	0.012	0.014
SU	40 3818	-	-	-	-	-	-	-	-	-	-	0.000	0.000
TCC	35 768	0.081	0.079	0.082	0.085	0.046	0.047	-	-	0.000	0.000	0.000	0.000
TCC	35 1881	0.523	0.537	0.539	0.599	0.663	0.654	-	-	0.000	0.000	0.000	0.000

Table 9A. (Cont.)

Lab.	Clock	56319	56349	56379	56409	56439	56469	56504	56534	56564	56594	56624	56654
TCC	40 8620	0.157	0.136	0.111	0.085	0.060	0.058	-	-	0.000	0.000	0.000	0.000
TCC	40 8624	0.658	0.445	0.362	0.372	0.331	0.000	-	-	0.000	0.000	0.000	0.000
TCC	40 8650	0.026	0.027	0.025	0.027	0.030	0.031	-	-	0.000	0.000	0.000	-
TL	35 1012	0.421	0.396	0.374	0.442	0.432	0.499	0.528	0.522	0.486	0.520	0.368	0.391
TL	35 1132	0.162	0.155	0.146	0.147	0.163	0.206	0.394	-	-	-	-	-
TL	35 1498	0.532	0.519	0.485	0.484	0.481	0.498	0.517	0.380	0.347	0.373	0.334	0.338
TL	35 1500	0.181	0.167	0.123	0.123	0.125	0.102	0.101	0.245	0.212	0.249	0.243	0.257
TL	35 1712	-	-	-	0.000	0.000	0.000	0.000	0.569	0.685	0.698	0.672	0.679
TL	35 2365	0.674	0.681	0.660	0.649	0.663	0.654	0.693	0.694	0.685	0.698	0.651	0.376
TL	35 2366	0.270	0.241	0.263	0.346	0.443	0.635	0.693	0.694	0.532	0.698	0.672	0.000
TL	35 2367	0.531	0.504	0.527	0.643	0.468	0.654	0.427	0.384	0.379	0.446	0.638	0.661
TL	35 2368	0.212	0.135	0.109	0.112	0.129	0.134	0.095	0.070	0.056	0.048	0.036	0.032
TL	35 2630	0.446	0.681	0.660	0.649	0.663	0.654	0.693	0.694	0.685	0.698	0.672	0.679
TL	35 2634	0.048	0.049	0.030	0.030	0.030	0.031	0.042	0.057	0.064	0.079	0.083	0.083
TL	35 2636	0.447	0.432	0.446	0.649	0.663	0.654	0.693	0.694	0.685	0.000	0.171	0.167
TL	35 2853	0.253	0.298	0.322	0.384	0.361	0.397	0.693	0.694	0.685	0.698	0.672	0.679
TL	35 2910	-	-	-	0.000	0.000	0.000	0.000	0.432	0.641	0.698	0.672	0.679
TL	40 57	0.003	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
TL	40 3052	0.674	0.681	0.660	-	-	-	-	-	0.000	-	-	0.000
TP	35 163	0.396	0.453	0.445	0.390	0.238	0.000	0.066	0.053	0.046	0.042	0.026	0.025
TP	35 1227	0.674	0.525	0.393	0.362	0.407	0.284	0.349	0.372	0.390	0.508	0.672	0.679
TP	35 2476	0.622	0.535	0.424	0.369	0.233	0.194	0.161	0.139	0.129	0.148	0.134	0.148
TP	36 154	0.279	0.232	0.245	0.142	0.125	0.122	0.118	0.108	0.109	0.120	-	-
UA	35 2465	0.092	0.069	0.067	0.067	0.049	0.048	0.051	0.049	-	-	0.000	0.000
UA	40 7854	0.090	0.084	0.082	0.081	0.058	0.056	0.059	0.058	-	-	0.000	0.000
UA	40 7881	0.110	0.118	0.111	0.113	0.139	0.268	0.169	0.120	-	-	0.000	0.000
UA	40 7882	0.283	0.256	0.253	0.321	0.330	0.309	0.344	0.330	-	-	0.000	0.000
UME	35 251	0.562	-	0.000	0.000	0.000	0.000	0.570	0.296	0.276	0.375	0.220	0.193
UME	35 252	0.194	-	0.000	0.000	0.000	0.000	0.519	0.617	0.604	0.452	0.402	0.440
UME	35 710	0.371	-	0.000	0.000	0.000	0.000	0.459	0.176	0.205	0.158	0.123	0.131
UME	35 2703	0.484	-	0.000	0.000	0.000	0.000	0.363	0.485	0.662	0.698	0.523	0.577
USNO	35 101	0.064	0.000	0.013	0.010	0.009	0.008	0.009	0.009	0.011	0.017	0.027	0.036
USNO	35 104	0.059	0.094	0.183	0.199	0.204	0.193	0.201	0.236	0.324	0.381	0.291	0.433
USNO	35 106	0.000	0.000	0.046	0.047	0.039	0.039	0.043	0.051	0.060	0.080	0.112	0.182
USNO	35 108	0.427	0.399	0.365	0.417	0.354	0.646	0.674	0.667	0.685	0.698	0.672	0.679

Table 9A. (Cont.)

Lab.		Clock	56319	56349	56379	56409	56439	56469	56504	56534	56564	56594	56624	56654
USNO	35	114	-	-	-	-	0.000	0.000	0.000	0.000	0.111	0.154	0.193	0.261
USNO	35	120	0.674	0.681	0.660	0.649	0.663	0.521	0.000	0.179	0.147	0.124	0.116	0.137
USNO	35	142	0.303	0.580	0.472	0.386	0.338	0.337	0.347	0.314	0.318	0.271	0.198	0.205
USNO	35	145	0.000	0.000	0.000	0.040	0.052	0.063	0.084	0.104	0.115	0.140	0.129	0.127
USNO	35	146	-	-	-	-	0.000	0.000	0.000	0.000	0.163	0.124	0.098	0.092
USNO	35	148	0.251	0.290	0.256	0.251	0.299	0.345	-	-	-	-	-	-
USNO	35	150	0.402	0.404	0.431	0.429	0.416	0.440	0.296	0.395	0.313	0.212	0.170	0.172
USNO	35	152	0.423	0.411	0.399	0.270	0.234	0.120	0.112	0.132	0.171	0.199	0.185	0.154
USNO	35	153	0.000	0.000	0.497	0.187	0.230	0.266	0.199	0.131	0.142	0.145	0.114	0.127
USNO	35	156	0.674	0.681	0.660	0.649	0.663	0.654	0.693	0.694	0.685	0.698	0.672	0.571
USNO	35	161	0.147	0.126	0.105	0.097	0.112	0.097	-	-	-	-	-	0.000
USNO	35	164	-	-	-	-	-	-	-	-	-	-	-	0.000
USNO	35	165	0.187	0.181	0.309	0.000	0.155	0.117	0.100	0.079	0.072	0.087	0.101	0.105
USNO	35	166	0.093	0.105	0.100	0.000	0.015	0.010	0.009	0.009	0.010	0.012	0.013	0.014
USNO	35	167	-	-	-	-	-	-	0.000	0.000	0.000	0.000	-	-
USNO	35	169	0.473	0.681	0.499	0.000	0.191	0.157	0.159	0.170	0.180	0.227	0.210	0.221
USNO	35	173	0.674	0.681	0.660	0.649	0.663	0.654	0.693	0.694	0.685	0.000	0.301	0.311
USNO	35	213	0.298	0.300	0.269	0.268	0.316	0.291	0.310	0.294	0.248	0.356	0.315	0.353
USNO	35	226	0.098	0.112	0.181	0.403	0.344	0.257	0.254	0.187	0.151	0.166	0.146	0.151
USNO	35	227	0.127	0.106	0.101	0.127	0.197	0.218	0.304	0.316	0.313	0.000	0.181	0.140
USNO	35	231	0.674	0.681	0.660	0.649	0.663	0.654	0.000	0.370	0.382	0.428	0.306	0.265
USNO	35	233	0.055	0.053	0.057	0.070	0.115	0.000	0.000	0.031	0.027	0.031	0.027	0.029
USNO	35	242	0.358	0.384	0.452	0.419	0.461	0.366	0.339	0.246	-	-	-	-
USNO	35	244	0.116	0.111	0.111	0.117	0.371	0.608	0.667	0.684	0.685	0.698	0.000	0.407
USNO	35	253	0.665	0.626	0.000	0.259	0.199	0.130	0.137	0.116	0.087	0.115	0.095	0.096
USNO	35	254	0.674	0.681	0.660	0.624	0.570	0.460	0.428	0.519	0.564	0.698	0.672	0.644
USNO	35	255	0.674	-	-	-	-	-	-	-	-	-	-	-
USNO	35	256	0.478	0.681	0.660	0.649	0.663	0.654	0.693	0.694	0.685	0.698	0.672	0.679
USNO	35	260	0.000	0.000	0.000	0.049	0.036	0.000	0.001	0.001	0.001	0.001	0.001	0.002
USNO	35	266	0.648	0.634	0.566	0.552	0.569	0.654	0.693	0.694	0.685	0.698	0.672	-
USNO	35	268	0.000	0.000	0.000	0.014	0.012	0.012	0.014	0.016	0.019	0.027	0.040	0.125
USNO	35	270	0.499	0.681	0.660	0.649	0.663	0.000	0.126	0.111	0.103	0.134	0.135	0.140
USNO	35	279	0.246	0.252	0.244	0.379	0.407	0.393	0.422	0.486	0.509	0.568	0.503	0.000
USNO	35	389	0.125	0.133	0.138	0.146	0.205	0.159	0.230	0.396	0.302	0.000	0.147	0.151
USNO	35	394	0.073	0.083	0.097	0.118	0.143	0.337	0.360	0.251	0.255	0.188	0.131	0.077

Table 9A. (Cont.)

Lab.	Clock	56319	56349	56379	56409	56439	56469	56504	56534	56564	56594	56624	56654
USNO	35 416	0.182	0.238	0.218	0.257	0.520	0.473	0.693	0.694	0.585	0.688	0.646	0.645
USNO	35 417	0.109	0.122	0.249	0.362	0.287	0.270	0.457	0.305	0.252	0.363	0.477	0.623
USNO	35 703	0.077	0.088	0.081	0.086	0.124	0.115	0.103	0.116	0.155	0.255	0.284	0.422
USNO	35 717	0.225	0.237	0.182	0.176	0.154	0.158	0.128	0.132	0.143	0.184	0.157	0.125
USNO	35 762	0.674	0.681	0.660	0.649	0.663	0.654	0.693	0.685	0.685	0.698	0.672	0.679
USNO	35 763	0.674	0.681	0.579	0.427	0.362	0.327	0.296	0.275	0.277	0.300	0.388	0.496
USNO	35 765	0.265	0.226	0.202	0.195	0.309	0.443	0.693	0.690	0.506	0.619	0.592	0.403
USNO	35 1096	0.674	0.681	0.660	0.649	0.663	0.654	0.693	0.694	0.490	0.559	0.506	0.356
USNO	35 1097	0.093	0.123	0.249	0.363	0.483	0.654	0.693	0.694	0.685	0.531	0.448	0.377
USNO	35 1125	0.003	0.003	0.003	0.005	0.017	0.196	0.000	0.036	0.028	0.025	0.020	0.021
USNO	35 1327	0.449	0.434	0.468	0.000	0.000	0.065	0.056	0.043	0.036	0.044	0.044	0.053
USNO	35 1328	0.318	0.495	0.625	0.649	0.499	0.481	0.374	0.415	0.280	0.285	0.256	0.297
USNO	35 1331	0.228	0.275	0.261	0.269	0.340	0.000	0.251	0.249	0.248	0.267	0.245	0.172
USNO	35 1438	0.000	0.000	0.217	0.284	0.297	0.376	0.400	0.413	0.410	0.391	0.256	0.000
USNO	35 1459	0.024	0.021	0.020	0.022	0.060	0.056	0.051	0.084	0.096	0.090	0.076	0.063
USNO	35 1462	0.517	0.450	0.413	0.371	0.282	0.269	0.307	0.309	0.529	0.695	0.607	0.679
USNO	35 1463	0.092	0.126	0.189	0.598	0.642	0.528	0.489	0.487	0.455	0.474	0.511	0.509
USNO	35 1468	-	-	-	-	-	-	-	-	-	-	0.000	0.000
USNO	35 1481	0.674	0.681	0.660	0.601	0.000	0.217	0.161	0.149	0.122	0.133	0.111	0.135
USNO	35 1543	0.624	0.633	0.525	0.649	0.663	0.654	0.619	0.000	0.230	0.218	0.202	0.201
USNO	35 1573	0.294	0.325	0.459	0.000	0.220	0.263	0.279	0.252	0.295	0.345	0.331	0.353
USNO	35 1575	0.674	0.681	0.503	0.431	0.299	0.286	0.346	0.404	0.335	0.456	0.422	0.522
USNO	35 1580	0.419	0.414	0.660	0.649	0.000	0.411	0.340	0.330	0.331	0.384	0.364	0.363
USNO	35 1585	0.073	0.056	0.069	0.070	0.073	0.080	0.108	0.130	0.214	0.313	0.349	0.321
USNO	35 1598	0.007	0.010	0.022	0.649	0.663	0.627	0.000	0.123	0.108	0.114	0.095	0.102
USNO	35 1658	0.187	0.130	0.121	0.116	0.106	0.108	0.118	0.174	0.193	0.320	0.441	0.649
USNO	35 1692	0.433	0.428	0.402	0.555	0.663	0.600	0.693	0.694	0.685	0.698	0.672	0.679
USNO	35 1694	0.674	0.681	0.660	0.649	0.663	0.654	0.693	0.694	0.685	0.698	0.672	0.679
USNO	35 1696	0.000	0.064	0.060	0.069	0.088	0.096	0.107	0.114	0.122	0.142	0.128	0.119
USNO	35 1697	0.674	0.681	0.646	0.504	0.623	0.634	0.693	0.694	0.685	0.698	0.672	0.679
USNO	40 701	-	-	-	-	-	0.000	0.000	0.000	0.000	0.059	0.078	0.111
USNO	40 702	0.674	0.681	0.660	0.649	0.663	0.654	0.693	0.694	0.685	0.698	0.672	0.679
USNO	40 704	0.674	0.681	0.660	0.649	0.663	0.654	0.693	-	-	0.000	0.000	0.000
USNO	40 705	0.382	0.353	0.343	0.357	0.426	0.612	0.693	0.694	0.685	0.698	0.672	0.679
USNO	40 708	-	-	-	-	-	-	0.000	0.000	0.000	0.000	0.384	0.299

Table 9A. (Cont.)

