BUREAU INTERNATIONAL DES POIDS ET MESURES

Annual Report of the BIPM Time Section

Rapport annuel de la Section du temps du BIPM

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[1] : Tables also available through the internet network ftp 62.161.69.5 or http://www.bipm.org.

[2] : Tables only available through the internet network ftp 62.161.69.5 or http://www.bipm.org.

Practical information about the BIPM Time Section

The Time Section of the BIPM issues two periodic publications. These are the monthly *Circular T and* the *Annual Report of the BIPM Time Section.* In addition, Technical Memoranda on the *TWSTFT* links computed at the BIPM are issued regularly. The complete texts of *Circular T, TWSTFT Report* and most tables of the present Annual Report are available through the internet network.
La Section du temps du BIPM produit deux publications périodiques : la Circulaire T, *mensuelle et le* Rapport annuel de la Section du temps du BIPM. De plus, des rapports techniques sur les liens TWSTFT calculés par le BIPM sont publiés régulièrement. *Les circulaires, les rapports du TWSTFT et la plupart des tableaux de ce rapport annuel sont disponibles par utilisation du réseau internet.*

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Foreword

The content of the *Annual Report of the BIPM Time Section* has been modified since the issue published in 2000, to make it better adapted to the needs of users.

Tables that are no longer included in this report are still available from the BIPM website or via anonymous ftp.

A questionnaire is included in this volume; we ask you please to fill it in and return it to the BIPM Time Section before 30 October 2001. This will help us to improve our means of distributing information.

Avant-propos

Le contenu du *Rapport annuel de la Section du temps du BIPM* a subi des modifications à partir du volume publié en 2000 pour le rendre mieux adapté aux besoins des utilisateurs.

Les tableaux qui n'apparaissent plus dans cette publication sont disponibles sur le site web du BIPM ou par l'intermédiaire du ftp anonyme.

Ce volume contient un questionnaire ; nous vous remercions de le remplir et de l'envoyer à la Section du temps du BIPM avant le 30 octobre 2001. Il nous aidera a améliorer les moyens de diffusion de l'information.

Access to the BIPM Time Section data via anonymous FTP

The BIPM Time Section is making available several publications and data files via anonymous ftp. You can access it via the BIPM Web site http://www.bipm.org or with the following procedure :
ftp 62.161.69.5 or ftp2.bipm.org, user anonymous
system requests that you enter your identity as a password
cd pub/tai to access the tai subdirectory and get the readme.txt file listed below.

Listing of the readme.txt file: last update : 25 January 2001

BUREAU INTERNATIONAL DES POIDS ET MESURES - TIME SECTION

The tai subdirectory offers via anonymous ftp (ftp2.bipm.org, node 62.161.69.5) informations of interest for the time and frequency community. This service presently contains three subdirectories:

data Data used for the computation of TAI, arranged in yearly directories, since May 1999. See data/readme.txt for more information.

In the following directories XY represents the last two digits of the year number (19XY or 20XY) ZT equals to 01 for Jan, 02 for Feb... 12 for Dec and XX,XXX are ordinal numbers.

publication The latest issues of the Time Section publications:

publication	filename
Leap seconds	leaptab.txt
Acronyms of laboratories	acronyms.txt
Circular T	cirt.XXX
Fractional frequency of EAL	etXY.ZT
Weights of clocks and their	wXY.ZT
Rates relative to TAI	rXY.ZT
Values of [TAI - TA(lab)], in separate files for each laboratory, starting January 1998,	TAI-lab
and the corresponding notes	notes.tai
Values of [UTC - UTC(lab)], in separate files for each laboratory, starting January 1998,	UTC-lab
and the corresponding notes	notes.utc
Results of the computation of TAI over the two-month Interval until Nov-Dec 1997	TAI.XYZ
Values of UTC(lab1) - UTC(lab2) by TWSTFT	lab1-lab2.tw
BIPM Two-Way Satellite Time and Frequency Transfer Reports, starting April 1999	twstftXX.pdf
GPS schedule # XX	schgps.XX
GLONASS schedule # XX	schglo.XX

scale Time scales data:

content	filename
TT(BIPMXY) computed in the year 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
[TAI-GPS time] and [UTC-GPS time]	UTCGPSXY.ar
[TAI-GLONASS time] and [UTC-GLONASS time]	UTCGLOXY.ar
Rates of clocks contributing to TAI	RTAIXY.ar
Weights of clocks contributing to TAI	WTAIXY.ar
• Until 1992:	
Local representations of UTC: Values of [UTC-UTC(lab)]	UTC.XY
Local values of [TAI-TA(lab)]	TA.XY

For any comment or query send a message to : tai@bipm.org

Note :

The latest issues of the Time Section publications are available on the bipm web site.

Leap seconds

Secondes intercalaires

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 Bureau International des Poids et Mesures (BIPM) under the authority of the Comité International des Poids et Mesures (CIPM). The dates of leap seconds of UTC are decided and announced by the International Earth Rotation Service (IERS), which is responsible for the determination of Earth rotation parameters and for 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.

Depuis le 1er janvier 1988, l'établissement du Temps atomique international, TAI, et du Temps universel coordonné, UTC, (à l'exception de l'annonce des secondes intercalaires de l'UTC) est placé sous la responsabilité du Bureau international des poids et mesures (BIPM) et du Comité international des poids et mesures (CIPM). Le choix des dates et l'annonce des secondes intercalaires de l'UTC constituent quelques-unes des missions du Service international de la rotation terrestre (IERS), qui est responsable de la détermination des paramètres de la rotation terrestre et de la conservation des systèmes de référence terrestre et céleste associés. Les ajustements de l'UTC et la relation entre le TAI et l'UTC sont donnés dans les tableaux 1 et 2 de ce volume.

Information on the leap second at the IERS can be obtained from:

Des renseignements sur la seconde intercalaire à l'IERS peuvent être obtenus à l'adresse suivante:

IERS Earth Orientation Product Center
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
Electronic mail : iers@obspm.fr
World Wide Web : http://hpiers.obspm.fr/
Anonymous ftp : hpiers.obspm.fr or 145.238.100.28

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 some 230 atomic clocks kept by about 65 laboratories spread worldwide and regularly reported to the BIPM by about 50 timing centres maintaining a local UTC, UTC(k) (list in Table 3). This data is 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 0h UTC, dates designated here as 'standard dates'. The equipment maintained by these timing centres is detailed in Table 4.

An iterative algorithm produces a free atomic time scale, EAL (Echelle atomique libre) defined as a weighted average of clock readings. The processing is done in deferred-time and treats as a whole one month blocks of data [1] (two month blocks were used before 1998). The weighting procedure and clock frequency prediction are chosen so 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 caesium standards, 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 a convenient 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 Tables 6 and 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), which are independent local atomic time scales. These differences, [*TAI* - *TA(k)*] and [*UTC* - *UTC(k)*], are computed for the standard dates ; they are available through the internet network.

The computation of TAI is carried out every month and the results are published monthly in *Circular T*. When preparing the Annual Report, the results shown in *Circular T* may be revised taking into account any improvement in the data made known after its publication.

4. Time links

In 2000, the network of time links used by the BIPM was non-redundant and relied on the observation of GPS satellites in common views and on two way satellite time and frequency transfer (TWSTFT). Most time links are based on GPS satellite common views. Since July 1999 several TWSTFT links have been progressively introduced in the computation of TAI ; the first link introduced, that between PTB and TUG, had been interrupted in July 2000 ; the links USNO/NPL and VSL/PTB have been introduced in TAI in January 2000; the link between NPL and PTB is in TAI since July 2000.

The BIPM organizes the international GPS network which takes the form of local stars within a continent joined by long-distance links. During the period 1 July 1999 – 1 May 2000, ionospheric corrections had been computed for long-distance links using the total electronic content maps produced by the International GPS Service (IGS). Starting from May 2000, all GPS links in TAI are corrected by using the IGS ionospheric maps and precise operational satellite ephemerides. The ultimate precision of one single measurement of [$UTC(k_1)$ - $UTC(k_2)$], obtained at the BIPM with these procedures, is about 2 ns for short distances and 4 ns for long distances. The BIPM also publishes an evaluation of [*UTC - GPS time*] which is accessible via the internet network.

The BIPM regularly publishes an evaluation of [*UTC - GLONASS time*], available via anonymous ftp and on the BIPM web site, using current observations of the GLONASS system at the NMi Van Swinden Laboratorium, The Netherlands.

International GPS tracking schedules are published by the BIPM about every six months. Tracking schedules for GLONASS are also established. The list of the schedules is reported in this volume and their content is available through the internet network.

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 [2]. The successive versions of TT(BIPMxx) are both updates and revisions: they may differ for common dates. These time scales are available on request from the BIPM or via the internet network.

Notes

Tables 8 and 9 of this report give the rates relative to TAI and the weights of the contributing clocks to TAI in 2000.

The yellow pages, at the end of this volume, give indications about time signal emissions and time dissemination services.

The report of the BIPM Time Section, for the period October 1999 - July 2000, to be published in 'Director's Report on the Activity and Management of the BIPM, 2000, Tome 1, BIPM Publications', is reproduced after the yellow pages. All the publications mentioned in this report are available on request from the BIPM.

References

[1] C. Thomas and J. Azoubib, TAI computation : study of an alternative choice for implementing an upper limit of clock weights, *Metrologia*, 1996, **33**, 227-240.

[2] B. Guinot, Atomic time scales for pulsar studies and other demanding applications, *Astron. Astrophys.*, 1988, **192**, 370-373.

Etablissement du Temps atomique international et du Temps universel coordonné

1. Données et mode de calcul

Le Temps atomique international (TAI) et le Temps universel coordonné (UTC) sont obtenus par une combinaison de données provenant de quelque 230 horloges atomiques conservées par environ 65 laboratoires répartis dans le monde entier, et fournies régulièrement au BIPM par environ 50 laboratoires de temps qui maintiennent un UTC local, UTC(k) (liste donnée dans le tableau 3). Ces données prennent la forme de differences de temps [UTC(k) - Horloge] *enregistrées de 5 jours en 5 jours pour les dates juliennes modifiées (MJD) se terminant par 4 et 9, à 0hUTC, 'dates normales'. L'équipement maintenu par ces laboratoires de temps est décrit dans le tableau 4.*

Un algorithme itératif qui traite en temps différé des blocs de 1 mois de données [1] produit une échelle atomique libre, EAL, définie comme étant une moyenne pondérée de lectures d'horloges (jusqu'en 1997 des blocs de deux mois étaient utilisés). Le choix de la pondération et du mode de prédiction de fréquence optimise la stabilité de l'EAL à long terme. Il n'est pas tenté d'assurer la conformité de l'intervalle unitaire de l'EAL avec la seconde du Système international d'unités.

2. Exactitude

La durée de l'intervalle unitaire de l'EAL est évaluée par comparaison aux données d'étalons de fréquence à césium primaires, après correction de leur propre fréquence pour tenir compte des effets connus (par exemple relativité générale, rayonnement du corps noir). Ensuite le TAI se déduit de l'EAL par l'addition d'une fonction linéaire du temps dont la pente est convenablement choisie pour assurer l'exactitude de l'intervalle unitaire du TAI. Le décalage de fréquence entre le TAI et l'EAL est changé quand c'est nécessaire pour maintenir l'exactitude, les changements ayant le même ordre de grandeur que les fluctuations de fréquence qui résultent de l'instabilité de l'EAL. Cette opération est désignée par l'expression 'pilotage du TAI'. Le tableau 5 donne les différences de fréquences normalisées entre l'EAL et le TAI. Des mesures de la durée de l'intervalle unitaire du TAI et des estimations de sa durée moyenne sont données dans les tableaux 6 et 7.

3. Disponibilité

Le TAI et l'UTC sont disponibles sous forme de différences de temps avec les échelles locales de temps UTC(k), approximation de l'UTC, et TA(k), temps atomique local indépendant. Ces différences, [TAI - TA(k)] *et* [UTC - UTC(k)], *calculées pour les dates normales sont disponibles sur le site Internet du BIPM.*

Le calcul du TAI est fait tous les mois et les résultats sont publiés mensuellement dans la Circulaire T *du BIPM. Quand le Rapport annuel est préparé, les résultats de la* Circulaire T *peuvent être révisés, en tenant compte des améliorations de données connues après la publication de la* Circulaire T.

4. Liaisons horaires

En 2000, le système des liaisons horaires utilisé par le BIPM était non-redondant et reposait sur l'observation des satellites du GPS en vues simultanées et sur la technique d'aller et retour sur satellite de télécommunications (TWSTFT). La plupart des liaisons se fait [PM1]*par vues simultanées des satellites du GPS. Depuis Juillet 1999 plusieurs liaisons TWSTFT ont été progressivement introduites dans le calcul du TAI ; la première introduite, celle entre PTB et TUG, est interrompue depuis Juillet 2000 ; les liaisons USNO/NPL et VSL/PTB ont été introduites dans le calcul du TAI en Janvier 2000 de même que celle entre NPL et PTB en Juillet 2000.*

Le BIPM organise le réseau international de comparaisons horaires utilisant le GPS selon un schéma en étoile au niveau des continents, et en liaisons à longue distance. Entre le 1^er^ Juillet 1999 et le 1^er^ May 2000 les corrections ionosphériques pour les liaisons à longue distance ont été calculées à l'aide des cartes du contenu électronique total produites par l'IGS. Depuis May 2000, toutes les liaisons GPS sont corrigées à l'aide des cartes ionosphériques et des éphemerides précises et opérationnelles des satellites produites par l'IGS. La précision ultime d'une mesure unique [UTC(k_1) - UTC(k_2)] *est alors d'environ 2 ns pour les liaisons à courte distance et d'environ 4 ns pour les liaisons à longue distance. Le BIPM publie aussi une évaluation de* [UTC - temps du GPS] *dont les valeurs sont disponibles sur le réseau internet.*

Le BIPM publie régulièrement une évaluation de [UTC - temps du GLONASS], *accessible par anonymous ftp and sur le site web du BIPM et déduite des observations habituelles du système GLONASS, réalisées au NMi Van Swinden Laboratorium, Pays-Bas.*

Le BIPM publie tous les six mois des programmes de poursuite des satellites du GPS, ainsi que des programmes pour les satellites du GLONASS. La liste de ces programmes est reproduite dans ce rapport et leur contenu est disponible sur le réseau internet.

5. Echelles de temps établies rétrospectivement

Pour les applications les plus exigeantes, comme le chronométrage des pulsars milliseconde, le BIPM produit des échelles de temps rétrospectivement, désignées par TT(BIPMxx), 19xx ou 20xx étant l'année du calcul [2]. Les versions successives de TT(BIPMxx) ne sont pas seulement des mises à jour, mais aussi des révisions, de sorte qu'elles peuvent différer pour les dates communes. Ces échelles de temps sont disponibles sur demande faite au BIPM ou par utilisation du réseau internet.

<u>Notes</u>

Les tableaux 8 et 9 de ce rapport donnent les fréquences relatives au TAI et les poids des horloges qui ont contribué au calcul en 2000.
Les pages jaunes, à la fin de ce volume, concernent les émissions de signaux horaires.

Le rapport (octobre 1999 - juillet 2000) de la section du temps du BIPM à paraître dans 'Rapport du directeur sur l'activité et la gestion du Bureau international des poids et mesures (BIPM), Tome 1, Publications du BIPM', est reproduit après les pages jaunes. Toutes les publications qui y sont mentionnées sont disponibles sur demande au BIPM.

Les références sont données dans le texte anglais, page 13.

TABLE 1. FREQUENCY OFFSETS AND STEP ADJUSTMENTS OF UTC, UNTIL 30 JUNE 2001

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

TABLE 2. RELATIONSHIP BETWEEN TAI AND UTC, UNTIL 30 June 2001

LIMITS OF VALIDITY (AT 0h UTC)	TAI - UTC (IN SECONDS)
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 -	32

TABLE 3. ACRONYMS AND LOCATIONS OF THE TIMING CENTRES WHICH MAINTAIN A LOCAL APPROXIMATION OF UTC, UTC(K), OR/AND AN INDEPENDENT LOCAL TIME SCALE, TA(K)

AMC	Alternate Master Clock station, Colorado Springs, Colorado, USA
AOS	Astronomiczne Obserwatorium Szerokosciowe, Borowiec, Polska
APL	Applied Physics Laboratory, Laurel, MA, USA
AUS	Consortium of laboratories in Australia
BEV	Bundesamt für Eich - und Vermessungswesen, Wien, Oesterreich
BIRM	Beijing Institute of Radio Metrology and Measurement, Beijing, P. R. China
CAO	Cagliari Astronomical Observatory , Cagliari, Italia
CH	Consortium of laboratories in Switzerland
CNM	Centro Nacional de Metrologia, Queretaro, Mexico
CRL	Communications Research Laboratory, Tokyo, Japan
CSAO	Shaanxi Astronomical Observatory, Lintong, P.R. China
CSIR	Council for Scientific and Industrial Research, Pretoria, South Africa
DLR	Deutsche Forschungsanstalt fuer Luft-und Raumfahrt, Oberpfaffenhofen, Deutschland
DTAG	Deutsche Telekom AG, Darmstadt, Deutschland
F	Commission Nationale de l'Heure, Paris, France
GUM	Glówny Urzad Miar, Central Office of Measures, Warszawa, Polska
IEN	Istituto Elettrotecnico Nazionale Galileo Ferraris, Torino, Italia
IFAG	Bundesamt fuer Kartographie und Geodaesie, Fundamentalstation, Wettzell, Deutschland
IGMA	Instituto Geografico Militar, Buenos-Aires, Argentina
INPL	National Physical Laboratory, Jerusalem, Israel
IPQ	Institute Português da Qualidade (Portuguese Institute for Quality), Monte de Caparica, Portugal.
JATC	Joint Atomic Time Commission, Lintong, P.R. China
KRIS	Korea Research Institute of Standards and Science, Taejon, Rep. of Korea
LDS	The University of Leeds, Leeds, United Kingdom
MSL	Measurement Standards Laboratory, Lower Hutt, New Zealand
NAO	National Astronomical Observatory, Misuzawa, Japan
NIM	National Institute of Metrology, Beijing, P.R. China
NIST	National Institute of Standards and Technology, Boulder, CO, USA
NML	National Measurement Laboratory, Sydney, Australia
NPL	National Physical Laboratory, Teddington, United Kingdom
NPLI	National Physical Laboratory, New-Delhi, India
NRC	National Research Council of Canada, Ottawa, Canada
NRLM	National Research Laboratory of Metrology, Tsukuba, Japan
OMH	Orszagos Mérésügyi Hivatal, Budapest, Hungary
ONBA	Observatorio Naval, Buenos-Aires, Argentina

TABLE 3. ACRONYMS AND LOCATIONS OF THE TIMING CENTRES WHICH MAINTAIN A LOCAL APPROXIMATION OF UTC, UTC(K), OR/AND AN INDEPENDENT LOCAL TIME SCALE, TA(K) (CONT.)

ONRJ	Observatorio Nacional, Rio de Janeiro, Brazil
OP	Observatoire de Paris, Paris, France
ORB	Observatoire Royal de Belgique, Bruxelles, Belgique
PSB	National Measurement Center, Singapore Productivity and Standards Board, Singapore
PTB	Physikalisch-Technische Bundesanstalt, Braunschweig, Deutschland
ROA	Real Instituto y Observatorio de la Armada, San Fernando, Espana
SCL	Standards and Calibration Laboratory, Hong Kong
SMU	Slovak Institute of Metrology, Bratislava, Slovakia
SP	Swedish National Testing and Research Institute, Boras, Sweden
SU	Institute of Metrology for Time and Space (IMVP), NPO "VNIIFTRI" Mendeleevo, Moscow Region, Russia
TL	Telecommunication Laboratories, Chung-Li, Taiwan
TP	Institute of Radio Engineering and Electronics, Academy of Sciences of Czech Republic - Czech Republic
TUG	Technische Universität, Graz, Oesterreich
UME	Ulusai Metroloji Enstitüsü, Marmara Research Centre, National Metrology Institute, Gebze-Kocaeli, Turkey
USNO	U.S. Naval Observatory, Washington D.C., USA
VSL	Van Swinden Laboratorium, Delft, Nederland

TABLE 4. EQUIPMENT AND SOURCE OF UTC(K) OF THE LABORATORIES CONTRIBUTING TO TAI IN 2000.

Ind. Cs : Industrial Cs standard

Lab. Cs : Laboratory Cs standard

H-maser : Hydrogen maser

* means 'yes'

Lab k	Equipment	Source of UTC(k) (1)	TA(k)	Time Links		
				GPS	GLONASS	Two-Way
AOS	2 Ind. Cs	1 Cs + micro-phase-stepper		*	*	
APL (a)	2 Ind. Cs 2 H-masers	1 Cs		*		*
AUS	15 Ind. Cs 4 H-masers 1 Linear Ion Trap Standard (2)	1 Cs	*	*	*	*
BEV	2 Ind. Cs 1 Ind. Rb	1 Cs		*		
BIRM	2 Ind. Cs 2 H-maser	1 Cs then 1 H-maser from 2000/06/04		*	*	
CAO	2 Ind. Cs	1 Cs		*		
CH	8 Ind. Cs (3)	all the Cs	*	*		
CNM	2 Ind. Cs	1 Cs		*		
CRL	14 Ind. Cs 1 Lab. Cs 2 H-masers	9 Cs	*	*	*	*
CSAO	6 Ind. Cs	all the Cs	*	*		*
CSIR	2 Ind. Cs	1 Cs		*	*	
DLR	1 Ind. Cs 1 H-masers	1 H-maser		*	* (4)	
DTAG	3 Ind. Cs	1 Cs		*		

TABLE 4. EQUIPMENT AND SOURCE OF UTC(K)... (CONT.)

Ind. Cs : Industrial Cs standard

Lab. Cs : Laboratory Cs standard

H-maser : Hydrogen maser

* means 'yes'

Lab k	Equipment	Source of UTC(k) (1)	TA(k)	Time Links		
				GPS	GLONASS	Two-Way
GUM	5 Ind. Cs	1 Cs		*		
IEN	5 Ind. Cs	1 Cs + micro-phase-stepper	*	*	*	*
IFAG	5 Ind. Cs 3 H-masers	1 Cs + micro-phase-stepper		*		
IGMA	4 Ind. Cs	1 Cs + micro-phase-stepper		* (5)		
INPL	2 Ind. Cs	1 Cs	*	*		
IPQ	3 Ind. Cs	1 Cs		*		
JATC	6 Ind. Cs (6)	1 Cs + micro-phase-stepper	*	*		*
KRIS	3 Ind. Cs 1 H-maser	1 Cs + micro-phase-stepper	*	*	*	
LDS (7)	1 Ind. Cs	1 Cs		*	*	
MSL	3 Ind. Cs	1 Cs		*		
NAO	4 Ind. Cs 1 H-maser	1 Cs + micro-phase-stepper		*		
NIM	3 Ind. Cs	1 Cs + micro-phase-stepper		*		
NIST	20 Ind. Cs 2 Lab. Cs 5 H-masers	11 Cs 5 H-maser	*	*	*	*

TABLE 4. EQUIPMENT AND SOURCE OF UTC(K)... (CONT.)

Ind. Cs : Industrial Cs standard

Lab. Cs : Laboratory Cs standard

H-maser : Hydrogen maser

* means 'yes'

Lab k	Equipment	Source of UTC(k) (1)	TA(k)	Time Links		
				GPS	GLONASS	Two-Way
NPL	3 Ind. Cs 2 H-maser	1 H-maser		*	*	*
NPLI (a)	3 Ind. Cs	1 Cs		*	*	
NRC	1 Ind. Cs 3 Lab. Cs 2 H-masers	1 Lab. Cs + micro-phase-stepper (8)	*	*		*
NRLM (a)	4 Ind. Cs 1 Lab. Cs	1 Cs		*		*
OMH	1 Ind. Cs	1 Cs		*		
ONBA (9)	2 Ind. Cs	1 Cs + micro-phase-stepper		*		
ONRJ (a)	7 Ind. Cs 2 H-masers	1 Cs		*		
OP	5 Ind. Cs 2 Lab. Cs 2 H-maser	1 Cs + micro-phase-stepper	* (10)	*		
ORB	3 Ind. Cs 2 H-maser	1 Cs + micro-phase-stepper		*	*	
PSB	2 Ind. Cs	1 Cs		*		
PTB	4 Ind. Cs 3 Lab. Cs (11) 3 H-masers	1 Lab. Cs	* (12)	*		*
ROA	5 Ind. Cs	all the Cs		*		*

TABLE 4. EQUIPMENT AND SOURCE OF UTC(K)... (CONT.)

Ind. Cs : Industrial Cs standard

Lab. Cs : Laboratory Cs standard

H-maser : Hydrogen maser

* means 'yes'

Lab k	Equipment	Source of UTC(k) (1)	TA(k)	Time Links		
				GPS	GLONASS	Two-Way
SCL	1 Ind. Cs	1 Cs + micro-phase-stepper		*		
SMU	1 Ind. Cs	1 Cs		*		
SP	4 Ind. Cs (13)	1 Cs + micro-phase-stepper		*		
SU	1 Lab. Cs 10 H-masers	6 H-masers	* (14)	*	*	
TL	5 Ind. Cs 2 H-masers	1 Cs + micro-phase-stepper		*	*	*
TP	4 Ind. Cs	1 Cs + output frequency steering		*		
TUG (15)	2 Ind. Cs	1 Cs		*		*
UME	3 Ind. Cs	1 Cs		*		
USNO	62 Ind. Cs 14 H-masers	UTC(USNO,MC) is an H-maser + frequency synthesizer steered to UTC(USNO) (16)	* (16)	*	*	*
VSL	4 Ind. Cs	1 Cs + micro-phase-stepper		*	*	*

NOTES

(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) AUS . Some of the standards are located as follows (at the end of 2000):

* National Measurement Laboratory (NML, Sydney)	4 Cs, 2 H-masers.
Australian laboratories intercompared by GPS are:	
* National Measurement Laboratory Melbourne branch (NMLMEL, Melbourne)	1 Cs,
* Camberra Deep Space Communication Complex (CDSCC, Camberra)	2 Cs, 2 H-masers, 1 Linear Ion Trap Standard (LITS)
* Telstra Corporation Ltd (TELSTRA, Melbourne)	5 Cs,
* Agilent Technologies (AGT, Melbourne)	1 Cs,
* Australian Defence Force Calibration Laboratory (ADF, Sydney)	1 Cs,
* Australian Land Information Group, Yarragadee Observatory (Yarragadee, Western Australia)	1 Cs.
Australian laboratories intercompared by TV are:	
* Solectron Telecommunications Calibration Services (Sydney)	1 Cs,

(3) CH . The standards are located as follows (at the end of 2000):

* Office Fédéral de Métrologie (OFMET, Bern)	7 Cs,
* Observatoire de Neuchâtel (ON, Neuchâtel)	1 Cs,

They are intercompared by GPS (OFMET-ON) and linked to the foreign laboratories through the Swiss Federal Office of Metrology and Accreditation.

(4) DLR . The Glonass receiver is not connected to UTC(DLR)

(5) GPS link via local restitution of GPS time.

(6) JATC . The standards are located at Shaanxi Astronomical Observatory (CSAO). The link between UTC(JATC) and UTC(CSAO) is obtained by internal connection.

(7) LDS . The contribution was suspended in March 2000 due to a clock failure.

(8) NRC . In 2000, UTC(NRC) was derived from NRC Cs VI A

(9) ONBA. Linked by TV to IGMA.

NOTES (CONT.)

(10) OP . The French atomic time scale TA(F) is computed by the BNM-LPTF with data from 21 industrial caesium clocks located as follows (at the end of 2000) :

* Centre Electronique de l'Armement (CELAR, Rennes) 1 Cs,
* Centre National d'Etudes Spatiales (CNES, Toulouse) 2 Cs,
* Centre National d'Etudes des Télécommunications (CNET, Lannion) 3 Cs,
* Hewlett-Packard (HP, Orsay) 2 Cs,
* Observatoire de la Côte d'Azur (OCA, Grasse) 2 Cs,
* Observatoire de Paris : Laboratoire Primaire du Temps et des Fréquences (BNM-LPTF, Paris) 5 Cs,
* Observatoire de Besançon (OB, Besançon) 2 Cs,
* Tekelec Technologies (TKL, Les Ulis, Paris) 1 Cs,
* Direction des Constructions Navales (DCN, Brest) 3 Cs.

Links by GPS : OP-OB, OP-OCA, OP-CNES, OP-CELAR, OP-HP, OP-TKL, OP-DCN, OP-CNET.

(11) PTB . The laboratory Cs, PTB CS1, PTB CS2 and PTB CS3, are operated continuously as clocks. Until further notice, TA(PTB)and UTC(PTB) are derived from PTB CS2, TA(PTB) directly, UTC(PTB) including steering.

(12) PTB . TA(PTB)-UTC(PTB) is published in PTB Time Service Bulletin.

(13) SP . The standards are located as follows (at the end of 2000):

* Swedish National Testing and Research Institute (SP, Boras) 3 Cs,
* STUPI AB (Stockholm) 1 Cs,

(14) SU . TA(SU)-UTC(SU) = 29.172 759 000 s from 51544 to 51909

(15) TUG . Stopped all time activities the 3rd of July 2000

(16) USNO. The time scales A.1(MEAN) and UTC(USNO) are computed by USNO. They rely on a number of Cs clocks and H-masers. A.1(MEAN) is a free atomic time scale while UTC(USNO) is closely steered on UTC. In addition, a number of clocks are in operation at the Alternate Master Clock Station, Colorado Springs, Colorado; their data are used to compute TA(AMC).

(a) Information based on the Annual Report for 1999, not confirmed by the laboratory.