Lab.		Clock	56319	56349	56379	56409	56439	56469	56504	56534	56564	56594	56624	56654
USNO	40	710	0.000	0.000	0.000	0.000	0.000	0.000	-	-	0.000	0.000	0.000	0.000
USNO	40	711	0.001	0.001	0.001	0.001	0.001	-	-	-	-	0.000	0.000	0.000
USNO	40	712	0.674	0.681	0.660	0.649	-	-	-	-	-	-	0.000	0.000
USNO	40	713	0.046	0.041	0.037	0.036	0.037	0.035	0.038	0.037	0.038	0.046	0.041	0.040
USNO	40	714	0.145	0.136	0.129	0.130	0.143	0.140	0.152	0.158	0.177	0.206	0.209	0.216
USNO	40	715	0.019	0.019	0.019	0.020	0.024	0.033	0.058	0.072	0.076	0.091	0.086	0.000
USNO	40	716	0.634	0.597	0.573	0.593	0.663	0.606	0.626	0.559	0.532	0.624	0.590	0.578
USNO	40	717	-	-	-	-	-	-	-	-	-	0.000	0.000	0.000
USNO	40	718	0.005	0.005	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.003	0.003
USNO	40	719	0.009	0.009	0.008	0.008	0.009	0.008	0.009	0.009	0.009	0.010	0.009	0.010
USNO	40	720	-	-	-	-	-	-	-	-	0.000	0.000	0.000	0.000
USNO	40	721	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	-	-	-	-
USNO	40	722	0.001	0.001	0.001	0.001	-	-	-	-	-	-	0.000	0.000
USNO	40	723	0.075	0.070	0.070	0.079	0.099	0.132	0.291	0.341	0.329	0.378	0.342	0.334
USNO	40	724	0.019	0.015	0.014	0.015	0.019	0.024	0.046	0.223	0.210	0.241	0.178	0.153
USNO	40	725	0.325	0.311	0.286	0.287	0.306	0.340	0.417	0.423	0.466	0.675	0.511	0.452
USNO	40	728	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
USNO	40	729	-	-	-	-	-	0.000	0.000	0.000	0.000	0.001	0.001	0.001
USNO	40	730	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
USNO	40	731	0.051	0.052	0.052	0.054	0.059	0.061	0.068	0.073	0.078	0.097	0.092	0.110
USNO	40	732	0.002	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
USNO	40	734	0.001	0.001	0.002	0.002	0.002	0.002	0.001	0.001	0.001	0.000	0.000	0.000
USNO	40	735	0.002	0.002	0.002	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
USNO	40	736	-	-	-	-	-	-	-	-	-	-	0.000	0.000
USNO	40	737	-	-	-	-	-	-	-	-	-	-	0.000	0.000
USNO	93	2	0.674	0.681	0.660	0.649	0.663	0.654	0.693	0.694	0.685	0.698	0.672	0.679
USNO	93	3	0.674	0.681	0.660	0.649	0.663	0.654	0.693	0.694	0.685	0.698	0.672	0.679
USNO	93	4	0.674	0.681	0.660	0.649	0.663	0.654	0.693	0.694	0.685	0.698	0.672	0.679
USNO	93	5	0.674	0.681	0.660	0.649	0.663	0.654	0.693	0.694	0.685	0.698	0.672	0.679
VMI	35	2230	-	0.000	0.000	0.000	-	0.000	0.000	0.000	0.000	0.045	0.055	-
VMI	36	1233	-	0.000	0.000	0.000	-	0.000	0.000	0.000	0.000	0.032	0.039	-
VMI	36	2314	-	0.000	0.000	0.000	-	0.000	0.000	0.000	0.000	0.046	0.062	-
VSL	35	179	0.674	0.681	0.660	0.649	0.663	0.654	0.693	0.694	0.685	0.000	0.353	0.346
VSL	35	456	0.212	0.202	0.188	0.202	0.243	0.235	0.254	0.255	0.262	0.284	0.000	0.188
VSL	35	548	0.306	0.284	0.254	0.353	0.322	0.225	0.223	-	-	-	-	-

Table 9A. (Cont.)

Lab.	Clock	56319	56349	56379	56409	56439	56469	56504	56534	56564	56594	56624	56654
VSL	35 731	0.674	0.681	0.660	0.649	0.663	0.654	0.659	0.694	0.685	0.698	0.672	0.616
ZA	35 2233	-	0.000	0.000	0.000	0.000	0.392	0.493	0.409	0.422	0.599	0.672	-
ZA	36 1034	-	0.000	0.000	0.000	0.000	0.012	0.018	0.013	0.015	0.021	0.019	-
ZA	36 1821	-	0.000	0.000	0.000	0.000	0.044	0.064	0.088	0.117	0.147	0.165	-
ZA	36 2232	-	0.000	0.000	0.000	0.000	0.059	0.073	0.084	0.109	0.161	0.163	-

Table 9B. Statistical data on the weights attributed to the clocks in 2013

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	
2013 Jan.	101	266	415	16	24	44	7	8	15	7	44	58	0.674
2013 Feb.	103	268	425	18	32	58	7	3	12	6	45	58	0.681
2013 Mar.	102	270	425	15	24	47	7	7	14	7	46	60	0.660
2013 Apr.	99	273	428	10	22	44	8	8	19	7	48	62	0.649
2013 May	95	272	422	7	26	45	9	7	18	7	47	61	0.663
2013 June	96	265	418	6	21	37	12	7	21	6	49	62	0.654
2013 July	90	265	412	10	30	52	10	9	19	5	49	61	0.693
2013 Aug.	86	271	414	13	32	54	7	7	15	5	47	58	0.694
2013 Sep.	90	280	427	19	36	62	8	3	14	5	46	56	0.685
2013 Oct.	97	275	427	29	38	69	8	10	21	5	48	59	0.698
2013 Nov.	108	277	438	36	30	66	8	10	19	6	52	64	0.672
2013 Dec.	109	283	440	36	35	72	9	9	19	6	43	55	0.679

Wmax=A/N, here N is the number of clocks, excluding those with *a priori* null weight, A=2.50.
* *A priori* null weight (test interval of new clocks).
** Null weight resulting from the statistics.
HM designates hydrogen masers and 5071A designates 5071A units with a high performance tube.
Clocks with missing data during a one-month interval of computation are excluded.

Table 10. Relative drifts of contributing clocks in 2013

(File is available at ftp://62.161.69.5/pub/tai/scale/DTAI/dtai13.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/30days.

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

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

Lab.	Clock	56319	56349	56379	56409	56439	56469	56504	56534	56564	56594	56624	56654
APL	35 0904	0.1714	0.1771	0.0092	-0.1305	-0.2157	0.1420	-0.1217	-0.1811	-0.3271	-	-2.2406	-0.4761
APL	35 1264	-1.8929	-1.2384	-0.9854	-0.5212	-0.1808	-0.1947	-0.0265	-0.0854	0.6327	-	0.4474	0.3975
APL	35 1791	-	-	-	-	-	-	-	-	-	-	-1.2943	-0.6129
APL	40 3107	0.1133	0.1406	0.1266	0.1436	0.1583	0.1735	0.1650	0.1792	0.0704	-	-	-
APL	40 3108	1.7939	2.6575	2.8680	2.9627	2.9601	2.9509	2.8933	2.9059	2.7538	-	1.6463	2.2930
APL	40 3109	-0.4067	-0.2948	-0.3221	-0.4042	-0.4034	-0.4560	-0.4850	-0.4041	-0.5646	-	-0.5297	-0.5288
AUS	35 2269	0.0632	-0.2768	-0.0390	0.0341	-0.4101	-0.3864	-0.1336	0.0320	0.0418	0.2194	0.2421	-0.2055
AUS	36 0299	0.4838	0.1156	0.0283	1.2326	1.0456	0.1787	-1.1942	-0.3871	0.5809	0.4926	-0.3923	-0.8968
AUS	36 0340	-0.3401	0.5658	-0.0035	-0.6405	0.0517	0.7317	0.4987	-0.7074	-0.4151	0.2591	0.2306	-0.4966
AUS	36 0654	-0.1141	-0.6076	-0.5952	-0.4819	-0.4174	0.0044	0.0122	0.1114	0.3113	0.2092	0.5922	0.1514
AUS	36 1141	0.4691	0.8382	-0.1292	-0.7547	-0.1748	-0.9577	0.5356	0.4769	0.4969	-0.0049	1.0059	0.4357
AUS	40 5401	-	-	7.4971	4.2539	0.3616	1.1857	-	-	-	-	-	-
AUS	40 5402	-1.2381	-	-0.2629	0.1448	-	-1.4858	-0.3479	5.6837	-	-	-	-
BEV	35 1065	-0.3274	-0.1308	-0.1774	0.1038	0.2063	0.2529	0.7114	2.5996	3.9019	1.8110	-0.7663	-0.9211
BEV	35 1793	-0.0942	-0.1586	-0.1084	0.2753	0.2849	-0.1332	-0.0844	-0.1493	-0.1906	-0.4840	-0.2837	-0.0020

Table 10. (Cont.)

Lab.	Clock	56319	56349	56379	56409	56439	56469	56504	56534	56564	56594	56624	56654
BEV	40 3452	-7.1957	-7.2200	-0.5203	6.1923	5.9027	5.9468	5.7609	5.9401	5.7964	5.8215	-	-
BIM	18 8058	0.1636	0.0131	0.0710	0.0749	-0.1331	-0.2528	-0.5773	-0.1547	-0.5476	-0.0975	0.7115	1.1326
BY	40 4222	-1.0431	0.3258	-	-	-	-	-	-	-	0.5369	1.1067	0.8874
BY	40 4227	-	-	-	-	-	-	-	-	-	-0.8391	-1.4787	-0.6773
BY	40 4229	-	-	-	-	-	-	-	-	-	1.0329	0.9358	-1.2750
BY	40 4260	-3.1783	-3.1104	-	-	-	-	-	-	-	-	-	-
BY	40 4278	-0.3992	0.4565	-	-	-	-	-	-	-	-0.8471	-0.3151	-
CH	22 0112	3.4390	3.5738	4.7853	4.4696	3.1151	2.2682	3.1736	4.3225	5.0291	4.8128	3.2834	2.3486
CH	35 2117	0.2273	-0.0337	0.0129	-0.1437	-0.1811	0.0493	0.1869	0.2153	-0.2351	0.3573	0.0406	-0.1749
CH	35 2743	-0.0034	-0.2307	0.4272	0.0867	0.2012	-0.0241	-0.1643	-0.1899	-0.0323	0.0958	0.2017	-0.0198
CH	36 0354	-0.1285	0.4674	0.3951	0.8264	-0.4384	-0.8900	-0.0945	0.5271	0.7252	-	-	-
CH	40 5701	-1.9922	-1.8391	-1.5986	-1.3138	-1.0660	-0.8995	-0.6883	-0.6058	-0.4596	-0.5219	-0.5657	-0.5515
CNM	35 2708	0.3279	0.4852	0.2308	0.1597	-0.1579	0.2151	-0.1808	-0.2519	-0.0684	-	-1.6200	0.0891
CNM	35 2709	0.2137	0.6475	0.1260	0.0156	-0.3118	0.3225	-0.3462	-0.1199	-0.1814	-	-	-
CNM	40 7301	0.0151	0.7523	-0.0229	0.0567	-0.5564	-0.1047	-0.6716	-0.0174	-0.1979	-	-	-
CNMP	36 1752	0.1808	-0.1342	0.2601	-0.5467	-0.0136	0.1076	-0.0333	-0.5602	0.3558	0.4045	0.3320	0.0757
CNMP	36 1806	-0.0940	0.0607	0.2106	0.2366	-0.2558	-0.2511	-0.2929	-0.0958	-0.5145	0.1158	-0.3025	0.9008
CNMP	36 2873	-	-	-	-	-0.2449	-0.3630	0.3029	0.6027	0.5917	-0.2701	-0.5176	-0.1872
DLR	35 1714	-0.1252	-0.3627	0.1255	-0.2687	-0.0460	0.2916	0.1620	-0.0126	0.1027	-	-	-
DMDM	35 2191	0.0900	0.2455	0.0610	-0.0185	-0.0208	0.0106	0.0177	-0.0234	-0.0386	-0.2294	0.0482	-0.1512
DMDM	36 2033	-0.0274	3.5324	3.6929	5.7086	15.7246	26.6910	33.1656	24.8564	14.7478	3.0145	-0.2140	0.4659
DTAG	35 2635	-0.3584	-0.7289	-0.5519	-0.0756	0.6918	0.5270	0.5044	0.1135	0.9006	-	-	-
DTAG	35 2805	-	-	-	-	0.7391	0.0087	0.1113	0.2161	0.3439	0.3979	0.0467	-0.1279
DTAG	35 2865	-0.2163	-0.2376	-0.6169	-	-	-	-	-	-	-	-	-
DTAG	35 2941	-	-	-	-	-	-	-	-	-	-	0.1388	-0.2348
DTAG	36 2794	0.1259	0.0449	0.1811	-	-	0.9439	0.2523	0.4843	0.3249	-0.2301	-0.9531	-0.6145
EIM	35 0716	-	-	-	-	-	-	-	-	-	2.6958	-0.5901	0.9558
EIM	35 2060	-	-	-	-	-	-	-0.5757	-0.3092	0.0470	0.0524	0.0279	-0.0111
ESTC	22 0132	4.2174	3.3223	2.5059	0.8410	-	-	-2.6242	-1.6688	-2.8793	-2.9799	-2.7851	-2.5840
ESTC	35 1615	1.9349	1.0256	0.5064	0.0211	-	-	1.7386	0.1048	0.1578	-0.1017	-0.2548	-0.1958
ESTC	35 2025	-2.1469	-0.5907	-0.1885	0.0524	-	-	-	-	-	-	-	-
ESTC	35 2353	1.0915	0.8546	0.3568	-0.0105	-	-	-1.0771	-0.3323	-0.2820	-0.0826	0.1484	0.2483
ESTC	40 2551	0.2406	-0.4642	-0.7047	-1.3938	-	-	-1.3331	-2.0531	-2.2608	-2.3985	-2.4527	-2.4836
HKO	35 1893	0.4505	0.0690	0.0174	0.1295	-	-	-1.9128	-	-	-	-	-
HKO	35 2425	-0.0781	-0.0356	0.0771	0.1586	-	-	-0.0528	0.2090	-0.1087	-0.1765	-0.2968	0.0424

Table 10. (Cont.)