TABLE 5. DIFFERENCES BETWEEN THE NORMALIZED FREQUENCIES OF EAL AND TAI, UNTIL APRIL 2001

(File available on http://www.bipm.org under the name EALTAI00.AR)

Date	MJD	f(EAL) - f(TAI) in 10^{-13}
until 1977 Jan 1	until 43144	0
1977 Jan 1 - 1977 Apr 26	43144 - 43259	10.0
1977 Apr 26 - 1977 Jun 25	43259 - 43319	9.8
1977 Jun 25 - 1977 Aug 24	43319 - 43379	9.6
1977 Aug 24 - 1977 Oct 23	43379 - 43439	9.4
1977 Oct 23 - 1978 Oct 28	43439 - 43809	9.2
1978 Oct 28 - 1979 Jun 25	43809 - 44049	9.0
1979 Jun 25 - 1979 Aug 24	44049 - 44109	8.8
1979 Aug 24 - 1979 Oct 23	44109 - 44169	8.6
1979 Oct 23 - 1982 Apr 30	44169 - 45089	8.4
1982 Apr 30 - 1982 Jun 29	45089 - 45149	8.2
1982 Jun 29 - 1982 Aug 28	45149 - 45209	8.0
1982 Aug 28 - 1984 Feb 29	45209 - 45759	7.8
1984 Feb 29 - 1987 Apr 24	45759 - 46909	8.0
1987 Apr 24 - 1987 Dec 30	46909 - 47159	8.0125
1987 Dec 30 - 1989 Jun 22	47159 - 47699	8.0
1989 Jun 22 - 1989 Dec 29	47699 - 47889	7.95
1989 Dec 29 - 1990 Feb 27	47889 - 47949	7.90
1990 Feb 27 - 1990 Apr 28	47949 - 48009	7.85
1990 Apr 28 - 1990 Jun 27	48009 - 48069	7.80
1990 Jun 27 - 1990 Aug 26	48069 - 48129	7.75
1990 Aug 26 - 1991 Feb 22	48129 - 48309	7.70
1991 Feb 22 - 1991 Apr 23	48309 - 48369	7.625
1991 Apr 23 - 1991 Aug 31	48369 - 48499	7.55
1991 Aug 31 - 1991 Oct 30	48499 - 48559	7.50
1991 Oct 30 - 1992 Apr 27	48559 - 48739	7.45
1992 Apr 27 - 1992 Jun 26	48739 - 48799	7.40
1992 Jun 26 - 1993 Apr 22	48799 - 49099	7.35
1993 Apr 22 - 1995 Feb 21	49099 - 49769	7.40
1995 Feb 21 - 1995 Apr 22	49769 - 49829	7.39
1995 Apr 22 - 1995 Jun 21	49829 - 49889	7.38
1995 Jun 21 - 1995 Aug 30	49889 - 49959	7.37
1995 Aug 30 - 1995 Oct 29	49959 - 50019	7.36
1995 Oct 29 - 1995 Dec 28	50019 - 50079	7.35
1995 Dec 28 - 1996 Feb 26	50079 - 50139	7.34
1996 Feb 26 - 1996 Apr 26	50139 - 50199	7.33
1996 Apr 26 - 1996 Jun 30	50199 - 50264	7.32
1996 Jun 30 - 1996 Aug 29	50264 - 50324	7.31
1996 Aug 29 - 1996 Oct 28	50324 - 50384	7.295
1996 Oct 28 - 1996 Dec 27	50384 - 50444	7.280
1996 Dec 27 - 1997 Feb 25	50444 - 50504	7.265
1997 Feb 25 - 1997 Apr 26	50504 - 50564	7.250
1997 Apr 26 - 1997 Jun 30	50564 - 50629	7.230
1997 Jun 30 - 1997 Aug 29	50629 - 50689	7.210
1997 Aug 29 - 1997 Oct 28	50689 - 50749	7.190
1997 Oct 28 - 1997 Dec 27	50749 - 50809	7.170
1997 Dec 27 - 1998 Jan 31	50809 - 50844	7.160
1998 Jan 31 - 1998 Feb 25	50844 - 50869	7.150
1998 Feb 25 - 1998 Mar 27	50869 - 50899	7.140
1998 Mar 27 - 1999 Feb 25	50899 - 51234	7.130
1999 Feb 25 - 1999 Dec 27	51234 - 51539	7.140
1999 Dec 27 - 2000 May 30	51539 - 51694	7.130
2000 May 30 - 2000 Sep 27	51694 - 51814	7.120
2000 Sep 27 - 2000 Nov 26	51814 - 51874	7.110
2000 Nov 26 - 2001 Jan 30	51874 - 51939	7.100
2001 Jan 30 - 2001 Apr 30	51939 - 52029	7.090

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 UTAI00.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 these tables, d is obtained on the given periods of estimation by comparison of the TAI frequency with that of the individual primary frequency standards (PFS) CRL-01, LPTF-JPO, LPTF-F01, NIST-7, NIST-F1, NRC CsVI A and C, NRLM-4, PTB CS1, PTB CS2, PTB CS3, PTB CSF1 and SU MCsR 102 for the period 1996-2000. Previous calibrations are available in the successive annual reports of the BIPM Time Section volumes 1 to 12.

The typical characteristics of the calibrations of the TAI frequency provided by the different primary standards over 1996-2000 are indicated below.

Primary Standard	Type B standard uncertainty	Operation	Comparison with	Duration of comparison
CRL-01	5 to 10×10^{-15}	Discontinuous	UTC(CRL)	10 d
LPTF-JPO	6×10^{-15}	Discontinuous	H maser	10 or 20 d
LPTF-F01	3×10^{-15}	Discontinuous	H maser	5 d to 30 d
NIST-7	5 to 10×10^{-15}	Discontinuous	H maser	5 d to 30 d
NIST-F1	1.5×10^{-15}	Discontinuous	H maser	20 d to 30 d
NRC CsVI A	$\approx 100 \times 10^{-15}$	Continuous	TAI	60 d or 30 d
NRC CsVI C	$\approx 100 \times 10^{-15}$	Continuous	TAI	60 d or 30 d
NRLM-4	29×10^{-15}	Discontinuous	TAI	5 d or 10 d
PTB CS1	8×10^{-15}	Continuous	TAI	60 or 30 d
PTB CS2	12×10^{-15}	Continuous	TAI	60 or 30 d
PTB CS3	14×10^{-15}	Continuous	TAI	30 d
PTB CSF1	1.4×10^{-15}	Discontinuous	H maser	15 d
SU MCsR 102	50×10^{-15}	Discontinuous	UTC(SU)	60 d

For the period 1996-1999 (Table 6A), no further information is available. Starting 2000 (Table 6B), each comparison is provided with the following information:

u_B is the combined uncertainty from systematic effects,

Ref(u_B) is a reference giving information on the stated value of u_B,

u_A is the uncertainty originating in the instability of the PFS,

$u_{link/lab}$ is the uncertainty in the link between the PFS and the clock participating to TAI,

$u_{link/TAI}$ is the uncertainty in the link to TAI,

u is the quadratic sum of all four uncertainty values.

For the data of Table 6B, a frequency over a time interval is defined as the ratio of the end-point phase difference to the duration of the interval.

TABLE 6A. PERIOD 1996-1999

d in 10^{-14}

Interval for transfer to TAI	Central date of the calibration	CRL CRL-01	LPTF JPO	NIST NIST-7	NRLM NRLM-4	SU MCsR 102	LPTF F01	NIST NIST-F1
50094-50124	1996 Jan 27					+8.4		
50124-50154	1996 Feb 26					+2.4		
50144-50149	1996 Mar 4			+2.1				
50154-50184	1996 Mar 27					+1.9		
50199-50209	1996 May 1			+2.5				
50209-50214	1996 May 8						+1.8	
50214-50219	1996 May 13						+2.3	
50219-50224	1996 May 18						+2.2	
50439-50449	1996 Dec 27			+2.7				
50619-50629	1997 Jun 25			+1.7				
50739-50749	1997 Oct 23			-0.3				
50754-50784	1997 Nov 17						+0.99	
50869-50874	1998 Feb 27				-2.4			
50879-50889	1998 Mar 12			-0.9				
50889-50894	1998 Mar 19				-0.3			
50929-50964	1998 May 13			+1.2				
50934-50939	1998 May 3				-1.0			
50969-50979	1998 Jun 10				-0.7			
51014-51024	1998 Jul 25				-0.9			
51009-51039	1998 Jul 30			-1.1				
51019-51044	1998 Aug 6	-1.2						
51034-51044	1998 Aug 14				-1.9			
51099-51129	1998 Oct 28			-0.3				
51124-51134	1998 Nov 12				-3.9			
51149-51159	1998 Dec 7				-0.8			
51144-51174	1998 Dec 12			-0.1				
51174-51184	1999 Jan 1				-2.0			
51209-51239	1999 Feb 15			+0.1				
51219-51229	1999 Feb 15				-4.3			
51299-51329	1999 May 16			-0.7				
51339-51359	1999 Jun 20		+0.8					
51359-51369	1999 Jul 5				-1.7			
51359-51389	1999 Jul 15			-0.7				
51379-51389	1999 Jul 25		+1.0					
51399-51409	1999 Aug 14				-3.3			
51439-51449	1999 Sep 23				-0.6			
51439-51469	1999 Oct 3			+0.1				
51444-51464	1999 Oct 3		+0.7					
51499-51519	1999 Nov 27							+0.2
51504-51514	1999 Nov 27				-4.2			
51519-51539	1999 Dec 17			+0.1				

TABLE 6A. (CONT.)

Interval for transfer to TAI	Central date of the calibration	NRC CsVIA	NRC CsVIC	PTB CS1	PTB CS2	PTB CS3
		d in 10^{-14}				
50079-50139	1996 Jan 27	-15.7	-8.2		+3.1	
50139-50199	1996 Mar 27	-17.6	-7.2		+2.8	
50199-50264	1996 May 28	-15.5	-5.9		+2.6	
50264-50324	1996 Jul 30	-15.6	-7.7		+2.9	+5.6
50324-50384	1996 Sep 28	-13.7	-2.5		+2.2	+2.6
50384-50444	1996 Nov 27	-12.5	-5.3		+2.9	+5.0
50444-50504	1997 Jan 26	-10.9	+1.7		+2.8	+5.6
50504-50564	1997 Mar 27	-11.0	+2.4		+2.8	+4.5
50564-50629	1997 May 28	-11.0	-0.5		+2.6	+4.9
50629-50689	1997 Jul 30	-11.2	+0.7		+0.4	+3.4
50689-50749	1997 Sep 28	-12.1	+0.7		+1.4	+3.8
50749-50809	1997 Nov 27	-12.3	+0.5		+0.5	+2.5
50809-50844	1998 Jan 13	-12.6	+0.6		+0.6	+1.6
50844-50869	1998 Feb 12	-13.6	-0.4		+0.6	+0.8
50869-50899	1998 Mar 12	-13.1	+0.2		+0.2	+3.3
50899-50929	1998 Apr 11	-13.5	-0.1		-0.1	+0.5
50929-50964	1998 May 13	-12.2	+0.3		+0.4	+0.1
50964-50994	1998 Jun 15	-13.4	-0.4		-0.3	+0.8
50994-51024	1998 Jul 15	-13.4	+0.1	-0.3	+0.2	+0.5
51024-51054	1998 Aug 14	-15.1	+0.2	-0.7	+0.5	+1.7
51054-51084	1998 Sep 13		+1.5	-0.8	+0.2	+2.4
51084-51114	1998 Oct 13		+0.4	-0.2	-0.6	+2.6
51114-51144	1998 Nov 12		+0.2	-1.0	-0.1	+4.0
51144-51174	1998 Dec 12		-0.1	-0.4	+0.1	+1.7
51174-51209	1999 Jan 14		+0.2	-1.5	-0.1	+3.9
51209-51234	1999 Feb 13	+2.8	+1.2	+0.2	+0.6	+3.4
51234-51264	1999 Mar 12	+1.5	+1.0	+0.1	+0.2	+3.9
51264-51294	1999 Apr 11	-0.7		-0.1	+0.5	+1.9
51294-51329	1999 May 14	-1.3		-0.3	-0.1	+2.7
51329-51359	1999 Jun 15	-0.4		-0.4	+0.5	+1.4
51359-51379	1999 Jul 10			+0.1		
51359-51389	1999 Jul 15				+0.3	+1.9
51389-51419	1999 Aug 14				+0.8	+2.2
51419-51449	1999 Sep 13	-0.7			+0.3	+2.2
51449-51479	1999 Oct 13	-0.8			+1.0	+2.7
51479-51509	1999 Nov 12	+0.3			+0.8	+3.5
51509-51539	1999 Dec 12	-1.8			+0.5	

TABLE 6B. YEAR 2000

Standard	Period of estimation	d (10^{-15})	u_B (10^{-15})	Ref(u_B)	u_A (10^{-15})	$u_{link/lab}$ (10^{-15})	$u_{link/TAI}$ (10^{-15})	Notes	u (10^{-15})
CRL-01	51649-51659	+14.3	2.7	[5]	19.	0.8	3.	(2)	19.
CRL-01	51704-51714	+4.7	4.7		14.9	0.8	3.		15.9
CRL-01	51754-51764	-7.0	5.4		22.4	0.8	3.		23.2
CRL-01	51834-51844	+29.8	4.3		6.4	0.8	3.		8.3
NIST-7	51579-51609	+0.5	4.1	[5]	1.9	1.0	1.		4.7
NIST-7	51649-51674	+7.3	7.3		2.1	1.0	1.5		7.8
NIST-7	51764-51794	+4.1	4.6		2.4	0.8	1.		5.3
NIST-F1	51579-51609	+5.3	0.8	[8]	1.4	0.2	1.		1.9
NIST-F1	51764-51794	+9.7	1.5		0.8	0.2	1.		2.0
NRLM-4	51584-51594	-10.	29.	[6]	Not available		15.	(3)	33.
NRLM-4	51619-51629	-29.0	29.		Not available		15.		33.
NRLM-4	51654-51664	-28.0	29.		4.	1.	3.		29.
NRLM-4	51684-51694	-19.7	29.		4.	1.	3.		29.
NRLM-4	51704-51714	-50.6	29.		4.	1.	3.		29.
NRLM-4	51724-51729	-54.5	29.		4.	1.	6.		30.
NRLM-4	51739-51744	-31.6	29.		4.	1.	6.		30.
NRLM-4	51769-51779	-50.9	29.		4.	1.	3.		29.
NRLM-4	51819-51824	-16.4	29.		4.	1.	6.		30.
PTB CS1	51644-51664	+7.2	8.	[1,4]	5.	0.	1.5	(1)	10.
PTB CS1	51664-51694	-3.6	8.		5.	0.	1.		9.
PTB CS1	51694-51724	+1.7	8.		5.	0.	1.		9.
PTB CS1	51724-51754	+3.2	8.		5.	0.	1.		9.
PTB CS1	51754-51784	+4.5	8.		5.	0.	1.		9.
PTB CS1	51784-51814	-0.5	8.		5.	0.	1.		9.
PTB CS1	51814-51844	-7.1	8.		5.	0.	1.		9.
PTB CS1	51844-51874	-11.2	8.		5.	0.	1.		9.
PTB CS1	51874-51909	+1.3	8.		5.	0.	1.		9.
PTB CS2	51539-51574	+5.	15.	[2,4]	3.	0.	1.	(1)	15.
PTB CS2	51574-51599	+5.	15.		3.	0.	1.		15.
PTB CS2	51599-51634	-2.	12.		3.	0.	1.		12.
PTB CS2	51634-51664	+3.5	12.		3.	0.	1.		12.
PTB CS2	51664-51694	+11.4	12.		3.	0.	1.		12.
PTB CS2	51694-51724	+8.7	12.		3.	0.	1.		12.
PTB CS2	51724-51754	+5.9	12.		3.	0.	1.		12.
PTB CS2	51754-51784	+8.0	12.		3.	0.	1.		12.
PTB CS2	51784-51814	+6.5	12.		3.	0.	1.		12.
PTB CS2	51814-51844	+4.4	12.		3.	0.	1.		12.
PTB CS2	51844-51874	+6.6	12.		3.	0.	1.		12.
PTB CS2	51874-51909	+7.6	12.		3.	0.	1.		12.

TABLE 6B. (CONT.)

Standard	Period of estimation	d (10^{-15})	u_B (10^{-15})	Ref(u_B)	u_A (10^{-15})	$u_{link/lab}$ (10^{-15})	$u_{link/TAI}$ (10^{-15})	Notes	u (10^{-15})
PTB CS3	51604-51634	+30.	14.	[3,4]	7.	0.	1.	(1)	16.
PTB CS3	51634-51664	+38.9	14.		7.	0.	1.		16.
PTB CS3	51664-51694	+41.3	14.		7.	0.	1.		16.
PTB CS3	51694-51724	+40.9	14.		7.	0.	1.		16.
PTB CS3	51724-51754	+28.5	14.		7.	0.	1.		16.
PTB CS3	51754-51784	+28.7	14.		7.	0.	1.		16.
PTB CS3	51784-51814	+19.1	14.		11.	0.	1.		18.
PTB CS3	51814-51844	+30.5	14.		7.	0.	1.		16.
PTB CSF1	51764-51779	+7.2	1.5	[7]	1.0	0.	2.		2.7
PTB CSF1	51799-51814	+5.4	1.4		1.0	0.	2.		2.6
PTB CSF1	51824-51839	+8.5	1.4		1.0	0.	2.		2.6
PTB CSF1	51864-51879	+9.5	1.4		1.0	0.	2.		2.6

Notes:
(1) Continuously operating as a clock participating to TAI.
(2) CRL-01 has been reported earlier as CRL-01. The evaluation procedure of its type B uncertainty is based on that of NIST-7 [5].
(3) The value *d* is calculated by NRLM.

References:

[1] Bauch A. et al., *Metrologia* 35, 829, 1998.
[2] Bauch A. et al., *IEEE Trans. IM*-36, 613, 1987.
[3] Bauch A. et al., *Metrologia* 33, 239, 1996.
[4] Bauch A. et al., *Metrologia* 37-6, 683, 2000.
[5] Lee W.D. et al., *IEEE Trans. IM*-44, 120, 1995.
[6] Hagimoto K. et al., *IEEE Trans. IM*-48, 496, 1999.
[7] Weyers S. et al., *Proc. 14th EFTF*, 53, 2000; *Metrologia* 38-4, in press.
[8] Jefferts S.R. et al., *Proc. 1999 EFTF&IEEE-FCS*, 12; *Metrologia*, submitted.

TABLE 7. MEAN FRACTIONAL DEVIATION OF THE TAI SCALE INTERVAL FROM THAT OF TT

(File available on http://www.bipm.org under the name SITAI00.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 13, 1977, pp. 87-93', using all available measurements from the most accurate primary frequency standards CRL-01, LPTF-F01, LPTF-JPO, NIST-7, NIST-F1, NRLM-4, PTB CS1, PTB CS2, PTB CS3 and PTB CSF1, consistently corrected for the black-body radiation shift.

In this computation, a model for the instability of EAL is needed. Starting in 1998, it has been expressed as the quadratic sum of three components: a white frequency noise $6.0\times10^{-15}/\sqrt{(\tau)}$, a flicker frequency noise 0.6×10^{-15} and a random walk frequency noise $1.6\times10^{-16}\times\sqrt{(\tau)}$, with τ in days. The relation between EAL and TAI is given in Table 5.

Month	Interval	$d/10^{-15}$	uncertainty/10^{-15}
Jan. 1998	50809-50844	+7.8	2.9
Feb. 1998	50844-50869	+5.9	3.0
Mar. 1998	50869-50899	+4.4	2.9
Apr. 1998	50899-50929	+2.7	2.9
May 1998	50929-50964	+2.2	2.8
Jun. 1998	50964-50994	+1.4	2.8
Jul. 1998	50994-51024	+0.8	2.6
Aug. 1998	51024-51054	+0.5	2.5
Sep. 1998	51054-51084	+0.9	2.6
Oct. 1998	51084-51114	+1.1	2.5
Nov. 1998	51114-51144	+1.1	2.5
Dec. 1998	51144-51174	+1.2	2.5
Jan. 1999	51174-51209	+1.6	2.5
Feb. 1999	51209-51234	+2.3	2.5
Mar. 1999	51234-51264	+3.7	2.5
Apr. 1999	51264-51294	+3.8	2.4
May 1999	51294-51329	+3.9	2.3
Jun. 1999	51329-51359	+4.4	2.3
Jul. 1999	51359-51389	+4.8	2.2
Aug. 1999	51389-51419	+5.3	2.4
Sep. 1999	51419-51449	+5.4	2.3
Oct. 1999	51449-51479	+5.6	2.2
Nov. 1999	51479-51509	+5.0	2.0
Dec. 1999	51509-51539	+4.6	1.9
Jan. 2000	51539-51574	+4.5	2.0
Feb. 2000	51574-51599	+4.8	1.7
Mar. 2000	51599-51634	+5.6	1.9
Apr. 2000	51634-51664	+6.4	2.1
May 2000	51664-51694	+6.9	2.1
Jun. 2000	51694-51724	+6.3	2.1
Jul. 2000	51724-51754	+6.6	2.0
Aug. 2000	51754-51784	+7.4	1.4
Sep. 2000	51784-51814	+7.2	1.5
Oct. 2000	51814-51844	+7.4	1.6
Nov. 2000	51844-51874	+7.7	1.8
Dec. 2000	51874-51909	+6.4	2.2

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. The differences between TAI and the atomic scale maintained by each laboratory are available on http://www.bipm.org or via anonymous ftp 62.161.69.5. 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, starting on 1 January 1998.

The file NOTES.TAI provides information concerning the time laboratories contributing to the calculation of TAI since 1 January 1998. This file should be considered as complementary to the individual files TAI-lab.

For dates between April 1996 and December 1997, the values of [*TAI-TA*(*lab*)] are given in yearly files, each one giving also values of [*UTC-UTC*(*lab*)].

Local representations of UTC

The time laboratories which submit data to the BIPM keep local representations of UTC. The computed differences between UTC and each local representation are available on http://www.bipm.org or via anonymous ftp 62.161.69.5. 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, starting on 1 January 1998.

The file NOTES.UTC provides information concerning the time laboratories since 1 January 1998. This file should be considered as complementary to the individual files UTC-lab.

For dates between April 1996 and December 1997, the values of [*UTC-UTC*(*lab*)] are given in yearly files, each one giving also values of [*TAI-TA*(*lab*)].

International GPS and GLONASS Tracking Schedules

(Files available on http://www.bipm.org)

GPS Schedule no 34 File SCHGPS.34	implemented on MJD = 51637 (2000 April 3) at 0h UTC	Reference date MJD = 50722 (1997 October 1)
GPS Schedule no 35 File SCHGPS.35	implemented on MJD = 51822 (2000 October 5) at 0h UTC	Reference date MJD = 50722 (1997 October 1)
GLONASS Schedule no 09 File SCHGLO.09	implemented on MJD = 51637 (2000 April 3) at 0h UTC	Reference date MJD = 50722 (1997 October 1)
GLONASS Schedule no 10 File SCHGLO.10	implemented on MJD = 51822 (2000 October 5) at 0h UTC	Reference date MJD = 50722 (1997 October 1)

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

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

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

where the time difference of 19 seconds is kept constant and C_0 is a quantity of order 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 1997 July 1, 0h UTC, until 1999 January 1, 0h UTC :

$$[UTC - GPS\ time] = -12\ \mathrm{s} + C_0,$$

from 1999 January 1, 0h UTC, until further notice :

$$[UTC - GPS\ time] = -13\ \mathrm{s} + C_0.$$

Here C_0 is given at 0h UTC every day.

C_0 is computed as follows: the GPS data taken at the Paris Observatory, from satellites with highest elevation, are first corrected for precise satellite ephemerides and for delays derived from IGS ionospheric maps, and then smoothed to obtain daily values of [*UTC(OP) - GPS time*] at 0h UTC. Daily values of C_0 are derived from them using linear interpolation of [*UTC - UTC(OP)*] provided on the BIPM internet network. The global uncertainty of daily C_0 values is of order 10 ns.

The tables giving daily values of C_0 at 0h UTC as well as the standard deviation σ which characterizes the dispersion of individual measurements, and the number N of measurements used to estimate the corresponding C_0 value are available on http://www.bipm.org under the name UTCGPS00.AR.

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

The GLONASS satellites disseminate a common time scale designated as 'GLONASS time'. The relation between GLONASS time and UTC is :

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

where the time difference 0 s is kept constant as a consequence of the leap seconds applied to GLONASS time in order to follow the UTC system, and C_1 is a quantity of order several hundreds 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 1997 July 1, 0h UTC, until 1999 January 1, 0h UTC :

$$[TAI - GLONASS\ time] = 31\ \mathrm{s} + C_1,$$

from 1999 January 1, 0h UTC, until further notice :

$$[TAI - GLONASS\ time] = 32\ \mathrm{s} + C_1.$$

Here C_1 is given at 0h UTC every day.

C_1 is computed as follows: the GLONASS data taken at the NMi Van Swinden Laboratorium, Delft, The Netherlands, for highest elevation, are smoothed to obtain daily values of [*UTC*(*VSL*)-*GLONASS time*] at 0h UTC. Daily values of C_1 are then derived from them using linear interpolation of [*UTC* - *UTC*(*VSL*)] provided on the BIPM internet network.

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 global uncertainty of daily C_1 values is of order several hundreds nanoseconds.

The tables giving daily values of C_1 at 0h UTC, as well as the standard deviation σ which characterizes the dispersion of individual measurements, and the number N of measurements used to estimate the corresponding C_1 value are available on http://www.bipm.org under the name UTCGLO00.AR.

TABLE 8A. RATES RELATIVE TO TAI OF CONTRIBUTING CLOCKS IN 2000

(File available on http://www.bipm.org under the name RTAI00.AR)

Mean clock rates relative to TAI are computed for one-month intervals ending at the 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 8A gives homogeneous rates for the whole year 2000. For studies including the clock rates of previous years, corrections must be brought to the data published in the Annual Report for 1988 to 1999, and in the BIH Annual Reports for the previous years. These corrections are given in Table 8B.
Unit is ns/day , *** denotes that the clock was not used.

LAB.	CLOCK		51574	51599	51634	51664	51694	51724
AMC	35	173	-14.06	-14.65	-14.96	-14.88	-15.21	-14.05
AMC	35	231	3.66	3.19	3.29	4.09	3.70	2.28
AMC	35	266	***	***	***	***	-12.67	-13.22
AMC	35	268	-14.69	-14.94	-14.31	***	***	***
AMC	35	389	-32.03	-31.46	-32.36	-30.97	-30.62	-30.51
AMC	35	416	***	***	***	***	***	***
AMC	35	703	-7.16	-8.06	-7.86	-6.90	-6.70	-6.98
AMC	35	717	***	***	***	***	-10.59	-10.82
AMC	35	762	-25.84	-26.36	***	***	-27.67	-26.68
AMC	35	763	***	-15.79	-15.70	-16.33	-16.39	-15.87
AMC	35	765	-6.91	-7.68	-7.26	-6.47	-6.81	-6.97
AMC	35	1331	***	***	***	***	***	***
AMC	40	713	-13.40	-13.40	-13.31	-13.12	-12.85	-12.49
AMC	40	714	***	***	***	***	***	-45.53
AMC	40	716	***	***	***	242.34	242.98	243.18
AOS	23	67	-36.67	-34.68	12.99	-18.26	-16.02	-16.90
APL	35	904	***	***	5.86	6.64	6.34	6.02
AUS	35	299	0.05	0.03	0.69	-3.10	-2.72	-2.54
AUS	36	249	***	-4.89	***	-3.08	***	***
AUS	36	340	0.86	1.56	0.68	-0.07	0.09	-0.64
AUS	36	654	-29.75	-29.74	-28.93	-28.51	-28.34	-29.72
AUS	36	1035	***	9.36	***	***	***	***
AUS	36	1141	-0.28	-0.72	-0.02	-0.46	-0.83	-0.06
AUS	40	5401	***	***	***	***	***	***
AUS	40	5402	***	***	***	***	***	***
AUS	40	5403	***	***	-5.34	3.04	***	***
AUS	40	7501	6.96	7.04	9.91	8.58	7.61	8.55
AUS	40	7502	-13.85	-14.76	-11.17	-12.92	***	***
BEV	35	1065	-1.54	-2.13	-1.88	-1.59	***	***
CAO	35	939	1.66	-0.23	1.81	-0.15	1.62	1.27
CAO	35	1270	2.87	2.93	2.75	1.92	2.62	3.09
CH	16	77	-168.11	***	***	***	***	***
CH	17	206	0.19	-1.25	6.51	10.31	8.54	15.31
CH	21	179	14.66	17.97	18.49	21.08	22.16	23.72
CH	21	194	-52.52	-54.88	-56.76	-57.47	-57.45	-51.99

TABLE 8A. (CONT.)

LAB.	CLOCK		51754	51784	51814	51844	51874	51909
AMC	35	173	-14.67	***	***	***	***	***
AMC	35	231	1.86	2.39	2.20	1.37	***	***
AMC	35	266	-14.24	-13.99	-13.60	-14.47	-14.33	-14.57
AMC	35	268	***	2.10	2.08	0.46	***	***
AMC	35	389	-31.16	-30.58	-31.11	-31.12	-30.74	-31.26
AMC	35	416	-24.34	-24.88	-24.68	-24.38	-24.31	-23.58
AMC	35	703	-6.38	-5.69	-6.32	-6.17	-5.72	***
AMC	35	717	-9.71	-11.04	-10.11	-9.82	-9.82	-10.39
AMC	35	762	-28.89	-27.86	-28.84	-28.61	-28.48	-29.22
AMC	35	763	-16.83	-16.40	-16.64	-17.73	-17.31	-17.15
AMC	35	765	-7.16	-7.04	-6.14	-7.84	-7.23	-7.18
AMC	35	1331	***	***	-6.17	-5.67	-5.67	-5.55
AMC	40	713	-12.36	-12.27	-11.66	-12.15	-11.91	-11.39
AMC	40	714	-45.50	-45.72	-45.18	-45.89	-45.90	-45.18
AMC	40	716	242.63	241.53	240.73	239.12	237.63	236.65
AOS	23	67	-18.31	-7.07	3.65	4.95	-2.30	4.72
APL	35	904	5.30	6.04	5.36	5.09	5.30	***
AUS	35	299	-2.90	-3.13	-3.64	-2.89	-3.38	***
AUS	36	249	***	***	-3.77	***	***	-4.37
AUS	36	340	-0.50	1.13	0.65	-0.32	0.51	5.24
AUS	36	654	-28.38	-27.75	-28.13	-29.28	-29.34	-28.28
AUS	36	1035	5.95	4.94	***	***	4.60	6.52
AUS	36	1141	-0.13	0.93	-0.18	0.76	0.01	0.71
AUS	40	5401	***	***	21.70	21.93	21.45	21.96
AUS	40	5402	***	***	***	-16.16	-19.58	-16.16
AUS	40	5403	5.37	4.03	-0.65	***	***	-19.35
AUS	40	7501	***	***	***	***	***	***
AUS	40	7502	***	***	***	***	***	***
BEV	35	1065	***	1.36	-0.40	-0.30	-0.07	0.54
CAO	35	939	-0.06	1.24	0.38	-0.07	1.68	1.32
CAO	35	1270	***	4.57	3.26	***	***	***
CH	16	77	***	***	***	***	***	***
CH	17	206	18.55	9.15	15.23	9.02	5.67	10.16
CH	21	179	18.81	19.85	20.15	19.20	22.54	23.32
CH	21	194	-55.33	-56.05	-57.31	-50.96	-53.29	-49.57

TABLE 8A. (CONT.)