Lab.	Clock	56319	56349	56379	56409	56439	56469	56504	56534	56564	56594	56624	56654
HKO	35 2884	-	-	-	-	-	-	-	-	-0.7872	0.0481	0.3208	0.3044
IFAG	36 1167	-0.6407	-0.7882	-1.0516	-0.0663	0.5353	1.1456	0.7298	0.4953	0.2985	0.0789	-0.1227	-0.6454
IFAG	36 1173	-1.5720	-1.6058	-0.9940	-0.4614	1.1427	1.6378	1.0688	-0.4172	0.5296	1.4358	1.1041	-1.2839
IFAG	36 1629	0.0900	-0.0226	-0.2392	-0.2248	-0.2481	0.3745	0.8778	0.8389	0.2086	-1.0404	-1.5671	-0.8946
IFAG	36 1732	-0.3529	-0.3012	-0.1586	0.1818	0.2820	-0.2786	-0.5549	-0.5398	-0.2415	-0.1750	-0.0402	0.1834
IFAG	36 1798	0.1077	0.0640	0.0023	0.1457	0.1455	-0.0620	-0.0140	-0.1534	0.0896	-0.0770	0.1042	-0.0808
IFAG	40 4418	0.3851	0.3974	0.3092	0.3262	0.1618	0.0153	0.0467	0.1276	0.3204	0.3331	0.5508	0.4572
IFAG	40 4439	-0.3748	-0.3591	-	-	-0.9998	-1.1704	-1.2922	-1.2974	-1.1329	-0.5235	-0.1762	-0.0976
IGNA	35 1196	0.3509	-0.5631	-0.8154	-	-	-	3.8986	1.2929	0.8150	0.2064	-0.3236	-0.4059
INPL	35 2480	-0.0200	0.3686	0.3354	0.1912	0.2492	0.0476	0.0744	0.0437	0.2170	0.1992	-0.0827	-0.3107
INPL	35 2481	-0.1215	0.0814	0.2758	0.2182	0.1697	-0.0572	-0.3177	-0.2626	-0.2112	-0.0386	0.0241	-0.1021
INTI	35 2377	-0.9362	0.7188	-0.4360	-	-7.7912	-2.0011	-1.1200	-0.7497	0.4799	0.3876	-0.9126	-0.0027
INXE	35 2393	-	-0.6142	-0.4042	-0.2242	-0.3301	0.0723	0.0907	0.0722	0.0812	-0.0826	0.0138	0.0755
IT	35 0219	-0.1604	-0.1785	-0.2620	-0.0588	-0.0173	0.2672	0.0649	-0.1688	-0.0878	0.1034	-0.0234	0.0109
IT	35 0505	-0.0472	0.1175	0.2419	0.3446	0.0800	-0.0173	-0.0688	-0.1207	0.0837	0.2638	0.3235	0.1245
IT	35 1115	-0.4057	-0.1297	0.1304	-0.1441	-0.1518	0.3566	-0.0741	-0.0511	-0.3588	-0.0251	-0.6143	-3.3097
IT	35 1373	-0.1253	-0.1662	-0.0480	0.0615	0.1061	-0.2311	-0.3122	-0.0298	0.3700	0.2708	-0.0152	-0.2837
IT	35 2118	-	-	-	2.4394	0.0353	0.2013	0.4322	0.1264	-0.0295	-0.1185	0.0420	-0.1165
IT	35 2487	0.3341	-0.0324	-0.2673	-0.0406	0.4330	0.3099	0.4332	0.2607	0.4551	0.2137	0.0473	-0.0910
IT	40 1101	5.2373	5.1418	5.1005	5.0236	4.9705	5.4091	5.3194	5.3120	5.2649	4.9131	4.8638	4.7442
IT	40 1102	5.6651	5.3765	5.3318	5.3210	5.4088	6.0061	5.8765	5.6923	5.7002	5.2298	5.2447	5.1129
IT	40 1103	1.3834	1.3383	1.3562	1.3749	1.4140	1.3858	0.9499	0.8975	0.7553	0.6715	0.8708	0.8694
JV	21 0216	1.8267	0.0441	0.7085	-0.1319	-1.3324	0.0212	2.7432	1.9155	1.9882	0.8245	1.5111	1.3314
JV	36 1277	-0.4505	-0.8247	0.7243	0.3330	0.3131	-0.2923	0.1774	0.2310	0.5077	0.6300	0.1448	0.2341
JV	36 2617	-	-4.1011	-0.2116	-0.9254	-0.6309	-0.2560	0.6548	0.6098	0.5799	-0.0045	-0.2075	-0.3193
JV	36 2629	0.0173	-0.1865	-0.2574	-0.4366	-0.5802	0.1384	0.5557	0.2658	0.0384	0.6527	0.4862	-0.5015
KEBS	35 2518	-0.1991	0.4337	0.9908	1.3084	-	-	-	-	-	-	-	-
KIM	36 0618	0.4026	-	-	-3.0703	0.5979	-0.7637	0.0992	0.5729	1.2995	-0.0687	-1.4273	-0.5367
KRIS	35 0321	0.3798	0.4734	0.2690	-0.0402	0.1089	0.1024	-	-	-0.5129	-0.6258	-0.0703	-0.0848
KRIS	35 0739	-0.0559	-0.1451	-0.1876	-0.0949	0.0813	0.1031	-	-	1.6814	-0.5314	-0.0606	0.1530
KRIS	35 1135	0.4750	0.3888	0.2036	0.4785	0.0999	0.0445	-	-	-1.2055	-0.0509	0.2600	0.3432
KRIS	35 1693	-0.1743	0.0302	0.0487	-0.0311	-0.1719	-0.1511	-	-	0.4985	-0.5540	0.0873	-0.0015
KRIS	35 1783	-0.3340	0.1227	0.1740	0.2764	0.3721	-0.1754	-	-	1.9488	0.2482	0.0782	-0.1403
KRIS	40 5624	0.1121	0.1035	0.0936	0.1141	0.1323	0.1509	-	-	0.0691	0.0686	0.1391	-
KRIS	40 5625	-0.0062	0.0339	0.0153	0.0671	0.1027	0.1161	-	-	-	-	-	0.0642

Table 10. (Cont.)

Lab.	Clock	56319	56349	56379	56409	56439	56469	56504	56534	56564	56594	56624	56654
KRIS	40 5626	0.9399	0.9487	0.5718	0.2584	0.2470	0.2553	-	-	0.1331	0.1668	0.2214	0.2085
KZ	35 2202	-	-	-	-	-11.8712	-3.5493	-1.0066	-0.8192	0.1238	-0.0862	0.2729	-0.1829
KZ	35 2665	-	-	-	-	30.8077	15.5504	6.3478	4.3142	0.0924	0.6205	0.4140	0.2044
KZ	35 2667	-	-	-	-	26.4980	14.1935	6.8126	4.1259	-0.1054	-0.0033	0.2661	0.2194
LT	35 1362	-0.0922	0.5729	0.0378	0.0075	0.1003	-	-2.2385	-2.1877	-1.6037	-1.0193	0.5114	0.2196
LT	35 1868	-0.6259	-0.4938	0.3127	0.6853	0.4314	-	-1.4585	0.3191	0.3439	0.0658	-0.3283	-0.1501
MIKE	35 1171	-0.4060	0.3461	0.4489	0.1484	-0.4089	0.0362	-	-	-	-	-	-
MIKE	36 0986	-0.5939	-0.1363	-0.1161	0.5514	0.3016	-0.0918	-0.3768	-0.0378	0.3098	0.7195	0.9038	0.0212
MIKE	40 4108	0.4738	0.5018	0.5110	0.5262	0.5462	-3.9517	-3.7783	-3.7741	-2.4783	0.5365	0.5612	0.8172
MIKE	40 4113	-	-	-	-	-	-	-	-	-2.5149	-0.5241	0.2379	0.1650
MIKE	40 4180	-	0.8196	0.6710	1.1264	0.9036	0.5393	-	-	-	0.1289	0.0994	0.1109
MKEH	36 0849	0.1885	0.3215	0.2026	-0.1375	-0.2681	-0.1893	-0.5084	-0.8236	-0.1572	0.4413	0.3854	-0.1086
MSL	12 0933	-	-	-	3.7080	2.3581	-	-	-	-	-	-	-
MSL	36 0274	-	-	-	2.2543	-0.7712	-1.1492	-1.8455	-	-	-	-	-
MSL	36 2869	-	-	-	7.1160	3.4784	1.0847	-0.9958	-	-	-	-	-
NAO	35 0779	0.2956	0.1246	-0.2491	-0.0524	0.3249	0.0052	-	-	0.5225	-0.4827	0.3954	0.3824
NAO	35 1206	0.4866	1.4593	0.0827	0.0665	0.5009	0.4585	0.1176	-0.3730	-0.4599	-0.6983	0.0050	0.3783
NAO	35 1214	-3.2552	-0.6634	0.0249	0.1898	0.2062	0.0600	0.1475	0.2675	-0.0250	-0.2390	-0.3514	0.6095
NAO	35 1689	0.3956	0.7052	0.8163	0.3574	0.1682	-0.3305	-0.5342	-0.6986	-0.6950	-0.4244	0.0474	-0.0550
NAO	40 1301	-2.0221	3.8611	1.4656	-0.9381	0.6366	-2.5952	-0.3333	-0.8274	-0.9062	-0.5352	-0.9136	-0.2715
NICT	35 0112	0.2110	0.3467	0.1989	0.4662	0.3762	0.4707	-0.2996	-0.3770	-0.0978	-0.1924	-0.7187	-0.6799
NICT	35 0332	0.3488	0.6610	0.1905	0.0289	-0.1713	-0.0316	-0.2290	-0.2657	-0.0800	-0.1255	-0.3505	-0.5287
NICT	35 0342	0.0553	0.0926	-0.2012	-0.2697	-0.6459	-	-	-	-	-	-	-
NICT	35 0343	-0.1632	-0.2255	-0.1914	-0.2440	-0.1133	0.1318	-0.0033	0.1480	0.0406	-0.0102	-0.1859	-0.0551
NICT	35 0715	0.1350	0.0171	-0.0536	-0.2220	-0.2010	-0.1547	0.0131	0.0257	0.1438	-0.0042	-0.0259	-0.1380
NICT	35 0732	-0.2156	-0.0756	0.0245	0.0883	-0.1276	-0.2216	-0.0141	0.0201	-0.1506	-0.2875	-0.1253	-0.0083
NICT	35 0907	0.1861	-0.0857	-0.0681	0.1081	0.0750	-0.0011	-0.0874	-0.0928	0.0379	0.1307	-0.0121	-0.1215
NICT	35 0913	1.2297	0.4416	0.1319	-0.0765	-0.4607	-0.8492	-0.5847	-0.4880	-0.2237	0.0519	1.1841	1.1623
NICT	35 0916	-0.1248	-0.1002	0.2217	0.0838	0.0407	-0.1626	-0.1901	-0.5500	-0.0946	-0.0160	-0.1416	-0.3628
NICT	35 1225	-0.1500	-0.1433	-0.4665	-0.1096	0.2726	0.2487	-0.2185	-0.2010	0.4741	0.1659	0.1442	-0.4007
NICT	35 1226	0.2879	-0.1300	-0.3644	-0.5015	-0.1294	-0.1634	0.1958	0.1321	-0.0452	-0.9974	-1.0440	-0.4541
NICT	35 1611	-0.5106	-0.5132	-0.4604	-0.2615	-1.1114	-1.7247	-1.1238	-4.4845	-3.6279	-0.0008	4.2600	0.4019
NICT	35 1778	0.0611	-0.4529	-0.3283	-0.0885	0.1446	-0.1891	-0.3350	-0.4324	-0.1597	0.1280	0.1711	0.1525
NICT	35 1789	-0.2129	-0.1310	0.2107	-0.1907	0.0706	-0.0342	0.0266	-0.1787	0.0757	-0.0054	0.0118	-0.2025
NICT	35 1790	0.2000	0.1163	-0.1496	-0.2651	-0.2056	-0.1125	0.2524	0.0175	-0.0930	-0.2085	-0.3222	-0.3664

Table 10. (Cont.)