LAB.	CLOCK		51574	51599	51634	51664	51694	51724
CH	21	217	131.80	121.82	123.59	115.23	116.84	118.53
CH	31	403	-64.67	-65.50	-65.84	-62.40	-63.74	-63.89
CH	35	413	***	20.52	20.48	21.70	20.46	21.55
CH	35	771	15.51	15.46	***	***	***	***
CH	36	354	56.26	54.57	55.68	55.13	55.81	55.60
CNM	35	237	1.22	0.88	2.19	2.16	2.07	1.93
CNM	35	382	-0.70	0.33	-1.56	-1.21	-0.50	-0.29
CRL	35	112	21.10	21.04	20.77	20.57	20.89	20.51
CRL	35	144	15.19	16.02	15.28	15.98	15.18	15.80
CRL	35	332	***	***	12.40	10.23	10.44	8.68
CRL	35	342	6.70	6.46	6.20	6.15	6.38	6.61
CRL	35	343	***	***	14.34	12.40	11.68	11.12
CRL	35	715	0.93	-0.13	-0.50	-0.27	-0.23	-1.15
CRL	35	732	-23.47	***	***	-0.05	-1.54	-0.44
CRL	35	907	14.10	15.68	14.56	14.71	15.05	14.48
CRL	35	908	9.65	10.59	9.76	10.33	10.80	10.95
CRL	40	2008	***	***	***	***	***	28.12
CRL	40	2009	***	***	***	***	***	29.35
CSAO	35	1007	-6.97	-7.15	-7.65	-7.69	-7.36	-8.79
CSAO	35	1008	9.53	9.77	11.15	11.07	11.78	11.54
CSAO	35	1011	-3.17	-4.19	-4.10	-4.81	-3.82	-5.33
CSAO	35	1016	-0.05	-0.71	0.20	0.01	0.41	-0.48
CSAO	35	1017	1.25	1.86	2.35	1.95	1.21	0.56
CSAO	35	1018	16.90	16.44	16.77	16.07	15.86	15.81
DLR	40	7424	-32.96	-33.00	-33.69	-34.00	-34.01	-33.60
DTAG	36	136	***	***	***	***	***	0.06
DTAG	36	345	-0.18	-0.54	-0.45	-1.85	-0.87	-2.15
DTAG	36	465	-1.87	-1.95	-1.53	-3.76	***	-0.04
F	35	122	7.24	5.33	6.05	4.44	6.86	6.14
F	35	124	-3.19	-3.06	-2.67	-2.48	-2.01	-2.30
F	35	131	6.70	7.52	6.80	7.20	5.91	6.42
F	35	158	***	***	***	***	17.11	16.79
F	35	172	3.13	3.32	2.81	3.23	3.53	3.38
F	35	198	7.56	7.10	6.69	7.61	7.44	8.20
F	35	355	1.83	2.19	1.17	1.79	2.23	1.39
F	35	385	5.28	6.56	7.30	7.40	7.49	7.94
F	35	396	5.83	5.44	***	***	***	***
F	35	469	-0.66	-0.61	-0.56	-0.35	-1.81	-1.13
F	35	489	10.94	9.64	8.00	7.52	8.36	9.15
F	35	521	-11.50	-11.14	-11.80	-12.50	-11.86	-11.58
F	35	536	-5.26	-5.71	-6.28	-6.09	-6.04	-5.57
F	35	609	19.97	24.45	23.44	24.22	24.39	23.30
F	35	770	13.31	12.39	12.78	12.76	11.53	11.99
F	35	781	-19.63	-20.53	-20.73	***	***	***
F	35	819	16.91	15.48	18.18	***	***	28.51

TABLE 8A. (CONT.)

LAB.	CLOCK		51754	51784	51814	51844	51874	51909
CH	21	217	119.09	118.62	116.40	110.40	120.95	126.12
CH	31	403	-63.40	-65.09	-64.95	-64.88	-63.80	-64.50
CH	35	413	20.92	19.03	16.71	14.67	12.77	10.43
CH	35	771	***	***	***	***	***	9.11
CH	36	354	54.14	53.97	54.48	55.09	54.54	54.53
CNM	35	237	0.91	1.15	2.10	1.63	0.75	0.75
CNM	35	382	-0.21	-0.52	0.30	0.03	0.49	0.01
CRL	35	112	21.13	20.25	20.98	21.15	20.23	***
CRL	35	144	15.53	15.75	15.81	15.78	15.05	15.97
CRL	35	332	9.02	8.83	9.75	10.46	10.16	10.78
CRL	35	342	6.76	6.60	7.05	6.57	6.05	5.93
CRL	35	343	10.65	9.28	10.89	10.62	10.58	11.00
CRL	35	715	-1.56	-1.04	-1.20	-0.80	-2.49	-1.84
CRL	35	732	-1.46	-2.21	-0.97	-1.26	-2.32	-1.53
CRL	35	907	15.45	15.35	14.70	14.89	15.44	15.61
CRL	35	908	11.26	9.60	10.06	11.68	9.80	10.07
CRL	40	2008	30.23	32.19	34.73	37.00	38.44	***
CRL	40	2009	***	***	***	***	***	***
CSAO	35	1007	-8.47	-9.66	-9.18	-9.45	-8.90	-8.20
CSAO	35	1008	11.31	12.70	13.37	14.62	13.83	13.88
CSAO	35	1011	-5.24	-4.79	-5.08	-4.33	-2.46	-2.96
CSAO	35	1016	-0.30	1.00	0.60	2.28	1.20	0.79
CSAO	35	1017	0.91	1.28	2.91	2.03	2.58	1.02
CSAO	35	1018	15.12	15.43	15.32	15.11	14.63	13.68
DLR	40	7424	-34.07	-34.06	***	-34.80	-35.29	-35.15
DTAG	36	136	-0.09	-1.79	-2.73	-0.92	1.08	0.27
DTAG	36	345	-1.24	-0.05	1.21	3.25	2.86	5.72
DTAG	36	465	0.52	1.41	1.08	-0.73	-1.39	-3.16
F	35	122	5.94	6.83	6.05	5.65	6.55	6.96
F	35	124	***	***	***	***	2.00	2.28
F	35	131	6.39	6.66	6.47	6.55	6.38	6.75
F	35	158	16.53	16.63	15.92	16.67	17.26	16.91
F	35	172	2.82	***	***	***	***	***
F	35	198	7.87	7.95	***	***	***	***
F	35	355	1.80	***	***	***	***	***
F	35	385	8.52	8.55	8.64	8.68	9.59	9.33
F	35	396	***	7.65	7.59	6.20	5.49	5.14
F	35	469	-0.95	-1.42	-0.32	-0.73	***	***
F	35	489	8.88	7.91	7.53	7.50	9.68	***
F	35	521	-11.33	-11.89	-10.66	-11.94	-10.80	***
F	35	536	-6.01	-5.79	-6.18	-5.82	-6.25	-6.05
F	35	609	22.20	22.65	22.79	23.28	23.04	23.64
F	35	770	12.26	11.53	12.30	12.03	12.04	11.58
F	35	781	***	***	***	***	-20.12	-20.80
F	35	819	27.25	27.25	26.05	26.44	26.38	25.80

TABLE 8A. (CONT.)

LAB.	CLOCK	51574	51599	51634	51664	51694	51724
F	35 859	11.24	10.28	10.37	10.08	9.17	9.33
F	35 1177	-11.33	-12.10	-10.70	-11.67	-12.03	-11.78
F	35 1178	1.59	2.72	2.03	2.54	3.16	3.55
F	35 1222	***	***	***	***	***	***
F	35 1321	8.22	7.66	8.37	8.68	9.10	8.93
F	35 1556	***	***	***	***	***	***
F	40 805	***	***	***	-10.90	-20.46	***
F	40 816	***	***	***	***	***	-15.87
GUM	18 746	***	***	***	***	***	***
GUM	31 652	-9.05	-11.56	-18.08	-11.95	-23.64	-24.28
GUM	35 441	-1.46	-2.27	-3.41	-4.69	-5.69	-4.39
GUM	35 502	-7.85	-6.30	-6.45	-6.73	-5.79	-5.53
GUM	35 745	***	1.27	-2.42	4.20	1.29	2.80
GUM	35 761	-0.19	-2.52	-0.18	0.90	0.96	0.87
GUM	35 1120	-14.30	-13.28	-13.49	-13.06	-12.39	-9.79
IEN	35 219	26.49	24.62	25.35	25.07	25.34	***
IEN	35 505	0.13	0.32	-0.04	-0.49	0.51	-1.01
IEN	35 1115	-8.27	-10.93	-10.10	-10.58	-9.87	-11.12
IEN	35 1373	7.04	7.09	5.88	5.88	5.51	7.01
IFAG	36 1034	-13.55	-13.00	-12.81	-7.25	-11.94	-12.77
IFAG	36 1173	-0.38	1.59	0.70	-2.85	-5.16	-1.44
IFAG	36 1176	***	***	***	-10.26	-12.88	-11.24
IFAG	40 4401	-63.10	15.60	36.23	***	80.88	***
IFAG	40 4403	71.00	129.28	157.18	169.69	-2.56	***
IFAG	40 4413	-36.70	-48.96	-55.87	-55.58	96.96	***
IGMA	14 2403	-8.63	-8.10	-2.76	7.47	-6.62	-9.85
IGMA	16 112	47.55	51.16	43.54	42.38	33.49	46.48
IGMA	35 631	16.39	16.09	15.98	17.38	17.42	16.04
IGMA	35 645	13.21	13.68	13.17	14.08	13.84	14.41
INPL	35 1021	***	-0.09	***	-2.43	-2.96	***
IPQ	35 125	***	***	***	***	29.23	28.32
IPQ	35 615	9.40	10.73	10.90	10.15	10.38	10.10
IPQ	35 1030	9.22	8.44	9.06	9.74	9.98	10.01
KRIS	36 321	4.83	7.14	4.53	5.66	3.71	5.92
KRIS	36 739	-11.50	-11.52	-12.41	-11.69	-10.36	-10.84
KRIS	36 1135	8.74	9.40	11.11	9.53	9.87	11.16
KRIS	40 5623	25.47	26.33	26.26	26.83	26.79	27.57
LDS	35 289	***	0.51	***	***	***	***
MSL	12 933	***	25.44	19.23	31.87	25.37	26.12
MSL	35 1025	***	-10.87	-10.66	***	***	-11.21
MSL	36 274	***	11.14	8.65	6.51	4.56	5.94
NAO	14 1315	-75.98	-81.92	-98.14	-107.54	-121.38	-129.03
NAO	35 779	17.15	17.06	17.04	17.02	17.40	17.67
NAO	35 1206	8.50	8.08	8.64	8.85	8.52	8.10
NAO	35 1214	7.14	7.04	7.76	6.70	7.53	8.35

TABLE 8A. (CONT.)

LAB.	CLOCK		51754	51784	51814	51844	51874	51909
F	35	859	9.20	9.16	8.86	7.69	9.51	6.03
F	35	1177	-12.10	***	***	-11.17	-13.50	-10.78
F	35	1178	3.67	***	***	5.25	5.27	4.87
F	35	1222	5.18	6.39	***	***	7.39	6.88
F	35	1321	10.01	9.48	10.22	9.94	9.88	10.07
F	35	1556	***	***	***	-15.72	-16.15	-16.96
F	40	805	***	***	***	***	***	***
F	40	816	-16.15	-16.71	-16.84	-16.65	-15.50	-15.87
GUM	18	746	***	***	***	***	7.41	***
GUM	31	652	-60.58	-1.04	-1.04	-12.00	11.40	***
GUM	35	441	0.62	-0.05	0.08	0.34	0.09	0.45
GUM	35	502	-7.82	-10.35	-10.19	-13.12	-11.00	-9.20
GUM	35	745	3.35	2.95	***	***	***	1.09
GUM	35	761	-0.43	-0.89	***	***	4.76	4.33
GUM	35	1120	-13.27	-11.05	-10.86	-10.90	-11.25	-11.00
IEN	35	219	***	***	***	***	***	***
IEN	35	505	0.41	2.06	2.12	-0.02	-0.07	-0.28
IEN	35	1115	-10.24	-6.92	-7.99	-8.46	-8.51	-9.98
IEN	35	1373	5.89	6.06	5.89	6.21	6.88	6.96
IFAG	36	1034	-11.27	-14.02	-13.15	-13.02	-12.89	-11.09
IFAG	36	1173	-1.31	-1.85	-2.98	-4.92	-5.15	-1.35
IFAG	36	1176	***	***	***	***	***	***
IFAG	40	4401	9.26	6.62	-23.63	-12.97	5.68	30.06
IFAG	40	4403	54.95	14.29	-15.74	1.82	-0.79	-0.89
IFAG	40	4413	-21.40	-6.48	-7.86	-11.97	-20.94	***
IGMA	14	2403	-18.69	-19.20	-26.74	-39.40	-25.34	-15.76
IGMA	16	112	48.00	48.95	42.51	53.78	49.04	44.98
IGMA	35	631	16.00	16.12	15.71	15.16	16.83	16.40
IGMA	35	645	12.97	13.20	11.63	12.74	13.10	13.38
INPL	35	1021	***	***	***	-1.80	-2.85	-3.01
IPQ	35	125	28.10	27.23	27.35	27.03	27.10	27.00
IPQ	35	615	10.24	10.68	10.59	10.60	10.22	9.78
IPQ	35	1030	9.70	10.12	10.50	10.83	11.02	10.94
KRIS	36	321	3.75	3.95	5.95	7.95	5.62	5.55
KRIS	36	739	-11.59	-13.00	-10.38	-11.61	-11.90	-11.24
KRIS	36	1135	15.46	10.45	13.33	14.71	12.91	13.55
KRIS	40	5623	27.91	28.14	28.24	28.13	28.23	26.51
LDS	35	289	***	***	***	***	***	***
MSL	12	933	18.02	15.80	17.62	26.29	***	***
MSL	35	1025	-10.50	-10.84	-10.77	-10.08	***	***
MSL	36	274	4.65	8.71	6.95	6.06	***	***
NAO	14	1315	-122.83	***	***	-127.46	-135.10	***
NAO	35	779	16.34	***	***	17.90	18.03	18.12
NAO	35	1206	8.36	***	***	9.40	9.10	10.00
NAO	35	1214	8.12	***	***	9.29	8.19	8.70

TABLE 8A. (CONT.)