Lab.	Clock	56319	56349	56379	56409	56439	56469	56504	56534	56564	56594	56624	56654
NICT	35 1866	-0.0822	-0.1554	0.1573	0.0804	0.0160	-0.0773	0.2683	-0.2019	-0.1220	-0.1378	0.1705	-0.1696
NICT	35 1882	-0.2681	-0.0488	0.0226	0.1170	-0.0767	0.0341	-0.0673	0.0496	-0.1421	-0.2932	-0.2617	-0.0412
NICT	35 1887	-1.4974	-1.3700	-2.3646	-2.7804	-6.2234	-7.5197	-6.8318	-3.9078	-2.0271	-2.0353	-2.1411	-2.4853
NICT	35 1944	-0.1946	-	-	-0.4337	0.0361	0.1406	0.1156	0.0469	0.1024	0.0827	-0.1022	-0.1002
NICT	35 2010	0.0038	-	-	-	-	-	-	-0.3040	0.1325	-0.3386	-0.3654	-0.2371
NICT	35 2011	-0.0138	0.1803	0.5807	0.3015	0.1232	0.0135	0.1704	-0.0221	0.0949	0.3938	0.4855	0.4660
NICT	35 2056	0.0188	0.0881	0.0429	-0.1082	-0.1358	-0.0126	0.1948	0.4613	0.4088	0.6542	0.4079	0.1342
NICT	35 2113	-	-	-	-1.0817	-0.6470	0.1958	0.1397	0.0929	0.0518	0.2527	0.2128	0.2002
NICT	35 2116	-0.3582	-0.0973	-	-	-	-	-	-	-	-	-	-
NICT	35 2570	-0.0368	-0.0345	0.0959	-0.1361	-0.0794	0.0219	0.0953	0.0616	0.7050	0.9103	0.4883	-0.3989
NICT	35 2574	0.1176	0.0913	0.0940	-0.1074	0.0475	0.2440	0.3062	0.3275	0.2698	0.3888	0.3638	0.1866
NICT	35 2627	-0.0210	-0.0770	-0.1873	-0.0179	0.1460	0.3408	0.4219	0.4473	0.3356	0.0459	-0.2551	-0.1467
NICT	35 2628	-0.3014	-0.1359	0.1385	0.2287	-0.0534	-0.1324	-0.0146	0.0214	-0.0508	-0.5571	-1.0974	-1.0148
NICT	35 2784	0.1739	0.1509	0.1376	-0.1116	-0.0113	0.4083	0.0650	0.2318	0.2386	0.4265	0.2446	0.3226
NICT	35 2903	-	-	-	-	-	-	-	-	-0.3621	-0.3165	-0.0377	-0.0255
NICT	36 1217	0.6728	0.4123	-0.0502	-0.2003	-0.4570	-0.9098	-0.1703	-0.0170	0.2353	0.2231	0.9746	0.7639
NICT	40 2003	-2.8914	-2.8096	-2.4960	-2.1172	-1.3843	-1.0978	-1.0033	-0.8574	-0.6562	-0.4819	-0.2771	-0.1306
NICT	40 2004	1.1121	1.2322	1.2727	1.4027	1.5027	1.5996	1.5800	1.5409	1.5471	1.5631	1.5647	1.6451
NICT	40 2005	1.8187	1.8896	1.7301	1.6323	1.6470	1.5161	1.3950	1.3959	1.0271	1.2448	1.5264	1.7407
NICT	40 2006	1.2443	1.4096	1.5023	1.4567	1.5149	1.6170	1.8117	1.9192	1.7354	1.5248	1.3438	1.2920
NIM	35 1235	0.1202	0.3111	0.1729	0.1225	-0.5231	0.6020	0.7840	0.0347	-0.6557	0.1589	0.8831	0.3233
NIM	35 2239	-0.1425	-0.1386	-0.0266	-0.2931	0.1174	0.2457	0.0651	-0.2291	-0.2387	-0.1294	0.1129	0.1924
NIM	35 2256	-0.0677	0.0436	-0.0560	-0.0209	0.0254	0.1722	0.0646	0.0450	0.0566	0.1840	-0.1446	0.1856
NIM	35 2483	0.3559	0.4206	0.2721	0.1829	0.2022	0.3404	0.1183	-0.0335	0.0766	0.2367	0.2857	0.2976
NIM	35 2643	0.1382	0.0798	0.0681	0.1547	0.3460	0.4081	0.1633	-0.0190	0.0868	0.4286	0.3882	0.2255
NIM	35 2744	0.4001	1.3042	0.9451	0.7859	0.6114	0.7029	0.6355	0.6838	0.7585	0.6822	0.6381	0.5461
NIM	35 2767	0.3003	0.1710	0.0390	-0.0447	0.2168	0.6291	0.5842	0.2565	0.1947	0.1826	0.1718	-0.3723
NIM	40 4832	2.0093	2.3400	2.6936	3.1314	3.3270	3.4048	3.2083	-	-	1.3929	2.0049	2.2945
NIM	40 4835	2.0025	2.3157	2.9005	2.1628	2.1705	2.4483	2.0050	2.2876	1.5071	-	-	1.0802
NIM	40 4871	3.7175	3.8826	3.8275	3.9019	3.9114	3.9909	3.9184	-	-	2.5289	3.3831	3.7321
NIM	40 4878	3.7269	4.0166	4.1649	4.3593	4.3531	4.2466	4.0300	-	-	2.5049	3.2813	3.5486
NIM	40 4879	6.1505	7.0287	8.0571	8.7454	8.5636	8.0153	7.5533	-	-	3.5769	5.1067	4.8709
NIM	40 4880	6.0422	6.3957	6.5214	6.7627	6.9270	7.0848	7.0984	-	-	4.7209	6.3213	6.6827
NIMB	35 0600	-0.3007	0.1655	-0.7191	-1.2134	-1.4374	-0.1981	0.0351	0.2063	1.0010	0.4798	-	-0.0796
NIMT	35 2246	0.3913	-0.0816	-0.1060	-0.3495	0.1370	0.0698	-	-	-1.2706	-0.1588	-	1.4222

Table 10. (Cont.)

Lab.	Clock	56319	56349	56379	56409	56439	56469	56504	56534	56564	56594	56624	56654
NIMT	35 2247	-0.2245	0.1177	0.1396	-0.3872	-0.2422	0.2598	-	-0.8938	0.2223	0.3160	-	0.5924
NIS	35 1126	-	-5.1879	-	-0.3000	-	-	-	-	-	-49.3842	-	-
NIST	35 0282	0.2997	0.0761	0.1362	-0.1156	0.1404	0.1904	0.2287	-0.0772	-0.1514	0.1184	0.3235	-
NIST	35 0408	0.0701	0.0188	-0.0831	0.0113	0.1589	0.1825	0.0371	0.2777	0.2169	0.0669	-0.2839	0.0639
NIST	35 1074	0.8710	0.4024	-0.3158	-0.4334	-0.3177	-0.0016	-0.6482	-0.5667	0.1105	0.4766	-0.0733	-0.9019
NIST	35 1519	-	-	1.2858	0.5360	0.4176	0.4847	0.3696	0.5378	0.5677	0.7127	0.7616	0.9183
NIST	35 2031	0.4275	0.4024	0.0268	-0.0533	0.2509	0.4127	-0.0244	0.0487	-0.2662	-0.4934	-0.5051	0.0438
NIST	35 2032	-	-	-	-	-	-	-	-	-	-2.3648	-0.2167	0.3577
NIST	35 2034	0.1959	0.1797	0.0642	-0.0549	0.0386	-0.1948	-0.3531	-0.3095	-0.0971	-0.0336	0.1549	-0.1081
NIST	35 2579	-0.2049	-0.3102	-0.0795	0.0853	0.1776	0.1808	0.0022	-0.0422	-0.0998	0.0150	-0.3968	-0.5442
NIST	35 2672	0.1119	0.2530	0.2753	0.4336	0.4059	0.1725	0.1188	-0.2150	0.0499	0.1673	0.3067	-0.0143
NIST	40 0203	0.9556	0.9452	0.9597	0.9853	-	-	-	-	-	-	-	-
NIST	40 0204	0.2825	0.2513	0.2084	0.2758	0.2349	0.2309	0.2217	0.2292	0.2171	0.2731	0.2464	0.2555
NIST	40 0205	-0.0253	0.0183	-0.0195	0.0445	0.0557	-0.0230	-0.0350	-0.0158	0.0338	0.0381	0.0464	0.0381
NIST	40 0206	0.4512	0.4757	0.4345	0.3714	0.3723	0.3179	0.4217	0.4992	0.5204	0.5415	0.5647	0.5772
NIST	40 0222	0.0187	0.0722	0.0675	0.0880	0.0922	0.1074	0.0750	0.0876	0.0654	0.0915	0.1125	0.1146
NMIJ	35 0224	-0.2153	-0.3960	-0.2117	-0.0581	-0.2207	-0.7236	-0.1798	-0.0250	-0.1224	-0.3504	-0.3443	-0.3203
NMIJ	35 0523	0.2024	0.1882	0.0555	0.3551	0.1309	0.0767	-0.1718	-0.0572	-0.0328	0.1586	0.3822	0.5244
NMIJ	35 1273	-0.0779	0.4732	0.3376	0.0155	-	-	-	-	-	-	-	-
NMIJ	40 5002	0.4408	-	-2.0309	-0.5970	-	-	-	-	-	-	-	-
NMIJ	40 5003	-0.0479	-0.0339	0.0553	0.0445	0.0540	-0.0073	-0.0716	-0.0958	-0.0279	0.0098	0.0690	-0.0124
NMIJ	40 5015	3.6425	3.5870	3.4623	3.4323	3.3653	3.3214	3.1917	3.0992	3.0738	3.0465	3.0517	2.9616
NMLS	35 0328	-0.4631	0.0780	-0.0126	0.1212	0.2256	1.1225	1.0555	0.2751	-0.0455	-0.3206	-6.5069	-8.5687
NPL	35 1275	-0.2160	-0.0158	0.1330	0.0278	0.1476	0.7299	1.0290	0.8627	-0.2267	-1.0477	-0.9635	-0.1154
NPL	36 0784	-0.4141	-0.3327	-	-	-	-	-	-	-	-	-	-
NPL	40 1701	0.2530	0.3000	0.2449	0.1558	0.3444	0.2987	0.2200	0.0409	0.1054	0.2215	0.2725	0.3877
NPL	40 1708	0.2662	0.3051	0.2458	0.2096	0.2209	0.1996	0.1601	0.2510	0.3469	0.3230	0.2375	0.2775
NPLI	35 0057	-0.8146	-0.7624	-0.3979	0.3096	0.8731	1.0561	0.9973	0.5213	-0.2897	-0.6618	-0.4840	-0.1483
NPLI	35 0140	-0.1814	-0.1278	-0.3036	-0.4297	-0.3623	1.1804	1.4786	1.1733	0.1643	-0.1704	-1.5002	-1.6693
NPLI	35 1324	0.6256	0.5432	-0.3031	-0.5041	-0.6407	-0.4496	0.0410	0.5249	0.2705	-0.2368	-0.0966	0.0745
NPLI	35 2245	-0.1357	-0.3325	-0.0323	0.4214	0.5417	0.4466	0.1026	0.1457	0.1630	0.2780	-0.0896	-0.2067
NPLI	35 2796	0.0873	0.1354	0.2467	-0.0224	0.1383	0.1782	0.4466	0.1000	0.0253	-0.0260	0.2427	0.2070
NPLI	40 5201	-1.8270	-1.6061	-1.3029	-0.0477	2.7914	3.2153	-4.2767	0.5309	1.0071	-1.0669	0.4099	-0.2158
NRC	35 2148	-0.0733	0.0549	-0.0526	-	-	-	-	-	-	-	-	-
NRC	35 2150	-0.1000	-0.1018	0.0547	0.1893	-0.2753	-0.0387	0.1366	0.2521	0.1242	0.2326	-0.0310	-0.3779

Table 10. (Cont.)

Lab.	Clock	56319	56349	56379	56409	56439	56469	56504	56534	56564	56594	56624	56654
NRC	35 2152	-0.0380	-0.2964	0.0931	-0.1628	-0.0530	-0.3626	-0.0972	-0.2653	-0.0315	0.1295	-0.0935	-0.0829
NRC	36 2219	-	-	-	-	0.8214	0.9826	0.5109	0.3416	-0.1366	0.1784	0.4487	0.4287
NRC	40 0304	-	-	-	-	-	-	-	-	-	-	0.2143	0.7039
NRC	40 0306	-	-	-	-	-	-	-	-	-	-	4.2063	5.5949
NRL	35 0714	-	0.2978	-0.3349	0.1588	0.1708	0.3682	-	-2.0869	-0.9844	-0.5853	-	-
NRL	35 0719	-	0.2121	-0.2531	0.0225	0.2180	0.2755	-	-0.3966	-1.1384	-1.1705	-	-
NRL	35 1245	-	2.2658	4.1575	1.5074	-0.4912	-1.7290	-	-5.5669	-5.2574	-7.1848	-	-
NRL	36 0387	-	2.4166	-0.4415	-0.1084	-0.3994	-0.1787	-	1.1497	-1.0356	-1.0184	-	-
NRL	40 1001	-	-1.8764	-1.5726	-1.1360	-1.2573	-0.7900	-	-0.7469	-2.3119	-0.6578	-	-
NTSC	35 1007	0.1466	0.1830	-0.0390	0.4765	0.0781	-	-	-	-	-	-	-
NTSC	35 1008	-0.0644	0.1518	0.2762	-0.2223	0.0378	0.0087	0.8868	1.1582	1.1078	-0.2969	-1.1689	-1.6300
NTSC	35 1011	0.3899	0.1058	0.4750	0.3521	0.6452	0.4081	0.6496	0.2994	0.1460	0.3639	0.7316	1.2055
NTSC	35 1016	-0.3437	-0.3925	-0.1027	-0.3510	0.0914	0.0358	0.1776	-0.0381	0.5945	0.3426	-0.2263	-0.7832
NTSC	35 1018	0.4876	-0.1058	-0.2448	0.0992	0.2808	-0.1663	-0.0792	-0.0306	0.0161	-0.0899	0.1758	0.3239
NTSC	35 1818	0.1443	-0.2699	-0.8446	-0.6381	-0.0907	-0.4592	-0.1817	-0.8603	-0.2024	-0.3975	-0.3642	-0.1974
NTSC	35 1820	0.4941	0.8849	0.9126	0.5412	-0.2234	0.5619	0.5059	0.6426	-0.0553	0.1806	0.3451	0.4893
NTSC	35 1823	0.2067	0.1063	0.2654	0.0817	0.0636	-0.0428	0.3446	0.1408	-0.0209	0.0144	0.2623	0.2475
NTSC	35 2096	-0.1990	-0.3356	-0.1064	0.2060	0.0284	0.2515	-0.0010	-0.0467	-0.1499	-0.2075	-0.3761	-0.0673
NTSC	35 2098	0.0049	0.4656	0.1665	0.0910	-0.4622	-0.4417	-0.1125	0.1169	0.0605	-0.2555	0.3415	0.0227
NTSC	35 2131	0.0902	0.0213	-0.0207	-0.0562	-0.2081	-0.2591	-0.1519	0.0539	0.0321	-0.2905	-0.4430	0.0978
NTSC	35 2141	4.4159	0.0822	-2.4724	-2.0401	2.4587	4.5419	1.2576	-1.8047	-2.9625	0.5338	2.0848	-2.5163
NTSC	35 2142	-0.2716	0.0357	-0.0942	-0.1396	0.0290	-0.0795	-0.0123	-0.0580	0.0158	0.1203	0.0280	-0.0546
NTSC	35 2143	-0.3685	0.0173	0.0431	-0.2961	-0.1318	-0.0875	0.4058	0.1438	0.3120	-0.2222	-0.1978	0.4657
NTSC	35 2144	-0.2842	0.5625	0.3438	-0.3704	-0.0688	0.3963	0.8997	0.0188	-0.2876	-1.1270	-0.4138	-0.0508
NTSC	35 2145	-0.1922	-0.0774	-0.1147	-0.0850	-0.1691	-0.1607	-0.0426	0.1582	0.1302	0.0390	-0.1763	-0.3388
NTSC	35 2147	-0.0878	-0.2900	-0.4615	-0.6427	-0.3813	0.0305	0.1491	-0.0932	-0.1162	-0.0944	0.1837	0.1890
NTSC	35 2573	-0.0625	0.2004	0.2020	0.0408	-0.0755	-0.1710	-0.0273	-0.0489	-0.0870	-0.1542	0.2150	0.4695
NTSC	35 2831	0.6918	0.5482	0.0781	0.2607	0.4062	0.6105	0.6635	0.3312	0.3216	0.0546	0.7697	0.3921
NTSC	35 2852	-	1.1206	0.2995	-0.1708	0.1482	0.1998	0.3578	0.0923	0.0563	-0.0278	0.0970	0.1031
NTSC	35 2855	0.3373	0.3576	0.2280	0.0195	-0.0790	0.2013	0.2843	0.0621	-0.1639	0.1040	0.3026	0.5090
NTSC	35 2921	-	-	-	-	-	-	-	1.1188	-0.1331	-0.0033	0.0146	0.0158
NTSC	35 2922	-	-	-	-	-	-	1.1772	0.4510	0.2197	0.0594	-0.0960	-0.1842
NTSC	35 2924	-	-	-	-	-	-	-	0.0217	0.9268	0.6360	0.2741	-0.0625
NTSC	35 2926	-	-	-	-	-	-	1.5843	0.4609	0.2420	0.0236	0.0019	0.3374
NTSC	35 2928	-	-	-	-	-	-	-	-0.9349	0.3746	0.3943	0.1700	-0.0446

Table 10. (Cont.)

Lab.	Clock	56319	56349	56379	56409	56439	56469	56504	56534	56564	56594	56624	56654
NTSC	35 2933	-	-	-	-	-	-	0.9672	-0.0725	-0.2100	-0.1311	0.0625	-0.0341
NTSC	40 4926	5.3608	6.4026	6.9910	6.7419	6.2870	5.7492	5.3450	5.1026	5.3971	5.5781	5.7890	5.8468
NTSC	40 4927	2.6947	3.1748	3.8692	3.7888	3.5949	3.2309	2.7533	2.7092	2.7821	2.3548	2.5560	-
NTSC	40 4943	-	-	-	-	-	-	-	-	-	-	-	-0.2398
NTSC	40 4945	-	-	-	-	-	-	-	-	-	-	-	0.6642
NTSC	40 4946	-	-	-	-	-	-	-	-	-	-	-	0.1122
ONBA	36 2228	0.3508	0.2159	-0.4448	-0.2289	0.3761	0.4957	-0.1414	-0.0645	0.1212	-0.0264	-0.1667	-
ONRJ	35 0102	0.1874	-0.1535	-0.1592	-0.2003	-0.4112	-0.3030	0.0727	0.3662	0.1689	-0.0566	0.2264	0.5684
ONRJ	35 0103	0.5996	-0.0068	-0.2062	-0.0945	-0.0321	0.0366	0.2539	-0.0297	-0.3054	-0.5609	0.1270	-0.1054
ONRJ	35 0123	0.2230	-0.0127	-0.3166	0.2912	-0.2469	-0.0373	-0.0540	0.0157	0.0544	0.3074	0.6981	0.3472
ONRJ	35 0129	0.1549	0.1231	0.1401	-0.1364	0.0088	-	-1.3899	-0.3290	-0.0643	-0.1293	-0.3438	-0.2795
ONRJ	35 0147	0.0160	0.1627	0.1086	0.0385	0.1696	0.0373	0.2166	0.0041	0.2223	0.2390	0.2464	-0.1201
ONRJ	35 1153	-0.1085	-0.0064	-0.0002	0.0886	-0.0407	0.0920	0.0601	0.2043	0.1403	0.0256	0.0458	0.0803
ONRJ	35 1942	0.0709	-0.1387	-0.2661	-0.2158	-0.0959	-0.3402	-0.7198	-0.5746	-0.2491	-0.2650	-0.2295	-0.1907
ONRJ	40 1950	-5.8613	-7.0477	-7.0508	-8.8129	-8.6225	-10.3517	-10.5916	-13.3974	-14.2496	-11.3002	-7.1275	-0.7097
ONRJ	40 1958	0.1817	-0.3487	-0.0629	-0.3746	-0.3356	-0.1465	0.2917	0.8292	0.9388	0.3565	-0.1101	-0.2784
OP	35 0124	0.0130	-0.3844	-0.3808	-0.3542	-0.0431	-0.0989	0.1864	0.2756	0.1192	-0.2195	-0.1895	0.1181
OP	35 0157	-0.0281	-0.0067	0.1910	-0.2269	-0.0731	-0.0831	0.1343	0.1248	0.2822	0.2083	-0.0530	-0.1908
OP	35 0158	-0.1564	-0.1289	-0.1854	-0.0034	-0.0830	-0.4070	-0.5556	-0.4508	-0.4147	-0.1073	0.8762	1.1274
OP	35 0355	0.1480	-0.2062	-0.2964	-0.4072	0.0088	0.0089	-0.1518	-0.3858	-0.3200	0.1525	0.2969	0.1117
OP	35 0385	0.4266	0.7552	0.5595	-0.4169	-1.0127	-0.9310	0.5763	0.8434	0.4065	0.0080	-0.1141	0.2917
OP	35 0396	0.2142	0.3062	0.1702	0.0746	0.2387	0.2976	0.5809	0.6352	0.5708	0.2748	-0.0222	-0.1323
OP	35 0469	1.0684	0.3086	0.6650	0.5658	0.1874	-	-	-	-	-	-	-
OP	35 0520	-0.1385	-0.0459	0.0600	-0.6501	-0.4318	-0.4425	-0.4304	-0.6759	0.0549	-0.0671	-0.6459	-0.4436
OP	35 0609	-0.4561	-0.0527	0.4345	0.4376	0.2022	-0.0387	0.1539	0.2513	0.2340	-0.2603	-0.9849	-1.0918
OP	35 0700	-1.8617	-1.4668	-1.0289	-0.4713	-0.3919	-0.4499	0.8460	1.9763	2.3790	1.8178	1.3152	1.1596
OP	35 0770	0.0405	0.0893	-0.1145	-0.2109	0.0807	0.1330	-0.0814	-0.1163	0.0788	-0.4595	-0.9002	-0.3258
OP	35 0774	0.0237	-0.1483	-0.1182	0.0946	0.1681	-0.2626	-0.2575	-0.3132	-0.1357	-0.1823	0.0176	-0.1681
OP	35 0781	0.5012	0.0835	-0.2221	0.0284	-0.1733	-0.4602	-0.3686	-0.5987	-0.4631	-0.2474	0.4941	0.3768
OP	35 0819	-0.1788	0.3653	0.6010	0.6296	-0.1121	-0.8486	-1.2857	-0.9366	-0.2117	0.6075	-	-
OP	35 0859	-	-4.1491	-	-	-0.2689	-	-	1.5851	-0.3572	0.0311	-0.2348	-0.0773
OP	35 1177	-0.5708	-0.1827	0.2471	-0.1499	-0.2395	-0.5066	0.0129	-0.2523	0.1818	-0.2201	0.0637	0.0515
OP	35 1222	-	-	1.8652	0.9732	0.2273	0.2771	0.0928	0.1933	0.0490	0.1664	0.1079	0.0842
OP	35 1321	0.0445	-0.1779	0.3274	0.7256	-0.1136	-0.9462	-0.6685	0.0265	-0.0896	-0.3725	-0.0731	0.4009
OP	35 1556	-0.0427	-0.0645	0.1770	0.4947	0.3546	0.2167	0.0297	0.1422	0.2592	0.3919	-0.1159	-0.2037

Table 10. (Cont.)

Lab.	Clock	56319	56349	56379	56409	56439	56469	56504	56534	56564	56594	56624	56654
OP	35 1644	0.0827	0.2165	0.2481	0.2596	-0.1694	-0.0916	-0.0702	0.0293	-0.0660	-0.0862	-0.1117	-0.3213
OP	35 2027	0.1634	0.1848	0.1754	-0.0902	-0.0037	0.0103	-0.0673	-0.0989	0.1566	-	-	-
OP	35 2388	0.0948	0.2411	-0.0307	-0.1832	-0.4529	-0.2975	-0.1884	0.0733	0.0072	-0.0468	-0.1976	-0.1181
OP	35 2609	0.0365	0.0740	0.2815	-0.0763	-0.0561	-0.0903	0.0694	0.0672	-0.2715	-0.1696	0.0609	0.0920
OP	35 2647	0.1811	-0.1707	0.0434	0.5075	0.4940	-	-	-	-	-	-	-
OP	35 2804	0.0886	0.2050	0.3382	0.1365	0.1294	0.1706	0.2201	0.2897	0.3236	0.3483	0.1009	0.0508
OP	40 0809	0.4947	0.4965	0.5353	-	-	-	-	0.4371	0.7536	0.7681	0.7525	0.7198
OP	40 0810	0.7747	0.7330	0.7858	0.7593	0.8436	0.9040	0.8600	0.6726	0.6988	0.6781	0.7090	0.7094
OP	40 0889	0.2878	0.2809	0.2292	0.2932	0.2592	0.2866	0.2434	0.2859	0.2771	0.2615	0.3299	0.3424
OP	40 0890	0.2060	0.2183	0.1945	0.2358	0.2122	0.2135	0.2000	0.1909	0.1971	0.1498	0.2221	0.1703
ORB	35 2722	-0.0059	-0.0305	0.0103	0.1832	0.2496	0.1091	-0.0433	-0.0752	0.1689	0.0639	0.1289	0.2198
ORB	35 2723	0.4283	0.1356	-0.0941	-0.3590	0.0769	-0.0581	-0.1855	-0.4589	-0.0951	0.1105	0.1088	0.0628
ORB	35 2724	-	-	-	-	-	-	-	-	-	-	2.8988	0.2993
ORB	36 0593	-0.3651	-1.1598	-1.1931	-0.7731	0.7627	-0.0112	-0.0317	-0.2357	-0.2079	-0.6886	-0.3879	0.3645
ORB	40 2602	0.6790	0.7313	0.6884	0.7158	0.7427	0.5770	-	-	-	-	-	-
PL	25 0124	-	-	-	1.7640	-5.4688	-6.0756	-3.5300	-0.4053	0.1947	-0.5438	-0.2115	1.2085
PL	25 0125	-2.7097	0.7558	0.1652	-	-	-2.2721	0.3064	-0.9456	-1.5548	-2.1645	-1.5673	-1.3580
PL	35 0441	-0.1207	0.1148	0.2219	0.2927	0.1640	0.1350	0.1221	-0.0634	-0.0007	0.0293	0.0729	-0.2659
PL	35 0502	-0.4344	-0.6649	-0.2672	0.0321	0.1798	0.0318	-0.0089	-0.1312	-0.2471	-0.1308	0.2956	0.1711
PL	35 0745	-1.8559	-1.0941	-0.1760	0.1712	-0.1850	-0.2397	-0.0202	-0.0174	0.1263	0.3603	0.5983	-0.1394
PL	35 0761	0.8216	0.5190	-0.2039	-0.2190	-0.6429	-0.1364	0.2187	-0.5416	-0.0874	-0.4103	0.3161	-0.3272
PL	35 1120	-0.3075	-0.0046	0.1465	0.6192	0.0066	-0.0697	-0.0182	0.2144	0.2022	-0.0844	0.0392	0.0566
PL	35 1746	-3.6359	-2.0839	-0.3805	0.3130	-0.1476	-0.4130	-0.2065	-0.2092	0.0183	0.4527	1.0561	-0.4297
PL	35 1934	-2.2772	-0.4900	-	-	-	-	-	-	-	-	-	-0.2064
PL	35 2175	-0.2262	0.0098	0.1320	-0.0307	-0.1283	0.0146	0.3751	0.2905	-0.0231	-0.1131	-0.2081	-0.1755
PL	35 2394	-0.4084	-0.0037	0.2902	0.1255	0.1059	0.1222	0.2316	-0.0884	-0.0479	-0.1626	0.0436	0.1751
PL	35 2891	-	-	-	1.5583	-0.3478	-0.5616	-0.1324	0.0750	0.0295	-	-	-
PL	40 4002	-0.1696	-0.7174	-0.6890	1.1262	0.3427	2.7022	0.6400	-	-	-	-	-
PL	40 4004	-	-79.6844	-80.9654	-73.4959	-71.7460	-64.1795	-55.0916	-55.8174	-48.5396	-41.6635	-35.6405	-25.2836
PL	40 4601	0.1382	0.7383	0.7110	0.7680	0.6784	0.6344	0.7633	0.7226	0.6921	0.6948	0.7456	0.6642
PL	40 4602	8.2112	8.0878	7.8605	8.0915	8.9775	8.7457	8.6867	8.2726	8.0821	8.2065	7.7299	7.7894
PTB	35 0128	0.3747	0.2037	0.1097	0.1844	0.5468	0.2323	0.0749	-0.1009	-0.0894	-0.1529	0.0982	-0.1323
PTB	35 0415	-0.1572	-0.2496	-0.0422	0.2880	0.1532	-0.1940	-0.6159	-0.7547	-0.6096	-0.2600	-0.8933	-1.5703
PTB	35 1072	-0.6246	-0.9717	-0.7002	0.2389	0.0890	-0.0152	0.0279	0.2204	0.0409	-0.1181	0.1028	-0.1679
PTB	40 0506	2.3991	2.4050	2.5353	2.6167	2.5079	1.3683	0.6900	0.5342	0.6838	1.3398	1.3299	1.3198

Table 10. (Cont.)