LAB.	CLOCK		51574	51599	51634	51664	51694	51724
NIM	35	479	11.11	12.31	12.44	12.38	8.59	***
NIM	35	1238	4.70	5.46	3.72	5.16	1.35	***
NIM	35	1239	11.22	12.24	10.76	11.30	8.09	***
NIST	35	132	***	***	***	***	***	-2.89
NIST	35	182	***	***	***	***	***	***
NIST	35	408	-8.97	-9.49	-9.26	-8.87	***	***
NIST	35	1074	-9.27	-8.63	-9.16	-9.32	-9.37	-9.09
NIST	40	201	23.40	23.71	24.13	24.25	24.70	25.08
NIST	40	203	7.24	7.54	8.01	8.09	8.79	9.25
NIST	40	204	-0.10	0.16	0.45	***	***	-2.11
NIST	40	205	-14.89	-15.39	-15.73	-16.42	-16.70	-17.04
NIST	40	222	-739.33	-739.34	-739.29	-739.53	-739.43	-738.01
NIST	50	2008	-95.61	***	***	***	***	***
NPL	35	784	6.09	5.86	5.22	4.92	5.26	5.60
NPL	35	1275	1.92	2.31	3.32	4.53	3.99	***
NPL	36	404	11.76	13.25	12.81	13.13	14.25	13.48
NPL	40	1701	-2.10	-1.77	-1.62	-1.22	-0.82	-0.86
NPL	40	1708	-1.14	-0.96	-0.98	-1.03	-0.61	-0.49
NRC	35	234	21.52	20.47	20.11	18.73	17.92	17.51
NRC	35	372	6.54	6.95	6.48	***	***	***
NRC	40	303	4.99	5.34	8.61	12.07	13.70	14.41
NRC	40	304	9.86	11.12	11.07	10.96	10.88	10.84
NRC	90	61	-0.27	0.43	1.18	0.27	0.33	-0.50
NRLM	35	224	7.87	7.68	6.50	6.03	6.18	6.20
NRLM	35	459	5.50	3.65	4.22	4.74	4.87	4.42
NRLM	35	523	2.94	1.53	1.21	0.85	0.84	0.95
NRLM	35	1466	***	***	***	***	***	***
OMH	36	849	***	1.40	3.69	2.29	2.96	3.82
ONRJ	35	903	***	2.62	1.97	1.37	2.37	***
ORB	35	201	0.93	2.44	3.11	3.24	2.72	1.43
ORB	35	202	8.55	5.90	5.74	6.50	7.58	5.21
ORB	35	593	39.87	45.92	52.43	56.04	55.54	57.61
ORB	40	2601	-204.17	-201.04	-197.33	-198.27	-196.39	-197.64
PSB	35	277	3.31	4.60	4.02	3.37	4.88	4.95
PSB	35	1035	***	***	***	***	***	***
PTB	35	128	***	***	***	***	***	***
PTB	35	271	8.69	***	***	***	***	***
PTB	35	415	2.21	2.52	2.95	2.42	2.62	2.67
PTB	35	1072	***	8.82	9.68	9.33	8.08	8.26
PTB	40	502	-2.52	-2.73	-2.41	-2.44	-1.97	-1.56
PTB	40	505	-5.74	-5.22	-4.63	-4.31	-3.61	-3.12
PTB	40	537	***	***	-1.26	0.29	-1.82	-5.13
PTB	92	1	1.50	1.40	1.90	1.26	1.91	1.32
PTB	92	2	1.03	1.03	1.60	1.10	0.48	0.68
PTB	92	3	***	***	***	-1.85	-1.92	-2.09

TABLE 8A. (CONT.)

LAB.	CLOCK		51754	51784	51814	51844	51874	51909
NIM	35	479	11.15	***	9.62	9.53	8.02	10.60
NIM	35	1238	3.77	***	2.77	3.62	2.13	4.11
NIM	35	1239	9.86	***	8.96	9.45	7.98	9.41
NIST	35	132	-3.30	-3.57	-3.94	-3.30	-3.97	-2.82
NIST	35	182	***	***	***	***	***	-11.65
NIST	35	408	***	***	***	***	***	***
NIST	35	1074	-9.16	-8.87	-9.15	-8.02	-8.27	-8.31
NIST	40	201	25.49	25.84	26.20	26.77	27.00	27.55
NIST	40	203	9.72	9.99	10.40	10.93	11.20	***
NIST	40	204	-1.73	-1.27	-1.02	-0.10	0.13	0.67
NIST	40	205	-17.37	-17.67	-18.00	-18.15	-18.64	-18.72
NIST	40	222	-736.80	-736.92	***	-14.04	-14.10	-13.77
NIST	50	2008	***	***	***	***	***	***
NPL	35	784	5.01	4.61	4.55	5.39	4.94	5.34
NPL	35	1275	***	***	4.12	4.05	3.73	4.24
NPL	36	404	12.39	15.15	14.47	13.45	12.61	13.56
NPL	40	1701	-0.71	-1.05	-0.94	-0.52	-0.09	0.08
NPL	40	1708	-0.33	-0.27	-0.15	-0.17	-0.13	-0.05
NRC	35	234	16.74	16.93	16.14	16.59	16.17	16.29
NRC	35	372	***	***	***	***	***	***
NRC	40	303	7.32	***	***	***	***	***
NRC	40	304	10.65	10.45	10.75	11.27	12.23	12.79
NRC	90	61	-0.39	0.15	-0.05	-0.03	0.53	0.45
NRLM	35	224	6.26	5.90	***	***	***	***
NRLM	35	459	4.67	4.53	5.36	6.55	3.85	***
NRLM	35	523	1.25	1.19	1.03	2.23	-0.78	***
NRLM	35	1466	***	***	***	***	12.68	***
OMH	36	849	5.73	5.31	4.67	2.89	2.00	2.03
ONRJ	35	903	2.20	1.43	2.46	0.58	6.84	2.82
ORB	35	201	1.47	2.32	0.47	2.74	2.75	3.15
ORB	35	202	7.74	7.21	5.70	8.88	5.60	7.20
ORB	35	593	***	***	***	***	***	***
ORB	40	2601	-196.86	-197.22	-199.78	-194.86	-189.59	-189.73
PSB	35	277	5.03	***	***	***	***	***
PSB	35	1035	***	***	3.17	3.71	2.50	3.32
PTB	35	128	***	-3.12	-2.81	-2.26	-2.80	-2.88
PTB	35	271	***	***	***	***	***	***
PTB	35	415	3.94	7.06	***	***	***	***
PTB	35	1072	7.93	7.17	8.57	8.21	9.80	9.28
PTB	40	502	-1.15	-0.69	-0.22	0.12	0.46	0.85
PTB	40	505	-2.53	-2.07	-1.61	-1.11	-0.94	-0.62
PTB	40	537	-7.19	-7.37	-8.58	-9.46	-10.49	-9.95
PTB	92	1	1.19	1.17	1.70	2.03	2.30	1.40
PTB	92	2	0.92	0.88	0.83	1.15	0.90	0.74
PTB	92	3	-0.82	-0.89	-0.03	-1.38	-0.90	-0.87

TABLE 8A. (CONT.)

LAB.	CLOCK		51574	51599	51634	51664	51694	51724
ROA	14	896	59.64	63.05	61.18	48.93	47.41	54.18
ROA	14	1569	15.02	19.26	21.97	24.63	35.86	39.44
ROA	31	422	0.79	0.97	7.15	6.19	8.85	19.29
ROA	35	583	0.17	0.68	0.01	-0.09	-0.14	-0.92
ROA	35	718	6.52	6.79	7.27	7.10	7.36	6.47
ROA	36	1488	***	***	***	***	***	11.03
ROA	36	1490	***	***	***	***	***	9.85
SCL	35	764	-7.98	-7.61	-9.00	-8.11	-8.40	-8.62
SMU	36	1063	***	-4.45	-4.98	-4.97	-4.83	-3.45
SP	16	137	99.79	98.08	100.70	94.22	91.12	85.11
SP	35	641	-16.58	-18.71	-17.96	-18.89	-18.05	-17.76
SP	35	1188	21.36	21.88	22.35	22.06	21.96	22.56
SP	36	1175	***	***	***	***	***	***
SU	40	3802	***	***	***	***	12.21	13.68
SU	40	3803	***	***	***	***	***	***
SU	40	3805	***	***	***	***	17.74	18.80
SU	40	3806	***	6.35	6.65	6.22	6.63	6.70
SU	40	3807	***	34.97	34.60	35.00	34.82	34.63
SU	40	3808	***	-14.73	***	***	***	***
SU	40	3809	***	0.59	0.63	0.19	0.41	0.32
SU	40	3810	***	70.18	***	***	***	-8.84
SU	40	3811	***	-18.51	-18.11	-19.85	-21.71	-21.87
SU	40	3812	***	-30.85	-31.16	-27.76	-28.48	***
TL	34	438	395.52	403.73	409.01	410.58	441.64	454.77
TL	35	160	2.86	2.06	1.64	2.22	1.84	***
TL	35	300	15.45	16.60	15.76	16.14	16.32	15.25
TL	35	474	-0.93	-1.32	-1.69	-0.86	0.21	-0.05
TL	35	809	-8.01	-6.49	-7.74	-6.41	-8.27	-8.65
TL	35	1012	-15.15	-16.52	-16.07	-15.22	-11.75	***
TL	35	1498	***	***	***	***	***	***
TL	35	1500	***	***	***	***	***	***
TL	40	3052	8.56	10.09	10.72	13.82	14.81	15.93
TL	40	3053	12.93	14.51	14.65	16.78	17.75	18.45
TP	35	1227	0.28	-0.35	-0.05	0.65	-0.33	1.18
TP	36	154	11.99	13.25	14.12	14.15	14.01	11.90
TP	36	163	-3.08	-5.10	-6.81	-3.07	-8.47	-7.54
TP	36	326	-5.78	-4.99	-4.62	-5.74	-6.50	-6.22
TUG	14	1654	40.98	24.12	27.15	23.17	24.41	30.35
TUG	35	247	-3.42	-3.93	-3.72	-4.96	-5.03	-4.55
UME	35	252	-0.79	-1.20	***	-3.52	-1.31	-1.50
UME	35	872	-6.03	-5.33	***	-7.80	-5.80	-5.93
USNO	35	101	13.76	13.30	13.28	13.30	12.73	12.90
USNO	35	104	18.24	18.68	19.05	19.25	19.21	18.74
USNO	35	106	-13.54	-13.15	-13.01	-14.26	-13.47	-13.08
USNO	35	108	4.13	4.45	3.56	3.22	8.92	8.64

TABLE 8A. (CONT.)

LAB.	CLOCK		51754	51784	51814	51844	51874	51909
ROA	14	896	64.60	63.63	64.63	66.08	41.38	***
ROA	14	1569	40.05	38.89	23.36	20.58	29.78	31.40
ROA	31	422	***	***	***	***	***	***
ROA	35	583	1.69	1.56	-1.95	-0.81	-1.02	0.90
ROA	35	718	5.85	7.21	7.40	6.87	6.13	7.33
ROA	36	1488	7.66	7.00	5.77	6.70	8.36	7.18
ROA	36	1490	8.57	9.02	6.23	5.36	8.20	6.63
SCL	35	764	-7.78	-9.21	-8.25	-8.92	***	***
SMU	36	1063	-3.20	-4.42	-2.82	-1.78	-3.25	-1.64
SP	16	137	82.05	83.49	98.25	86.80	98.63	108.56
SP	35	641	-18.54	-17.81	-17.77	-17.95	-17.52	-17.38
SP	35	1188	22.74	23.08	23.32	22.48	22.60	22.51
SP	36	1175	***	***	***	***	-1.42	0.50
SU	40	3802	15.13	16.40	17.70	18.53	19.60	20.83
SU	40	3803	***	***	***	***	***	-5.84
SU	40	3805	19.99	21.15	22.50	23.74	25.08	27.11
SU	40	3806	7.16	6.80	6.78	7.14	7.25	7.46
SU	40	3807	34.64	34.78	35.30	35.74	36.23	36.55
SU	40	3808	***	***	***	***	***	***
SU	40	3809	0.34	0.92	0.43	-0.72	-0.89	***
SU	40	3810	-6.90	-5.10	-3.10	-0.15	2.53	5.09
SU	40	3811	-21.45	-21.61	-22.24	-22.35	-22.32	-22.22
SU	40	3812	***	***	***	***	***	***
TL	34	438	***	***	***	***	***	***
TL	35	160	***	***	***	***	***	***
TL	35	300	***	***	***	***	***	***
TL	35	474	***	***	***	***	***	***
TL	35	809	-8.02	-8.53	-8.84	-9.20	-7.57	***
TL	35	1012	***	-10.24	-11.07	***	***	-10.44
TL	35	1498	***	16.50	16.77	15.82	16.11	13.61
TL	35	1500	***	10.75	9.43	9.91	24.32	13.72
TL	40	3052	17.65	19.23	20.72	21.75	23.88	26.01
TL	40	3053	19.33	20.93	21.87	22.48	23.95	***
TP	35	1227	0.59	2.09	0.02	2.15	1.51	1.74
TP	36	154	13.32	13.65	11.80	13.32	13.11	12.99
TP	36	163	-4.83	-7.00	-7.34	-6.85	-5.41	-4.53
TP	36	326	-7.55	-6.32	-7.18	-5.59	-5.94	-6.85
TUG	14	1654	***	***	***	***	***	***
TUG	35	247	***	***	***	***	***	***
UME	35	252	-11.11	-1.93	-1.23	9.70	-0.77	-0.01
UME	35	872	***	***	218.74	226.32	-414.92	-139.77
USNO	35	101	12.33	12.05	12.34	12.63	12.09	11.48
USNO	35	104	18.67	17.23	16.35	16.28	15.98	16.00
USNO	35	106	-13.87	-13.05	-13.71	-13.25	-13.44	-12.96
USNO	35	108	7.76	6.66	6.97	6.05	6.33	6.23

TABLE 8A. (CONT.)

LAB.	CLOCK		51574	51599	51634	51664	51694	51724
USNO	35	114	26.32	26.31	26.45	25.95	25.24	25.60
USNO	35	120	***	***	***	0.20	0.27	-0.02
USNO	35	142	***	***	***	4.88	***	***
USNO	35	146	***	***	***	-1.28	-1.14	-1.94
USNO	35	148	-2.53	-1.72	-1.55	-0.71	***	***
USNO	35	150	21.57	21.60	***	-4.01	***	***
USNO	35	152	15.92	16.79	16.41	15.79	15.75	15.81
USNO	35	153	12.43	11.28	12.35	11.43	11.84	12.57
USNO	35	156	***	14.88	16.10	15.07	***	***
USNO	35	161	-16.88	-17.12	-17.28	-17.01	-17.72	-16.66
USNO	35	164	0.95	0.14	-0.05	-0.21	0.02	-0.07
USNO	35	165	6.34	6.77	6.11	5.79	5.61	5.19
USNO	35	166	-2.36	-1.88	-0.70	-0.34	-0.67	-1.15
USNO	35	167	5.76	5.28	4.43	3.47	3.69	3.78
USNO	35	169	14.52	14.12	16.00	14.35	15.17	14.91
USNO	35	171	***	***	***	***	1.63	1.48
USNO	35	213	14.83	15.14	14.82	15.50	14.86	15.23
USNO	35	217	-0.29	-0.72	-0.55	-1.02	-0.37	-1.18
USNO	35	225	***	***	***	3.55	3.16	2.08
USNO	35	226	2.87	2.44	***	***	22.56	22.58
USNO	35	227	14.63	14.74	14.37	14.42	14.09	14.23
USNO	35	229	1.13	0.89	-0.11	-0.48	-0.13	-0.29
USNO	35	233	***	***	***	-1.12	-0.17	-0.23
USNO	35	242	13.18	13.28	12.51	12.23	12.36	12.91
USNO	35	244	***	***	***	19.13	19.55	18.00
USNO	35	249	-5.26	-5.13	-5.76	-5.90	-6.22	-5.39
USNO	35	253	***	***	***	6.80	4.96	3.76
USNO	35	254	-0.40	-0.76	-1.25	-0.28	-0.53	-0.19
USNO	35	255	-11.57	-11.04	-12.02	-11.99	-12.43	***
USNO	35	256	-13.60	***	***	14.68	13.33	12.08
USNO	35	260	10.84	10.11	11.27	10.18	9.93	9.99
USNO	35	270	10.49	***	***	-12.20	-12.59	-13.21
USNO	35	279	-7.70	-7.11	-7.90	-7.01	-7.36	-7.06
USNO	35	392	4.72	5.03	4.97	4.33	4.96	4.42
USNO	35	394	12.58	13.64	13.35	13.88	14.36	14.29
USNO	35	417	15.64	15.50	15.81	14.94	13.88	15.23
USNO	35	1096	18.43	17.73	17.41	16.31	18.31	17.46
USNO	35	1097	6.75	7.48	6.85	6.42	7.51	8.15
USNO	35	1125	-3.48	-3.69	***	21.92	***	***
USNO	35	1438	***	***	***	5.64	3.16	0.01
USNO	35	1459	***	***	***	***	***	1.52
USNO	35	1462	***	***	***	7.98	7.90	6.47
USNO	35	1463	***	***	***	6.65	5.57	5.01
USNO	35	1468	***	***	***	0.79	-1.00	-0.87
USNO	35	1481	***	***	***	***	0.88	-0.14

TABLE 8A. (CONT.)