Lab.	Clock	56319	56349	56379	56409	56439	56469	56504	56534	56564	56594	56624	56654
PTB	40 0508	3.2418	3.3626	2.8084	3.6549	4.5879	3.6692	4.1084	-8.3574	-8.1112	-7.8552	-6.7970	3.2850
PTB	40 0509	-	-	-	-	-	-	-	-0.9789	-0.4573	-0.1754	-0.0405	0.3042
PTB	40 0590	0.6060	0.5713	0.3388	0.4410	0.3983	0.3718	0.5584	0.5426	0.5221	0.4148	0.3560	0.3894
PTB	92 0001	0.2998	0.1290	0.0616	-0.0595	0.0996	0.0801	0.1971	-0.1395	-0.2258	-0.1091	0.0409	-0.0624
PTB	92 0002	0.4060	0.0405	0.0294	-0.2755	-0.3489	-0.2889	-0.1226	0.0270	0.1397	0.3011	0.2533	0.1481
ROA	35 0583	-0.4653	-0.2467	0.1164	0.1359	-0.1810	-0.1444	0.2457	0.3104	0.4262	0.3425	0.2404	-0.1754
ROA	35 0718	0.0668	-0.2612	-0.1330	0.0392	-0.1178	-0.1667	0.0626	0.2465	0.0981	0.3111	0.1170	-0.2503
ROA	35 1699	0.3286	0.3507	0.0578	-0.1918	0.1111	0.1870	0.0676	-0.1724	-0.1863	-0.1886	-0.2094	-0.0265
ROA	35 2270	-0.4582	-0.5002	0.1873	0.2472	-0.0151	-0.3737	-0.4253	-0.1408	-0.1666	0.1422	-0.0452	-0.1736
ROA	36 1488	-0.1907	0.0557	0.1571	-0.0874	0.3015	0.0613	0.2206	0.4680	0.5560	-0.1495	0.0004	0.2788
ROA	36 1490	0.8711	0.5980	-0.6932	-0.3282	0.2282	0.3529	-0.2217	0.1881	0.1354	0.1536	0.0558	-0.1435
ROA	40 1436	2.6478	2.7035	2.9875	2.9297	2.9775	2.5474	2.7067	2.7226	2.9788	3.0415	2.8030	2.6311
SASO	35 0221	-	-	-	-	-	-	-	-	-	-	-	1.2781
SASO	35 1628	-	-	-	-	-	-	-	-	-	-	-	1.6073
SASO	35 2923	-	-	-	-	-	-	-	-	-	-	-	0.2873
SASO	35 2932	-	-	-	-	-	-	-	-	-	-	-	1.9742
SCL	35 2178	0.0762	-0.2654	-0.1279	0.0382	0.1804	0.2688	0.0730	-0.3826	-0.4954	-0.4913	-0.1387	0.0085
SCL	35 2525	-0.3534	-0.2426	-0.3886	-0.4052	-0.3330	0.0788	0.5220	0.6593	0.2919	0.0712	0.2128	0.1798
SG	35 0475	-0.0997	-0.2128	0.1549	0.1658	-0.0476	-0.3575	-0.1550	0.3936	0.2853	0.0202	-0.3449	0.0628
SG	35 0476	0.1180	-0.0084	-0.6659	-0.9441	-1.2756	-1.1903	-1.1393	-0.0910	0.3890	0.2510	-	-
SG	35 1889	0.1196	0.1084	0.3140	-0.0485	0.2076	0.0035	-0.2616	-0.4722	-0.0525	0.5473	0.8555	-0.0312
SG	36 0522	0.0200	0.1254	-0.2426	0.2897	-0.1023	-0.1798	0.1552	0.1540	-0.2260	-0.4782	0.1186	-0.0027
SG	40 7701	-	-	-	-	-0.0798	-0.0140	0.2545	0.8476	1.5488	2.4931	2.8986	3.6050
SIQ	36 1268	0.3532	0.4234	-0.0143	0.1235	0.1287	-0.4211	-1.5204	-0.9721	-0.0942	0.2829	0.4607	0.6299
SMD	35 1766	-	-	-	-	-	-	-1.0814	0.3145	0.2553	0.1722	0.0430	-0.0327
SMD	35 2003	-	-	-	-	-	-	-1.1757	0.0310	-0.3850	-0.2297	-0.7599	-0.2215
SMD	35 2543	-	-	-	-	-	-	-0.0571	-0.6073	-0.0005	0.1282	0.3008	-0.0584
SMD	40 7909	-	-	-	-	-	-	-4.4798	-11.7098	-8.8541	-7.2902	-4.9379	-3.3028
SMU	36 1193	0.3029	0.8100	0.6846	0.0234	-0.6701	-	-	1.9519	0.1803	-	-	1.6724
SP	35 0572	-0.0372	0.0759	-0.0796	0.0393	-0.0643	0.2963	0.0430	-0.2119	-0.3870	-0.0949	0.2857	0.0959
SP	35 0641	-0.2105	-0.6535	-0.4889	-0.3228	-0.2402	-0.3292	-0.0811	-0.1457	-0.1933	-0.1142	-0.2773	-0.1384
SP	35 0767	-	-	-	-	-	-	-	-	-	-	0.0154	-0.0309
SP	35 1188	0.0759	-0.6012	-1.1874	-1.2127	-0.5302	0.1333	0.2707	-0.0304	-0.6223	-0.5469	-	-
SP	35 1642	-0.1024	-0.0591	-0.0468	-0.1193	-0.2908	-0.0174	0.0765	0.0782	-0.0414	-0.2450	-0.1271	0.0824
SP	35 2166	-1.9960	-0.4585	-0.4529	-0.4098	-0.2172	-0.0435	-0.1125	-0.2493	-0.0726	-0.0151	0.3095	0.1054

Table 10. (Cont.)

Lab.	Clock	56319	56349	56379	56409	56439	56469	56504	56534	56564	56594	56624	56654
SP	35 2745	-	-	-	-	-	-	-	-	-	-	1.7880	0.8313
SP	35 2746	-	-	-	-	-	-	-	-	-	-	-0.1766	0.3047
SP	35 2749	-	-	-	-	-	-	-	-	-	-	1.0577	-0.1774
SP	35 2758	-	-	-	-	-	-	-	-	-	-	0.6394	0.2464
SP	36 0223	-0.1018	0.1467	0.1499	0.2196	0.8286	0.4822	-0.0420	0.0028	-0.5733	-0.8592	-1.2498	0.0287
SP	36 1175	0.0201	-0.1027	-0.3286	0.2605	0.2073	0.0391	0.1326	0.2213	-0.0723	0.1019	-0.3774	0.0176
SP	36 1187	0.4036	-0.0589	-0.3410	0.1750	0.3980	0.0243	-0.1987	0.4572	0.8710	1.0928	0.8882	0.7981
SP	36 1531	0.0112	-0.1520	0.4900	0.2426	-0.2242	-0.2416	0.2778	0.2890	0.3836	0.4350	0.5521	0.0391
SP	36 2068	-0.6244	-0.6208	-0.1858	0.2414	-0.1982	-0.1843	0.5976	0.6183	-0.2605	-0.3154	0.1740	0.3623
SP	36 2218	-0.0688	0.1412	-0.1199	-0.1043	-0.2081	0.0643	0.1699	-0.1087	0.0160	0.2086	0.2273	-0.0493
SP	36 2295	0.0992	-0.2926	0.1669	-0.2997	-0.3698	0.0217	0.1716	0.3734	-0.0739	0.4078	0.4947	0.5513
SP	36 2297	-0.0070	-0.1222	-0.0637	-0.0104	-0.3495	-0.0192	0.2069	0.2956	0.3215	0.3276	-0.0695	-0.1232
SP	40 7201	2.4686	2.4826	2.3910	2.5158	2.5862	2.6153	2.5050	2.4476	2.4771	1.5531	2.2534	2.2120
SP	40 7203	0.7938	0.8461	0.7527	0.7854	0.8036	0.7614	0.7534	0.7492	0.7404	0.6915	0.7143	0.7059
SP	40 7210	2.6808	2.5696	2.2066	2.2340	2.4888	2.3648	2.4584	2.7276	2.5054	2.2198	2.1282	2.0989
SP	40 7211	1.3521	1.4461	1.2779	1.3610	1.3827	1.3648	1.3384	1.3442	1.3104	1.2481	1.3108	1.5285
SP	40 7212	0.4582	0.5435	0.4049	0.4601	0.5010	0.4257	0.3934	0.4192	0.3954	0.3665	0.3908	0.3720
SP	40 7218	-0.3018	-0.2322	-0.1742	-	-	-	-	-	-	-	-	-
SP	40 7221	0.1382	0.2009	0.1284	0.1767	0.2088	-	0.0802	0.1402	0.1503	0.1465	0.1699	0.1772
SP	40 7223	-	-	-	-	-	-	-	-	-	-	0.5503	-
SU	40 3809	-	0.2756	0.2310	0.1981	0.1914	0.1805	0.1384	0.2059	0.2388	0.2198	0.2343	0.2450
SU	40 3810	0.1521	0.1296	0.1927	0.1836	0.2140	0.1753	0.1234	0.1876	0.2288	0.2031	0.2047	0.2172
SU	40 3812	0.2547	0.2270	0.2623	0.2601	0.2801	0.2622	0.2183	0.2742	0.2788	0.2348	0.2343	0.2537
SU	40 3814	0.7695	0.7609	0.7892	0.7958	0.8140	0.7753	0.7400	0.7976	0.7938	0.7515	0.7682	0.7737
SU	40 3815	0.5208	0.5070	0.5492	0.5506	0.5688	0.5370	0.4984	0.5492	0.5538	0.5065	0.5073	0.5077
SU	40 3816	0.5730	0.5522	0.5753	0.5784	0.6158	0.6048	0.5667	0.6326	0.6104	0.5665	0.6325	0.6468
SU	40 3817	-	-	-	-	-	-	0.9802	1.3302	1.2370	1.1931	1.1212	0.8082
SU	40 3818	-	-	-	-	-	-	-	-	-	-	2.5823	1.1258
TCC	35 0768	0.7439	0.0259	-0.8729	-0.2705	0.9395	1.2464	-	-	1.9694	-1.1603	-0.0316	0.2899
TCC	35 1881	0.1589	0.3399	0.2257	0.0766	0.0430	0.1198	-	-	-2.2512	-0.7818	-0.5773	-0.3067
TCC	40 8620	0.2460	0.3644	0.3405	0.4410	0.6053	0.6240	-	-	0.3331	13.6868	0.4991	0.0433
TCC	40 8624	-0.2201	-0.2130	-0.0056	0.0706	-0.0208	-0.7569	-	-	-0.2749	-0.0441	-0.5362	-0.2889
TCC	40 8650	-0.6479	-0.5400	-0.5482	-0.3068	0.0922	0.1787	-	-	0.5091	-4.1786	-0.0139	-
TL	35 1012	0.0658	0.1290	0.0546	0.2213	-0.0038	0.1622	-0.2427	0.1029	-0.1534	0.1117	-0.4270	-0.0890
TL	35 1132	-0.0872	-0.0389	-0.2706	-0.2411	-0.2244	0.2984	-0.3362	-	-	-	-	-

Table 10. (Cont.)

Lab.	Clock	56319	56349	56379	56409	56439	56469	56504	56534	56564	56594	56624	56654
TL	35 1498	-0.5395	-0.1018	0.3509	0.4200	0.1184	0.0583	-0.0320	0.1365	0.1757	0.1269	-0.2458	0.0065
TL	35 1500	-0.1961	0.0425	-0.2758	-0.2880	0.1214	-0.0244	-0.3870	-0.3944	-0.1320	-0.3489	0.1766	0.3997
TL	35 1712	-	-	-	-0.6908	0.0835	-0.2212	-0.0468	0.0516	0.0699	0.0498	0.0976	0.1230
TL	35 2365	0.1659	0.1150	0.1562	0.0134	-0.1094	0.0770	-0.1993	-0.2791	-0.2929	-0.2065	-0.1381	-0.3741
TL	35 2366	0.4214	0.2581	0.1501	-0.0439	-0.0244	-0.1633	-0.0646	-0.0332	-0.2728	-0.0629	0.0370	-0.4370
TL	35 2367	0.0486	0.3099	-0.0098	-0.0506	0.1126	-0.0664	0.2341	0.1133	0.1730	-0.2668	-0.0436	-0.0423
TL	35 2368	-0.5441	-0.8149	-0.5593	-0.1850	0.4304	0.8716	1.1418	0.7466	0.4621	0.3416	0.3611	0.2117
TL	35 2630	0.0395	-0.0587	0.0546	0.1147	0.0866	-0.0403	0.0590	-0.1547	-0.3250	-0.2419	-0.1432	0.2567
TL	35 2634	0.5083	0.7140	0.8940	1.0705	-0.2471	-1.0383	-0.1060	0.4932	0.0184	0.1006	0.9302	0.2256
TL	35 2636	0.0015	0.1278	0.0538	0.0140	0.1099	-0.1153	0.0264	0.1085	0.1627	-0.8548	-0.7214	0.1755
TL	35 2853	-0.0016	-0.0926	-0.0061	-0.1751	0.1443	0.2660	0.1767	-0.1295	-0.0654	0.1490	0.2448	0.1962
TL	35 2910	-	-	-	-1.9423	0.1200	0.1595	-0.0499	-0.2367	-0.1529	0.0840	0.0297	0.0306
TL	40 0057	-2.1262	-2.2113	-2.1169	-1.9920	-1.8104	-2.1847	-1.8450	-1.9824	-1.9979	-1.7235	-2.6423	-1.9358
TL	40 3052	-0.1209	-0.1469	-0.2647	-	-	-	-	-	-1.9869	-	-	-0.0078
TP	35 0163	-0.3205	0.0720	0.1800	0.2229	0.6503	1.3859	0.8175	0.4571	-0.0583	0.4254	0.9562	1.0060
TP	35 1227	-0.2463	-0.2941	-0.0743	-0.0489	0.0268	-0.2100	-0.2960	0.0325	0.3180	0.1618	-0.0163	0.0402
TP	35 2476	-0.4244	-0.2967	-0.0080	0.5354	0.6824	0.5063	0.1156	-0.0611	0.0323	-0.1548	-0.2286	-0.0677
TP	36 0154	0.6980	0.0907	-0.2421	0.4482	0.0805	-0.1213	-0.5413	0.0777	-0.0783	0.6744	-	-
UA	35 2465	0.9009	0.6329	-0.2357	-1.1206	0.3308	0.8437	0.3374	-0.4950	-	-	-3.2897	-0.9674
UA	40 7854	-0.1157	0.1435	0.0258	0.0636	1.3984	-0.0595	-0.6916	-0.8974	-	-	1.2143	0.3985
UA	40 7881	0.3295	0.2913	0.1423	0.0080	0.4958	0.3301	0.3667	0.4109	-	-	0.4943	0.0058
UA	40 7882	-0.0514	0.3835	0.0692	0.0514	0.5375	-0.0404	-0.1750	-0.0958	-	-	1.8863	0.3621
UME	35 0251	0.2445	-	-0.3359	0.1521	0.1515	0.0611	-0.1764	-0.4299	-0.3763	-0.0643	-0.2225	-0.3647
UME	35 0252	-0.3366	-	-0.3497	-0.4974	-0.2614	0.0332	0.1215	0.1223	0.0545	0.3134	0.1714	0.0389
UME	35 0710	0.2549	-	1.4469	0.0338	0.0633	0.0135	-0.2381	-0.4848	-0.3406	-0.3473	-0.3451	-0.3706
UME	35 2703	0.1021	-	0.0378	0.0560	0.2313	0.2998	0.2287	-0.1178	-0.1219	-0.0604	0.2707	0.1983
USNO	35 0101	-1.3454	-2.7915	-2.3772	-1.5136	-0.0978	0.6099	1.0701	1.0790	0.5119	0.0237	-0.0217	0.2854
USNO	35 0104	-0.2240	0.0007	0.6482	0.7130	0.0942	-0.1246	-0.2294	-0.0912	-0.3107	-0.1177	0.2319	0.0991
USNO	35 0106	0.5604	0.6810	0.6180	0.5564	0.5645	0.4580	0.3433	-0.0866	-0.1469	-0.1263	0.1811	0.1358
USNO	35 0108	0.0523	-0.1266	-0.2848	-0.0073	0.4988	0.1064	-0.1635	-0.1525	0.1139	-0.0307	-0.0786	-0.0584
USNO	35 0114	-	-	-	-	1.0717	-1.1048	0.0492	0.0384	0.1772	-0.3233	-0.0402	0.1009
USNO	35 0120	-0.1266	-0.0546	-0.1054	-0.1445	-0.1196	-0.2123	-0.6211	-0.4520	-0.1902	-0.2016	-0.2691	0.2025
USNO	35 0142	-0.1193	-0.1059	-0.1422	-0.1408	-0.3592	0.3681	0.4973	0.0550	-0.3771	-0.6859	-0.4909	-0.2935
USNO	35 0145	0.1496	-0.0642	-0.7352	-0.9472	-0.3945	0.3176	0.2486	0.1780	0.4388	0.5559	0.3723	0.0497
USNO	35 0146	-	-	-	-	0.4991	0.7153	0.3728	0.2387	0.2190	0.4146	0.5083	0.3770

Table 10. (Cont.)

Lab.	Clock	56319	56349	56379	56409	56439	56469	56504	56534	56564	56594	56624	56654
USNO	35 0148	0.2363	0.0954	0.1706	0.2100	-0.0186	-0.2623	-	-	-	-	-	-
USNO	35 0150	-0.0462	-0.3094	-0.2615	-0.0472	-0.0542	0.1201	0.5246	0.2930	0.1219	0.2564	0.4333	-0.2934
USNO	35 0152	-0.1397	0.1331	0.1314	-0.4603	-0.3338	-0.5125	-0.1996	0.3688	0.7157	0.6582	-0.0217	0.3852
USNO	35 0153	0.1438	0.2370	0.1495	0.2993	0.1676	0.1623	0.1707	0.5364	0.3311	0.1825	0.2090	0.2005
USNO	35 0156	-0.0803	-0.1150	-0.0495	-0.0654	0.1287	0.1748	0.2645	0.1930	0.1497	0.0335	-0.0538	-0.2903
USNO	35 0161	0.5213	0.2445	0.0563	0.0405	-0.1146	-0.7175	-	-	-	-	-	1.0553
USNO	35 0164	-	-	-	-	-	-	-	-	-	-	-	0.0404
USNO	35 0165	-0.2209	-0.2489	0.4672	-0.3597	-0.7919	-0.7622	-0.1257	-0.1930	-0.1903	0.1090	0.1717	0.0008
USNO	35 0166	-0.5912	-0.0758	-0.2461	-2.2440	-2.7659	-2.1303	-0.1528	1.4225	2.1180	1.8972	0.1375	-0.2223
USNO	35 0167	-	-	-	-	-	-	0.9886	1.1334	0.4378	0.3823	-	-
USNO	35 0169	0.0810	-0.0653	0.1755	0.5834	0.5568	0.2082	0.0168	-0.2187	0.0468	0.1295	0.4003	0.1120
USNO	35 0173	-0.1508	-0.1091	0.1322	0.2113	-0.2392	-0.3611	-0.0878	0.0030	-0.2391	-0.5529	-0.4130	0.0797
USNO	35 0213	0.2498	-0.1681	-0.0827	0.1396	-0.2126	-0.0734	-0.0007	-0.1955	-0.4192	0.1895	0.3153	0.5464
USNO	35 0226	-0.1956	0.2486	0.3707	0.2409	0.2773	0.2147	-0.5050	-0.9403	-0.7894	-0.0129	0.3094	0.5215
USNO	35 0227	0.6765	0.4795	0.1362	0.1012	-0.2082	-0.2524	-0.2138	0.0529	0.0065	-0.6338	-1.0117	-0.5991
USNO	35 0231	0.0834	0.2621	0.2396	-0.1780	-0.0893	0.1231	-0.3150	-0.4470	-0.0309	0.3096	-0.0972	-0.3896
USNO	35 0233	-0.0001	-0.1277	0.0185	-0.0418	0.0466	1.1606	1.7413	1.6069	0.1616	-0.3913	-0.4373	-0.2319
USNO	35 0242	0.1132	0.0585	-0.0220	0.1830	0.4539	-0.1755	-0.5017	-0.4777	-	-	-	-
USNO	35 0244	-0.2190	-0.1229	-0.1435	-0.1740	0.2416	0.3527	0.1267	-0.2025	-0.2780	-0.3812	-0.5226	-0.2065
USNO	35 0253	-0.0862	0.0543	-0.4345	-0.5838	-0.5100	-0.2130	0.0104	0.0115	-0.2321	-0.3339	-0.2195	-0.3171
USNO	35 0254	-0.2068	0.0270	-0.1138	-0.2571	-0.1344	-0.0634	-0.0072	0.1904	0.2592	0.2840	0.0772	0.2168
USNO	35 0255	0.1466	-	-	-	-	-	-	-	-	-	-	-
USNO	35 0256	-0.0324	-0.0776	-0.0143	-0.0140	-0.0419	-0.0905	-0.0983	-0.0901	-0.2719	0.1033	0.1175	0.1805
USNO	35 0260	1.1738	1.0346	0.6435	0.3893	0.6950	6.5401	7.6271	3.3914	-1.8498	-2.3335	-0.5356	-0.8074
USNO	35 0266	0.0202	0.2476	0.0611	-0.1476	-0.3381	-0.0934	0.2722	0.2529	-0.0210	-0.3429	-0.2562	-
USNO	35 0268	-1.1231	-1.9066	-1.9254	-0.7854	-0.1616	0.6044	0.7354	0.7910	0.1669	-0.1849	-0.2807	0.1487
USNO	35 0270	-0.1396	-0.0204	0.0885	-0.1853	0.0932	-0.5305	-0.6931	-0.4955	0.4018	0.5797	0.3069	0.2191
USNO	35 0279	0.2759	0.3178	0.1227	-0.2049	-0.1080	-0.0635	-0.1498	0.1962	0.3902	0.2714	0.0391	0.2003
USNO	35 0389	-0.0179	0.0369	0.1675	0.2667	0.1200	0.3441	0.0297	-0.0107	0.1652	0.6251	0.5172	0.0113
USNO	35 0394	-0.4264	-0.1414	0.3464	0.2720	0.2946	0.2177	-0.2005	-0.5758	-0.4494	-0.4622	-0.3551	-0.7016
USNO	35 0416	0.1706	0.0752	0.2144	0.1562	0.0098	-0.1033	0.1522	0.0662	0.0377	0.0982	-0.1220	-0.3757
USNO	35 0417	-0.2950	-0.2314	-0.1804	-0.2615	-0.3722	-0.0387	0.1658	-0.2220	-0.3719	0.0419	0.4669	0.2984
USNO	35 0703	0.3496	0.3830	0.3578	0.3095	0.0318	0.2029	0.3349	0.1346	-0.4551	-0.4031	0.0746	0.1965
USNO	35 0717	0.2216	-0.0788	0.0600	0.1894	0.4327	0.3357	0.5818	0.1782	0.3039	0.1368	0.2953	0.2958
USNO	35 0762	0.0536	0.1958	0.1700	0.0062	-0.0849	0.2263	0.3973	0.2758	-0.0262	-0.1147	-0.1539	-0.0506

Table 10. (Cont.)

Lab.	Clock	56319	56349	56379	56409	56439	56469	56504	56534	56564	56594	56624	56654
USNO	35 0763	-0.0614	-0.1860	-0.4141	-0.4931	-0.4285	0.0629	0.0006	-0.0598	-0.0194	-0.0180	0.0382	0.1295
USNO	35 0765	0.2150	0.1278	0.0275	-0.0041	-0.0814	0.1288	0.1446	0.2604	0.2355	0.2741	0.1321	0.2538
USNO	35 1096	0.1007	-0.0053	-0.1815	-0.0493	-0.1687	-0.0496	-0.1883	0.1372	-0.1471	-0.0729	-0.1325	-0.1473
USNO	35 1097	0.2188	0.4096	-0.0803	-0.0998	-0.2022	-0.1052	-0.1378	-0.0662	-0.2135	-0.3968	-0.3177	0.3841
USNO	35 1125	-0.1950	-0.2568	-0.3923	-0.3594	-0.1384	-0.3347	-1.3613	-1.4218	-0.8944	-0.5068	-0.6288	-0.1836
USNO	35 1327	0.0955	-0.1817	-0.3733	-0.7718	-0.9474	-1.0389	-0.3610	-0.2584	-0.1511	0.0290	0.1718	0.0445
USNO	35 1328	0.2527	0.1343	-0.1334	-0.0349	0.1578	0.0810	-0.4520	-0.3300	-0.1919	-0.0545	-0.0566	0.3726
USNO	35 1331	-0.2631	-0.0471	-0.0492	0.4026	-0.1104	0.3932	-0.1695	-0.2909	-0.4933	0.1875	0.2752	0.5207
USNO	35 1438	-0.1335	-0.1308	0.2893	0.2104	-0.1509	-0.2311	-0.2740	0.2190	0.3427	0.6551	0.4420	0.6538
USNO	35 1459	-0.3614	-0.1974	0.0390	0.2254	0.3752	-0.4468	-0.6620	-0.7611	-0.1066	-0.4051	-0.0352	-0.3796
USNO	35 1462	0.0505	0.0578	0.3002	0.1890	0.3122	-0.0630	0.0447	-0.1827	0.1522	-0.0517	0.1993	0.0443
USNO	35 1463	0.0942	0.4086	0.0331	-0.1337	-0.2261	-0.3467	0.1194	0.2886	0.4317	0.0782	0.1518	-0.1803
USNO	35 1468	-	-	-	-	-	-	-	-	-	-	-0.9309	-0.8168
USNO	35 1481	-0.1213	-0.2239	-0.1342	-0.1098	-0.4377	-0.5569	-0.4264	-0.1552	-0.1582	-0.0472	-0.1684	-0.0969
USNO	35 1543	0.0323	-0.1128	-0.2411	-0.0989	0.0911	0.0703	0.2271	0.5588	0.4924	0.2467	-0.4331	-0.4198
USNO	35 1573	-0.0913	-0.0152	-0.0281	-0.4056	-0.4231	0.2307	0.5562	-0.0251	-0.4889	-0.2974	0.0160	0.1335
USNO	35 1575	0.2740	0.2786	0.3527	0.0254	0.2845	-0.1105	-0.3338	-0.4032	0.2586	0.2441	0.2092	0.0411
USNO	35 1580	0.0772	-0.1919	0.0698	0.1100	0.4625	0.1713	-0.4882	-0.5193	-0.1017	-0.0057	-0.2325	0.1468
USNO	35 1585	0.4428	0.7621	0.2678	-0.0656	-0.0737	0.3246	0.2055	0.0444	-0.0815	-0.2372	-0.2374	-0.4690
USNO	35 1598	-0.1527	-0.2008	-0.1380	0.0669	0.3896	0.5066	0.7829	0.6782	0.1495	-0.2331	-0.0886	-0.3552
USNO	35 1658	0.4188	0.4411	0.2733	0.1626	0.1054	0.1662	0.1563	0.0135	0.0661	-0.1298	-0.2284	-0.3969
USNO	35 1692	0.0062	-0.0059	0.0466	0.0555	0.0018	-0.2483	-0.2541	-0.2470	-0.0973	-0.1075	0.0357	0.0609
USNO	35 1694	-0.0829	0.0390	-0.0803	0.0689	-0.2263	-0.1059	-0.0868	0.0733	-0.0518	-0.0985	-0.0671	-0.1179
USNO	35 1696	-0.7551	-0.8425	-0.1368	0.6508	0.8268	0.4876	0.2285	0.1057	-0.1372	-0.0970	-0.0342	0.2889
USNO	35 1697	0.2197	0.0248	0.1792	0.3433	0.2011	-0.2149	-0.1579	0.1716	0.0984	-0.0015	0.0652	0.1412
USNO	40 0701	-	-	-	-	-	-0.4698	-0.8045	-0.7585	-0.6629	-0.3469	-0.0301	0.2607
USNO	40 0702	0.0669	0.1574	0.0536	0.0428	0.0505	0.0796	0.0267	0.0126	0.0738	0.0581	0.0586	0.0520
USNO	40 0704	-0.1157	0.0757	0.0953	0.1071	0.0540	-0.0804	-0.1150	-	-	0.0889	0.1104	0.1533
USNO	40 0705	0.1139	0.1174	0.1318	0.0897	0.0557	-0.0526	-0.0133	0.0409	0.2204	0.2515	0.1386	0.1442
USNO	40 0708	-	-	-	-	-	-	0.2535	0.2469	0.2570	0.2481	0.2377	0.2363
USNO	40 0710	8.2721	8.3731	8.3579	8.3506	8.4210	8.2066	-	-	-0.0109	0.1377	0.1955	0.2311
USNO	40 0711	3.1608	2.7261	2.5388	2.1749	2.4992	-	-	-	-	1.1049	1.3940	1.3839
USNO	40 0712	0.0060	0.0322	0.0414	0.0532	-	-	-	-	-	-	0.0783	0.1294
USNO	40 0713	0.4269	0.5383	0.4657	0.5019	0.4384	0.4240	0.4517	0.4592	0.3938	0.4198	0.4864	0.5216
USNO	40 0714	0.2025	0.2600	0.2188	0.2462	0.2575	0.2448	0.2750	0.2176	0.1521	-0.1735	0.1316	0.3668

Table 10. (Cont.)