LAB.	CLOCK	51754	51784	51814	51844	51874	51909
USNO	35 114	25.69	25.03	25.17	25.00	24.89	24.46
USNO	35 120	-0.05	0.08	0.03	-0.39	0.40	0.17
USNO	35 142	4.09	4.63	4.47	4.95	4.47	4.50
USNO	35 146	-2.91	-2.47	-3.45	-2.59	-3.02	-2.81
USNO	35 148	4.58	4.90	5.74	5.95	5.60	5.69
USNO	35 150	-1.69	-1.26	-1.69	-0.56	-0.15	1.27
USNO	35 152	17.14	15.25	15.06	15.13	14.56	15.37
USNO	35 153	12.38	12.48	12.55	12.83	11.77	12.67
USNO	35 156	15.42	15.75	15.52	16.20	16.14	16.06
USNO	35 161	-18.33	-18.56	-18.82	-18.54	-18.12	-18.20
USNO	35 164	-0.51	-0.42	0.32	-0.67	-1.21	-0.61
USNO	35 165	5.88	4.94	5.20	4.55	4.83	5.57
USNO	35 166	-1.19	-0.98	-1.83	-0.56	-0.71	-1.24
USNO	35 167	3.53	4.29	3.55	4.28	3.50	3.81
USNO	35 169	15.34	15.94	14.59	14.54	14.88	15.77
USNO	35 171	1.27	1.10	1.77	1.87	1.60	2.20
USNO	35 213	13.90	14.33	13.64	14.35	14.46	14.87
USNO	35 217	-0.84	-1.30	-1.68	-0.86	-1.27	-1.87
USNO	35 225	-1.08	0.24	0.23	0.03	-0.15	0.79
USNO	35 226	21.14	20.79	20.81	19.93	19.98	19.77
USNO	35 227	15.76	10.20	7.86	6.12	5.97	5.84
USNO	35 229	8.08	-0.51	-0.20	-0.14	-0.55	-0.77
USNO	35 233	-0.96	-0.69	-0.45	-0.83	-1.07	-1.10
USNO	35 242	12.65	12.30	12.85	12.86	13.16	14.05
USNO	35 244	16.36	15.65	14.84	15.78	14.78	16.07
USNO	35 249	***	***	***	9.62	8.43	7.92
USNO	35 253	3.51	2.74	2.12	2.52	2.70	1.72
USNO	35 254	0.05	-1.36	-1.09	***	***	***
USNO	35 255	***	8.47	8.05	8.16	7.94	8.58
USNO	35 256	11.69	11.84	12.96	13.58	15.02	15.43
USNO	35 260	10.94	9.58	10.76	10.63	10.28	10.57
USNO	35 270	-12.31	-12.28	-12.32	-12.38	-11.93	-12.34
USNO	35 279	-7.35	-6.72	-6.60	***	***	1.07
USNO	35 392	4.67	4.78	4.58	5.08	5.02	4.44
USNO	35 394	14.70	15.78	16.08	15.51	15.22	16.06
USNO	35 417	14.86	16.55	17.80	17.99	17.34	17.85
USNO	35 1096	16.16	18.43	19.07	18.60	19.10	19.80
USNO	35 1097	6.73	7.76	7.07	7.45	7.74	7.81
USNO	35 1125	21.76	22.07	22.74	23.03	22.53	22.15
USNO	35 1438	0.46	0.71	1.19	0.72	0.12	0.25
USNO	35 1459	0.57	0.07	-0.85	-0.49	-1.63	-0.98
USNO	35 1462	7.49	6.87	6.92	7.22	7.33	7.26
USNO	35 1463	5.14	4.54	4.90	5.24	4.93	5.66
USNO	35 1468	0.10	0.15	-0.57	-1.28	-0.60	-1.36
USNO	35 1481	-0.91	0.20	1.01	0.15	1.03	-0.20

TABLE 8A. (CONT.)

LAB.	CLOCK		51574	51599	51634	51664	51694	51724
USNO	40	701	-27.73	-27.68	-27.73	-27.94	-27.78	-27.74
USNO	40	702	-8.46	-8.58	-8.55	-8.87	***	-8.82
USNO	40	703	-1.53	-1.72	-1.60	-1.95	-1.70	-1.55
USNO	40	704	-46.51	-46.45	-46.25	-46.32	-46.09	-45.93
USNO	40	705	-32.60	-32.74	***	-32.82	-30.97	-31.71
USNO	40	708	4.44	4.58	4.99	5.06	5.56	5.97
USNO	40	709	-36.72	-36.54	-35.86	-35.46	-34.80	-34.51
USNO	40	710	22.20	22.57	23.05	23.28	23.86	24.41
USNO	40	711	76.26	77.63	79.31	80.68	82.38	83.98
USNO	40	712	-8.74	-8.82	-8.71	-8.93	-8.77	-8.77
USNO	40	715	-19.90	-19.91	-19.66	-19.80	-19.54	-19.37
USNO	40	722	-6.57	-9.20	-11.61	-14.58	-16.74	***
USNO	40	723	0.79	-0.82	-2.09	-4.45	-5.69	***
VSL	35	179	13.57	11.65	11.56	11.25	11.50	10.91
VSL	35	456	24.14	24.68	24.11	23.19	22.28	23.04
VSL	35	548	4.84	5.31	4.50	4.82	4.46	4.54
VSL	35	731	17.90	18.15	17.12	17.86	16.75	18.28

TABLE 8A. (CONT.)

LAB.	CLOCK		51754	51784	51814	51844	51874	51909
USNO	40	701	-27.71	-27.86	-27.71	-27.89	-27.78	-27.72
USNO	40	702	-8.74	-8.80	-8.68	-9.16	-9.18	-9.28
USNO	40	703	-1.53	-1.59	-1.44	-1.43	-0.82	-0.43
USNO	40	704	-45.81	-45.79	-45.57	-45.53	-45.44	-45.26
USNO	40	705	-32.75	-33.49	-33.55	-33.85	-33.98	-34.05
USNO	40	708	6.33	6.58	6.95	7.05	7.08	7.35
USNO	40	709	-34.81	-34.35	-38.95	-46.27	-45.07	-42.79
USNO	40	710	24.89	25.23	25.85	26.39	26.85	27.15
USNO	40	711	85.49	87.26	89.02	90.55	92.22	93.86
USNO	40	712	-8.70	-8.85	-8.71	-8.82	-8.70	-8.72
USNO	40	715	-19.21	-19.17	-18.93	-18.90	-18.74	-18.54
USNO	40	722	***	***	***	***	***	***
USNO	40	723	***	***	***	***	***	***
VSL	35	179	10.64	9.41	9.29	9.11	10.21	7.51
VSL	35	456	22.86	22.04	22.58	22.87	22.38	21.57
VSL	35	548	4.16	5.11	4.78	***	***	***
VSL	35	731	18.23	17.70	17.46	17.91	18.34	18.14

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
18 FREQ. AND TIME SYSTEMS INC. 5030A
4x HYDROGEN MASERS
9x PRIMARY CLOCKS AND PROTOTYPES
21 OSCILLOQUARTZ 3210
23 OSCILLOQUARTZ EUDICS 3020
30 HEWLETT-PACKARD 5061B
31 HEWLETT-PACKARD 5061B OPT. 4
34 H-P 5061A/B with 5071A tube
35 HEWLETT-PACKARD 5071A High perf.
36 HEWLETT-PACKARD 5071A Low perf.
50 FREQ. AND TIME SYSTEMS INC. 4065A

TABLE 8B. CORRECTIONS FOR AN HOMOGENEOUS USE OF THE CLOCK RATES PUBLISHED IN THE CURRENT AND PREVIOUS ANNUAL REPORTS.

Each line refers to the same clock working without interruption.

	2000	1999		1998		1997	
	clock nø	clock nø	corr. (ns/d)	clock nø	corr. (ns/d)	clock nø	corr. (ns/d)
AUS	36 340	36 340	3.28				
BEV	35 1065	35 1065		35 1065	-31.71		
CH	17 206	17 206		17 206		17 206(1)	
DTAG	36 345	36 345		36 345		36 345(2)	-2.76
GUM	35 441	35 441		35 441	-2.68	35 441(3)	+2.85
	35 502	35 502		35 502	-6.57	35 502	-6.57
IEN	35 505	35 505		35 505	+2.21	35 505(4)	+4.94
NPL	40 1701	40 1701	-1.80	40 1701	-3.40	40 1701(5)	-6.20
NRLM	35 523	35 523		35 523		35 523(6)	
PTB	40 505	40 505	-7.78	40 505	-12.10	40 505	-25.06
ROA	14 896	14 896		14 896		14 896(7)	
	14 1569	14 1569		14 1569		14 1569(8)	
	35 583	35 583		35 583	+0.55	35 583(9)	-0.55
TUG	35 247	35 247		35 247		35 247	+12.58

(1) A correction of +78.00 ns/d has to be applied in 1994, 1993 and in 1992.

(2) A correction of -2.76 ns/d has to be applied in 1996.

(3) A correction of +2.85 ns/d has to be applied in 1996 and in 1995.

(4) A correction of +4.94 ns/d has to be applied in 1996 and a correction of +1.11 ns/d has to be applied in 1995.

(5) A correction of -7.4 ns/d has to be applied in 1996, a correction of -3.75 ns/d has to be applied in 1995, 1994, 1993 and 1992, and a correction of +23.25 ns/d has to be applied in 1991.

(6) A correction of +2.76 ns/d has to be applied in 1995.

(7) A correction of - 31.00 ns/d has to be applied in 1994.

(8) A correction of - 6.00 ns/d has to be applied in 1994.

(9) A correction of +2.15 ns/d has to be applied in 1996 and 1995.

TABLE 9A. RELATIVE WEIGHTS (IN PERCENT) OF CONTRIBUTING CLOCKS IN 2000

(File available on http://www.bipm.org under the name WTAI00.AR)

Clocks weights are computed for one-month intervals ending at the dates given in the table. Since 1998 January 1, the maximum relative weight of a given clock cannot exceed 0.7 % .

***** denotes that the clock was not used

LAB.	CLOCK		51574	51599	51634	51664	51694	51724
AMC	35	173	0.700	0.700	0.700	0.700	0.700	0.700
AMC	35	231	0.000	0.000	0.000	0.000	0.700	0.700
AMC	35	266	*****	*****	*****	*****	0.000	0.000
AMC	35	268	0.000	0.000	0.000	*****	*****	*****
AMC	35	389	0.700	0.700	0.700	0.700	0.700	0.700
AMC	35	416	*****	*****	*****	*****	*****	*****
AMC	35	703	0.000	0.000	0.000	0.700	0.700	0.700
AMC	35	717	*****	*****	*****	*****	0.000	0.000
AMC	35	762	0.700	0.700	*****	*****	0.000	0.000
AMC	35	763	*****	0.000	0.000	0.000	0.000	0.700
AMC	35	765	0.700	0.700	0.700	0.700	0.700	0.700
AMC	35	1331	*****	*****	*****	*****	*****	*****
AMC	40	713	0.700	0.700	0.700	0.700	0.700	0.700
AMC	40	714	*****	*****	*****	*****	*****	0.000
AMC	40	716	*****	*****	*****	0.000	0.000	0.000
AOS	23	67	0.003	0.003	0.003	0.003	0.004	0.004
APL	35	904	*****	*****	0.000	0.000	0.000	0.000
AUS	35	299	0.700	0.700	0.700	0.700	0.700	0.634
AUS	36	249	*****	0.000	*****	0.000	*****	*****
AUS	36	340	0.700	0.700	0.700	0.700	0.700	0.700
AUS	36	654	0.700	0.700	0.700	0.700	0.700	0.700
AUS	36	1035	*****	0.000	*****	*****	*****	*****
AUS	36	1141	0.537	0.580	0.607	0.674	0.700	0.683
AUS	40	5401	*****	*****	*****	*****	*****	*****
AUS	40	5402	*****	*****	*****	*****	*****	*****
AUS	40	5403	*****	*****	0.000	0.000	*****	*****
AUS	40	7501	0.000	0.000	0.383	0.457	0.567	0.570
AUS	40	7502	0.000	0.000	0.494	0.666	*****	*****
BEV	35	1065	0.700	0.700	0.700	0.700	*****	*****
CAO	35	939	0.000	0.000	0.000	0.000	0.690	0.700
CAO	35	1270	0.000	0.000	0.000	0.000	0.700	0.700
CH	16	77	0.005	*****	*****	*****	*****	*****
CH	17	206	0.042	0.036	0.036	0.036	0.032	0.024
CH	21	179	0.201	0.150	0.127	0.090	0.063	0.059
CH	21	194	0.197	0.435	0.431	0.415	0.433	0.276

Table 9A. (Cont.)

LAB.	CLOCK		51754	51784	51814	51844	51874	51909
AMC	35	173	0.700	*****	*****	*****	*****	*****
AMC	35	231	0.700	0.700	0.700	0.700	*****	*****
AMC	35	266	0.000	0.000	0.700	0.700	0.700	0.700
AMC	35	268	*****	0.000	0.000	0.000	*****	*****
AMC	35	389	0.700	0.700	0.700	0.700	0.700	0.700
AMC	35	416	0.000	0.000	0.000	0.000	0.700	0.700
AMC	35	703	0.700	0.700	0.700	0.700	0.700	*****
AMC	35	717	0.000	0.000	0.700	0.700	0.700	0.700
AMC	35	762	0.000	0.000	0.645	0.686	0.700	0.700
AMC	35	763	0.700	0.700	0.700	0.700	0.700	0.700
AMC	35	765	0.700	0.700	0.700	0.700	0.700	0.700
AMC	35	1331	*****	*****	0.000	0.000	0.000	0.000
AMC	40	713	0.700	0.700	0.700	0.700	0.700	0.700
AMC	40	714	0.000	0.000	0.000	0.700	0.700	0.700
AMC	40	716	0.000	0.700	0.700	0.276	0.141	0.142
AOS	23	67	0.006	0.005	0.004	0.003	0.003	0.005
APL	35	904	0.700	0.700	0.700	0.700	0.700	*****
AUS	35	299	0.700	0.700	0.571	0.446	0.365	*****
AUS	36	249	*****	*****	0.000	*****	*****	0.000
AUS	36	340	0.700	0.700	0.700	0.700	0.700	0.000
AUS	36	654	0.700	0.700	0.700	0.700	0.700	0.700
AUS	36	1035	0.000	0.000	*****	*****	0.000	0.000
AUS	36	1141	0.700	0.700	0.700	0.552	0.639	0.700
AUS	40	5401	*****	*****	0.000	0.000	0.000	0.000
AUS	40	5402	*****	*****	*****	0.000	0.000	0.000
AUS	40	5403	0.000	0.000	0.000	*****	*****	0.000
AUS	40	7501	*****	*****	*****	*****	*****	*****
AUS	40	7502	*****	*****	*****	*****	*****	*****
BEV	35	1065	*****	0.000	0.000	0.000	0.000	0.700
CAO	35	939	0.700	0.700	0.700	0.700	0.700	0.700
CAO	35	1270	*****	0.000	0.000	*****	*****	*****
CH	16	77	*****	*****	*****	*****	*****	*****
CH	17	206	0.028	0.038	0.027	0.025	0.024	0.035
CH	21	179	0.113	0.101	0.097	0.098	0.087	0.181
CH	21	194	0.383	0.325	0.244	0.163	0.147	0.165

Table 9A. (Cont.)