Lab.	Clock	56319	56349	56379	56409	56439	56469	56504	56534	56564	56594	56624	56654
USNO	40 0715	0.3191	0.4165	0.3927	0.4010	0.4784	0.2014	0.1917	0.1942	0.4271	0.3998	0.3438	-2.7828
USNO	40 0716	0.0843	0.1383	0.0884	0.1506	0.1305	0.1353	0.1650	0.1442	0.1154	0.0998	0.0847	0.1129
USNO	40 0717	-	-	-	-	-	-	-	-	-	1.0249	1.4086	1.5274
USNO	40 0718	1.3852	1.4131	1.4414	1.4445	1.4975	1.5022	1.5700	1.5726	1.6438	1.6231	1.6082	1.5164
USNO	40 0719	0.9121	0.9817	1.0449	0.9871	0.9531	0.9648	0.9284	0.9292	0.9154	0.8915	0.9143	0.8989
USNO	40 0720	-	-	-	-	-	-	-	-	1.0451	1.6541	1.8850	2.0642
USNO	40 0721	7.4930	7.7017	7.2745	5.5001	5.4331	5.4883	5.4184	5.3959	-	-	-	-
USNO	40 0722	2.6878	2.7122	2.7858	2.6653	-	-	-	-	-	-	2.0063	2.6203
USNO	40 0723	0.1034	0.1348	0.1214	0.1436	0.1757	0.2396	0.1900	0.1609	0.1271	0.1265	0.1456	0.1633
USNO	40 0724	0.3138	0.4635	-0.0647	-0.0981	-0.6851	-0.2891	-0.0316	-0.0158	0.0188	0.0431	0.4725	0.4416
USNO	40 0725	0.1678	0.0270	0.0988	0.2236	0.1966	0.1370	0.1300	0.0542	0.1104	0.1648	0.1612	0.1685
USNO	40 0728	3.0495	3.3035	3.0779	2.8897	2.8992	3.2744	3.1950	3.1076	3.0438	2.6215	2.7108	2.7859
USNO	40 0729	-	-	-	-	-	3.1381	4.1388	4.4437	4.5771	4.5648	4.4951	4.4677
USNO	40 0730	3.0947	3.1070	3.1319	3.0862	3.0731	3.1040	3.1033	3.1359	3.1438	3.1015	3.0586	3.0450
USNO	40 0731	-0.3853	-0.2461	-0.3551	-0.3312	-0.3304	-0.2752	-0.2983	-0.2624	-0.2646	-0.2569	-0.1883	-0.1793
USNO	40 0732	2.3852	2.4148	2.4414	2.4810	2.4697	2.4587	2.5100	2.5442	2.5871	2.5748	2.6186	2.5755
USNO	40 0734	0.2217	-0.8565	-2.1395	-3.2755	-4.1564	-4.7430	-5.4517	-5.8591	-6.2879	-6.5035	-6.5205	-6.4663
USNO	40 0735	2.1956	2.2774	2.4918	2.7332	3.1358	3.3718	3.5217	3.6842	3.8554	4.0548	4.2690	4.4433
USNO	40 0736	-	-	-	-	-	-	-	-	-	-	-0.4337	-0.2088
USNO	40 0737	-	-	-	-	-	-	-	-	-	-	4.4223	6.1003
USNO	93 0002	-0.0203	-0.0093	-0.0077	0.0032	-0.0026	0.0017	-0.0097	-0.0081	0.0093	-0.0070	-0.0254	0.0110
USNO	93 0003	-0.0216	-0.0061	0.0058	0.0202	0.0047	0.0111	-0.0242	-0.0217	-0.0036	-0.0097	-0.0215	0.0236
USNO	93 0004	-0.0250	-0.0002	0.0171	0.0207	0.0025	0.0080	-0.0102	0.0016	0.0184	-0.0018	-0.0236	0.0046
USNO	93 0005	-0.0232	-0.0020	0.0080	0.0193	-0.0003	0.0061	-0.0049	-0.0062	0.0090	-0.0147	-0.0325	-0.0102
VMI	35 2230	-	-0.5354	-0.9387	0.0805	-	-1.5212	1.8908	0.8800	0.7072	-0.0432	0.2221	-
VMI	36 1233	-	1.6143	-1.1154	-0.4693	-	0.3645	2.9510	1.2733	0.6476	-0.2723	0.0483	-
VMI	36 2314	-	0.7401	-0.3236	-0.2044	-	-3.6572	2.3299	0.7895	0.6898	-0.1898	-0.0380	-
VSL	35 0179	-0.2133	-0.1235	0.1402	0.0591	-0.0664	-0.1317	-0.1981	-0.2792	-0.3277	-0.3420	-0.2477	-0.0964
VSL	35 0456	0.4920	0.6942	0.2126	-0.0920	-0.2230	-0.0581	0.1747	0.1726	0.0595	-0.3662	-0.8746	-0.7070
VSL	35 0548	-0.4010	-0.2497	-0.1189	0.0606	-0.2170	-0.3405	-0.3499	-	-	-	-	-
VSL	35 0731	0.0680	0.0216	-0.1306	-0.2350	-0.1903	0.0367	-0.0292	-0.0421	0.3190	0.0897	0.0868	-0.2736
ZA	35 2233	-	1.6966	-0.0341	0.1867	-0.0248	0.0801	-0.1595	0.1881	0.1559	0.2114	-0.1894	-
ZA	36 1034	-	0.1709	-1.8694	-0.8303	-0.9403	-0.8839	-0.4692	1.5709	2.0420	0.1433	-0.3098	-
ZA	36 1821	-	-0.5731	-0.6127	0.6592	0.4330	-0.1955	-0.2974	-0.0233	0.3167	0.1010	0.0182	-
ZA	36 2232	-	-0.5799	-0.2594	-0.6286	-0.1520	-0.5163	-0.3109	-0.0898	0.3301	0.1326	-0.1183	-

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 between February and April 2014.

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	Centre for Metrology and Accreditation Tekniikantie 1 FI-02150 Espoo 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 (1)	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.

(1) Information based on the Annual Report 2012, not confirmed by the Laboratory

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-86	Bishkek Kirgizstan 43° 03'N 73° 37'E	25.0 25.1 25.5 23.0 20.5	03 h 06 m to 03 h 47 m 09 h 06 m to 09 h 47 m	A1N type signals are transmitted between minutes 10 and 22 : 0.025 second pulses of 12.5 ms duration are transmitted between minutes 10 and 13; second pulses of 0.1 s duration, 10 second pulses of 1 s duration, 0.1 second pulses of 25 ms and minute pulses of 10 s duration are transmitted between minutes 13 and 22.

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

(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
WWV	Fort-Collins CO, USA 40° 41'N 105° 3'W	2 500 5 000 10 000 15 000 20 000	continuous	Second pulses are 1 000 Hz tones, 5 ms in duration. 29th and 59th second pulses omitted. Hour is identified by 0.8 second long 1 500 Hz tone. Beginning of each minute identified by 0.8 second long 1 000 Hz tones. DUT1: ITU-R code by double pulse. BCD time code given on 100 Hz subcarrier, includes DUT1 correction.
WWVB	Fort-Collins CO, USA 40° 41'N 105° 3'W	60	continuous	Second pulses given by reduction of the amplitude, reversal of phase, and by binary phase shift keying of the carrier, AM, PM and BPSK coded announcement of the date, time, DUT1 correction, daylight saving time in effect, leap year and leap second.
WWVH	Kauai HI, USA 21° 59'N 159° 46'W	2 500 5 000 10 000 15 000	continuous	Second pulses are 1 200 Hz tones, 5 ms in duration. 29th and 59th second pulses omitted. Hour is identified by 0.8 second long 1 500 Hz tone. Beginning of each minute identified by 0.8 second long 1 200 Hz tones. DUT1: ITU-R code by double pulse. BCD time code given on 100 Hz subcarrier, includes DUT1 correction.

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 2014.

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 Manual 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 – State Metrology Service A. Goštauto 11 Vilnius LT01108, Lithuania
METAS	Swiss Federal Institute of Metrology Length, Optics and Time Section Lindenweg 50 CH-3003 Bern-Wabern Switzerland
MIKES	Centre for Metrology and Accreditation Tekniikantie 1 FI-02150 Espoo - 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	Slovenian Institute of Quality and Metrology 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, 32601 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 TUBITAK Gebze Yerleskesi, National Metrology Institute 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 2012, 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/

Transmission of voice by radio in Mexico City to more than 20 million inhabitants. The voice messages are transmitted every minute, 24 hours a day, every day of the year, by the radio station XEQK, whose signal is at 1350 kHz amplitude modulated (AM).

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 79.129.32.76. This route is offered under an open policy. The server uses the 10 MHz signal from our primary standard as reference and is synchronized with UTC(EIM). The same server is accessible under restrictions through a different IP address by using a dedicated internet connection, for specific organizations.

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	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.
JV	Network Time Protocol JV operates an open access stratum 1 server referenced to UTC(JV) ntp.justervesenet.no Other stratum 1 servers over a separate network are available by special agreement. Contact: hha@justervesenet.no
KIM	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 (1)	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	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/

(1) Information based on the Annual Report 2012, 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. Access phone numbers: +41 31 323 32 25, +41 31 323 47 00. Network Time Protocol METAS operates public NTP servers in free access. Host names: ntp.metas.ch ntp11.metas.ch ntp12.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 UTC(MIKE) ntp4.mikes.fi 194.100.49.134 Synchronized to UTC(GPS) ntp1.mikes.funet.fi 193.166.4.49 Synchronized to UTC(MIKE) ntp2.mikes.funet.fi 193.166.4.50 Synchronized to UTC(GPS) Stratum-2 NTP servers (public service) time1.mikes.fi time2.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 a Stratum 1 NTP time server linked to UTC(NICT) through a leased line. Internet Time Service (ITS) NICT operates five Stratum 1 NTP time servers linked to UTC(NICT) through the Internet. Host name of the servers: ntp.nict.jp (Round robin).

GPS common view data
NICT provides the GPS common view data based on UTC(NICT) to the time business service in Japan.

NIM

Telephone Time Service
The coded time information generated by NIM time code generator, referenced to UTC(NIM). Telephone Code provides digital time code at 1200 to 9600 bauds, 8 bits, no parity, 1 stop bit.
Access phone number: 8610 6422 9086.

Network Time Service
Provides digital time code across the Internet using NTP.
Further information at: http://en.nim.ac.cn/page/976

NIMB (1)

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 (4 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 2012, 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 and http://time.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.
Note: this is a premium rate number and can only be accessed from within the UK.

Internet Time Service
Two servers referenced to UTC(NPL) provide Network Time Protocol (NTP) time code across the internet.
More information is available from the NPL web site at www.npl.co.uk/time. The server host names are:
ntp1.npl.co.uk
ntp2.npl.co.uk

NPLI

Telephone Time Service
The coded time information generated by time code generator of NPLI, referenced to UTC(NPLI). Telephone Code provides digital time code (for the current time of Indian standard Time) at 1200 bauds, 8 bits, no parity, 1 stop bit. This service is known as TELECLOCK Service.
Accessible by :

a. an NPLI-developed Teleclock Receiver already available in the market.
b. a Computer through Telephone Modem and NPLI-developed software.

NRC

Telephone Code
Provides digital time code by telephone modem for setting time in computers.
Access phone number : +1 613 745 3900.
http://www.nrc-cnrc.gc.ca/eng/services/time/time_date.html

Talking Clock Service
Voice announcements of Eastern Time are at ten-second interval 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.

	Network Time Protocol Operates two time servers using the " Network Time Protocol ", each one being on a different location and network. 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 (1)	Network Time Service. Computers connected to the Internet can be synchronized to UTC(UA) using NTP protocol. NTP servers are referenced to UTC(UA) directly. Link to Time server: ntpd.metrology.kharkov.ua or IP address: 81.17.128.133. More information on 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 (mailto: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 www.hidro.gov.ar/hora/hora.asp
ONRJ	Telephone Voice Announcer (55) 21 25806037. Telephone Code (55) 21 25800677 provides digital time code at 300 bauds, 8 bits, no parity, 1 stop bit (Leitch CSD5300) Internet Time Service at the address : 200.20.186.75 and 200.20.186.94 SNTP at port 123 Time/UDP at port 37 Time/TCP at port 37 Daytime/TCP at port 13 WEB-based Time Services: 1) A real-time clock aligned to UTC(ONRJ) and corrected for internet transmission delay. Further information at: http://200.20.186.71/ or http://www.horalegalbrasil.mct.on.br/ 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.

(1) Information based on the Annual Report 2012, not confirmed by the Laboratory

ORB

Network Time Service via NTP protocol
Hostname : ntp1.oma.be and ntp2.oma.be
Access policy : free
Synchronization to UTC(ORB)
Contact : mailto: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.

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.
Free software available for download from the website.
Access phone number : +65 67799978.

Network Time Service (NeTS)
Transmits digital time code via the Internet using three protocols - Time Protocol, Daytime Protocol and Network Time Protocol.
Free software available for downloading from the website. Operates two time servers at addresses nets.org.sg and 203.117.180.35.

	Web-based time service: Displays a real time clock referenced to NeTS. User-selectable display of local time (adjusted for daylight saving) of any major city worldwide and time difference information between any two cities. Further information is available on the website.
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 two NTP servers using the Network Time Protocol (NTP). Access host names : ntp1.sp.se and ntp2.sp.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. The Computer Time Service Provides digital time code by telephone modem for setting time in computers. Access phone number : +886 3 4245117. NTP Service TL operates a time server using the "Network Time Protocol" (NTP). Host name of the server : time.stdtime.gov.tw, further information at http://www.stdtime.gov.tw/english/e-home.aspx
TP	Internet Time Service IPE operates time servers directly referenced to UTC(TP). Time information is accessible through Network Time Protocol (NTP). Server host name: time.ufe.cz, 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: eml@ume.tubitak.gov.tr. Access phone number: +90 262 679 50 24 Network Time Service UME operates an NTP server referenced to UTC(UME). Host server 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 accessing the website, please contact: bangn@vmi.gov.vn. The server host name is: http://standardtime.vmi.gov.vn/
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 2012, not confirmed by the Laboratory