LAB.	CLOCK		51574	51599	51634	51664	51694	51724
CH	21	217	0.028	0.024	0.022	0.021	0.025	0.027
CH	31	403	0.099	0.093	0.154	0.639	0.563	0.491
CH	35	413	*****	0.000	0.000	0.000	0.000	0.700
CH	35	771	0.700	0.700	*****	*****	*****	*****
CH	36	354	0.700	0.700	0.700	0.700	0.700	0.700
CNM	35	237	0.700	0.700	0.700	0.700	0.700	0.700
CNM	35	382	0.700	0.700	0.700	0.700	0.700	0.700
CRL	35	112	0.700	0.700	0.700	0.700	0.700	0.700
CRL	35	144	0.700	0.700	0.700	0.700	0.700	0.700
CRL	35	332	*****	*****	0.000	0.000	0.000	0.000
CRL	35	342	0.000	0.000	0.000	0.000	0.700	0.700
CRL	35	343	*****	*****	0.000	0.000	0.000	0.000
CRL	35	715	0.700	0.700	0.700	0.700	0.700	0.700
CRL	35	732	0.700	*****	*****	0.000	0.000	0.000
CRL	35	907	0.700	0.700	0.700	0.700	0.700	0.700
CRL	35	908	0.700	0.700	0.700	0.700	0.700	0.700
CRL	40	2008	*****	*****	*****	*****	*****	0.000
CRL	40	2009	*****	*****	*****	*****	*****	0.000
CSAO	35	1007	0.700	0.700	0.700	0.700	0.700	0.700
CSAO	35	1008	0.700	0.700	0.700	0.700	0.700	0.700
CSAO	35	1011	0.700	0.700	0.700	0.700	0.700	0.700
CSAO	35	1016	0.700	0.700	0.700	0.700	0.700	0.700
CSAO	35	1017	0.700	0.700	0.700	0.700	0.700	0.700
CSAO	35	1018	0.000	0.000	0.000	0.000	0.700	0.700
DLR	40	7424	0.375	0.377	0.396	0.383	0.368	0.342
DTAG	36	136	*****	*****	*****	*****	*****	0.000
DTAG	36	345	0.700	0.700	0.700	0.700	0.700	0.700
DTAG	36	465	0.700	0.700	0.664	0.461	*****	0.000
F	35	122	0.000	0.000	0.000	0.000	0.575	0.687
F	35	124	0.700	0.700	0.700	0.700	0.700	0.700
F	35	131	0.700	0.700	0.700	0.700	0.700	0.700
F	35	158	*****	*****	*****	*****	0.000	0.000
F	35	172	0.700	0.700	0.700	0.700	0.700	0.700
F	35	198	0.700	0.700	0.700	0.700	0.700	0.700
F	35	355	0.700	0.700	0.700	0.700	0.700	0.700
F	35	385	0.700	0.700	0.700	0.700	0.700	0.700
F	35	396	0.700	0.700	*****	*****	*****	*****
F	35	469	0.700	0.700	0.700	0.700	0.700	0.700
F	35	489	0.700	0.700	0.700	0.700	0.700	0.700
F	35	521	0.700	0.700	0.700	0.700	0.700	0.700
F	35	536	0.700	0.700	0.700	0.700	0.700	0.700
F	35	609	0.700	0.000	0.581	0.383	0.276	0.219
F	35	770	0.700	0.700	0.700	0.700	0.700	0.700
F	35	781	0.700	0.700	0.700	*****	*****	*****
F	35	819	0.700	0.700	0.700	*****	*****	0.000

Table 9A. (Cont.)

LAB.	CLOCK		51754	51784	51814	51844	51874	51909
CH	21	217	0.051	0.058	0.045	0.034	0.031	0.038
CH	31	403	0.700	0.700	0.700	0.555	0.603	0.700
CH	35	413	0.700	0.700	0.329	0.135	0.074	0.068
CH	35	771	*****	*****	*****	*****	*****	0.000
CH	36	354	0.700	0.700	0.700	0.700	0.700	0.700
CNM	35	237	0.700	0.700	0.700	0.700	0.700	0.700
CNM	35	382	0.700	0.700	0.700	0.700	0.700	0.700
CRL	35	112	0.700	0.700	0.700	0.700	0.700	*****
CRL	35	144	0.700	0.700	0.700	0.700	0.700	0.700
CRL	35	332	0.363	0.391	0.436	0.459	0.494	0.700
CRL	35	342	0.700	0.700	0.700	0.700	0.700	0.700
CRL	35	343	0.376	0.271	0.295	0.299	0.308	0.505
CRL	35	715	0.700	0.700	0.700	0.700	0.700	0.700
CRL	35	732	0.000	0.700	0.700	0.700	0.700	0.700
CRL	35	907	0.700	0.700	0.700	0.700	0.700	0.700
CRL	35	908	0.700	0.700	0.700	0.700	0.700	0.700
CRL	40	2008	0.000	0.000	0.000	0.036	0.028	*****
CRL	40	2009	*****	*****	*****	*****	*****	*****
CSAO	35	1007	0.700	0.700	0.700	0.700	0.700	0.700
CSAO	35	1008	0.700	0.700	0.639	0.428	0.317	0.479
CSAO	35	1011	0.700	0.700	0.700	0.700	0.700	0.700
CSAO	35	1016	0.700	0.700	0.700	0.700	0.700	0.700
CSAO	35	1017	0.700	0.700	0.700	0.700	0.700	0.700
CSAO	35	1018	0.700	0.700	0.700	0.700	0.700	0.700
DLR	40	7424	0.518	0.700	*****	0.000	0.000	0.000
DTAG	36	136	0.000	0.000	0.000	0.321	0.242	0.420
DTAG	36	345	0.700	0.700	0.700	0.000	0.332	0.000
DTAG	36	465	0.000	0.000	0.000	0.556	0.358	0.251
F	35	122	0.700	0.700	0.700	0.700	0.700	0.700
F	35	124	*****	*****	*****	*****	0.000	0.000
F	35	131	0.700	0.700	0.700	0.700	0.700	0.700
F	35	158	0.000	0.000	0.700	0.700	0.700	0.700
F	35	172	0.700	*****	*****	*****	*****	*****
F	35	198	0.700	0.700	*****	*****	*****	*****
F	35	355	0.700	*****	*****	*****	*****	*****
F	35	385	0.700	0.700	0.700	0.700	0.672	0.700
F	35	396	*****	0.000	0.000	0.000	0.000	0.321
F	35	469	0.700	0.700	0.700	0.700	*****	*****
F	35	489	0.700	0.700	0.700	0.700	0.700	*****
F	35	521	0.700	0.700	0.700	0.700	0.700	*****
F	35	536	0.700	0.700	0.700	0.700	0.700	0.700
F	35	609	0.345	0.345	0.321	0.345	0.381	0.700
F	35	770	0.700	0.700	0.700	0.700	0.700	0.700
F	35	781	*****	*****	*****	*****	0.000	0.000
F	35	819	0.000	0.000	0.000	0.478	0.526	0.700

Table 9A. (Cont.)

LAB.	CLOCK		51574	51599	51634	51664	51694	51724
F	35	859	0.540	0.427	0.424	0.517	0.463	0.454
F	35	1177	0.700	0.700	0.700	0.700	0.700	0.700
F	35	1178	0.700	0.668	0.700	0.656	0.578	0.547
F	35	1222	*****	*****	*****	*****	*****	*****
F	35	1321	0.700	0.700	0.700	0.700	0.700	0.700
F	35	1556	*****	*****	*****	*****	*****	*****
F	40	805	*****	*****	*****	0.000	0.000	*****
F	40	816	*****	*****	*****	*****	*****	0.000
GUM	18	746	*****	*****	*****	*****	*****	*****
GUM	31	652	0.083	0.067	0.049	0.047	0.029	0.021
GUM	35	441	0.700	0.700	0.700	0.700	0.463	0.342
GUM	35	502	0.544	0.505	0.566	0.533	0.683	0.693
GUM	35	745	*****	0.000	0.000	0.000	0.000	0.098
GUM	35	761	0.603	0.427	0.569	0.644	0.691	0.670
GUM	35	1120	0.092	0.096	0.111	0.121	0.127	0.123
IEN	35	219	0.700	0.700	0.700	0.700	0.700	*****
IEN	35	505	0.700	0.700	0.700	0.700	0.700	0.700
IEN	35	1115	0.700	0.650	0.578	0.461	0.391	0.272
IEN	35	1373	0.000	0.000	0.700	0.700	0.700	0.700
IFAG	36	1034	0.700	0.700	0.680	0.442	0.466	0.377
IFAG	36	1173	0.440	0.314	0.298	0.271	0.233	0.196
IFAG	36	1176	*****	*****	*****	0.000	0.000	0.000
IFAG	40	4401	0.000	0.000	0.000	*****	0.000	*****
IFAG	40	4403	0.002	0.001	0.001	0.001	0.001	*****
IFAG	40	4413	0.000	0.000	0.000	0.000	0.000	*****
IGMA	14	2403	0.023	0.020	0.018	0.014	0.014	0.011
IGMA	16	112	0.158	0.128	0.126	0.131	0.000	0.063
IGMA	35	631	0.700	0.700	0.700	0.700	0.700	0.700
IGMA	35	645	0.700	0.700	0.700	0.700	0.700	0.700
INPL	35	1021	*****	0.000	*****	0.000	0.000	*****
IPQ	35	125	*****	*****	*****	*****	0.000	0.000
IPQ	35	615	0.700	0.700	0.700	0.700	0.700	0.700
IPQ	35	1030	0.700	0.700	0.700	0.700	0.700	0.700
KRIS	36	321	0.700	0.700	0.700	0.700	0.700	0.700
KRIS	36	739	0.700	0.700	0.700	0.700	0.700	0.700
KRIS	36	1135	0.664	0.618	0.677	0.658	0.591	0.524
KRIS	40	5623	0.618	0.678	0.700	0.700	0.700	0.700
LDS	35	289	*****	0.000	*****	*****	*****	*****
MSL	12	933	*****	0.000	0.000	0.000	0.000	0.030
MSL	35	1025	*****	0.000	0.000	*****	*****	0.000
MSL	36	274	*****	0.000	0.000	0.000	0.000	0.088
NAO	14	1315	0.002	0.002	0.002	0.002	0.003	0.002
NAO	35	779	0.700	0.700	0.700	0.700	0.700	0.700
NAO	35	1206	0.700	0.700	0.700	0.700	0.700	0.700
NAO	35	1214	0.700	0.700	0.700	0.700	0.700	0.700

Table 9A. (Cont.)

LAB.	CLOCK		51754	51784	51814	51844	51874	51909
F	35	859	0.673	0.582	0.506	0.408	0.580	0.582
F	35	1177	0.700	*****	*****	0.000	0.000	0.000
F	35	1178	0.700	*****	*****	0.000	0.000	0.000
F	35	1222	0.000	0.000	*****	*****	0.000	0.000
F	35	1321	0.700	0.700	0.700	0.700	0.700	0.700
F	35	1556	*****	*****	*****	0.000	0.000	0.000
F	40	805	*****	*****	*****	*****	*****	*****
F	40	816	0.000	0.000	0.000	0.700	0.700	0.700
GUM	18	746	*****	*****	*****	*****	0.000	*****
GUM	31	652	0.000	0.006	0.005	0.004	0.003	*****
GUM	35	441	0.411	0.328	0.264	0.204	0.180	0.232
GUM	35	502	0.700	0.470	0.378	0.000	0.140	0.195
GUM	35	745	0.182	0.206	*****	*****	*****	0.000
GUM	35	761	0.700	0.700	*****	*****	0.000	0.000
GUM	35	1120	0.248	0.243	0.453	0.605	0.490	0.640
IEN	35	219	*****	*****	*****	*****	*****	*****
IEN	35	505	0.700	0.700	0.700	0.700	0.700	0.700
IEN	35	1115	0.356	0.295	0.237	0.337	0.440	0.680
IEN	35	1373	0.700	0.700	0.700	0.700	0.700	0.700
IFAG	36	1034	0.524	0.393	0.322	0.340	0.280	0.364
IFAG	36	1173	0.444	0.413	0.353	0.232	0.172	0.233
IFAG	36	1176	*****	*****	*****	*****	*****	*****
IFAG	40	4401	0.000	0.000	0.000	0.000	0.002	0.002
IFAG	40	4403	0.000	0.000	0.000	0.000	0.001	0.001
IFAG	40	4413	0.000	0.000	0.000	0.000	0.007	*****
IGMA	14	2403	0.015	0.015	0.011	0.006	0.006	0.008
IGMA	16	112	0.089	0.073	0.057	0.037	0.031	0.044
IGMA	35	631	0.700	0.700	0.700	0.700	0.700	0.700
IGMA	35	645	0.700	0.700	0.700	0.700	0.700	0.700
INPL	35	1021	*****	*****	*****	0.000	0.000	0.000
IPQ	35	125	0.000	0.000	0.700	0.683	0.688	0.700
IPQ	35	615	0.700	0.700	0.700	0.700	0.700	0.700
IPQ	35	1030	0.700	0.700	0.700	0.700	0.700	0.700
KRIS	36	321	0.700	0.700	0.700	0.585	0.490	0.700
KRIS	36	739	0.700	0.700	0.700	0.700	0.700	0.700
KRIS	36	1135	0.411	0.364	0.307	0.187	0.177	0.248
KRIS	40	5623	0.700	0.700	0.700	0.700	0.700	0.700
LDS	35	289	*****	*****	*****	*****	*****	*****
MSL	12	933	0.038	0.030	0.028	0.027	*****	*****
MSL	35	1025	0.000	0.000	0.000	0.700	*****	*****
MSL	36	274	0.148	0.162	0.172	0.171	*****	*****
NAO	14	1315	0.003	*****	*****	0.000	0.000	*****
NAO	35	779	0.700	*****	*****	0.000	0.000	0.000
NAO	35	1206	0.700	*****	*****	0.000	0.000	0.000
NAO	35	1214	0.700	*****	*****	0.000	0.000	0.000

Table 9A. (Cont.)

LAB.	CLOCK		51574	51599	51634	51664	51694	51724
NIM	35	479	0.636	0.700	0.700	0.700	0.580	*****
NIM	35	1238	0.700	0.700	0.700	0.700	0.607	*****
NIM	35	1239	0.700	0.700	0.700	0.700	0.700	*****
NIST	35	132	*****	*****	*****	*****	*****	0.000
NIST	35	182	*****	*****	*****	*****	*****	*****
NIST	35	408	0.700	0.700	0.700	0.700	*****	*****
NIST	35	1074	0.700	0.700	0.700	0.700	0.700	0.700
NIST	40	201	0.700	0.700	0.700	0.700	0.700	0.700
NIST	40	203	0.700	0.700	0.700	0.700	0.700	0.700
NIST	40	204	0.700	0.700	0.700	*****	*****	0.000
NIST	40	205	0.700	0.700	0.700	0.639	0.559	0.456
NIST	40	222	0.700	0.700	0.700	0.700	0.700	0.700
NIST	50	2008	0.049	*****	*****	*****	*****	*****
NPL	35	784	0.700	0.700	0.700	0.700	0.700	0.700
NPL	35	1275	0.576	0.451	0.439	0.407	0.363	*****
NPL	36	404	0.000	0.000	0.000	0.000	0.700	0.700
NPL	40	1701	0.700	0.700	0.700	0.700	0.700	0.700
NPL	40	1708	0.700	0.700	0.700	0.700	0.700	0.700
NRC	35	234	0.000	0.000	0.000	0.056	0.061	0.059
NRC	35	372	0.700	0.700	0.700	*****	*****	*****
NRC	40	303	0.700	0.700	0.370	0.145	0.090	0.063
NRC	40	304	0.700	0.700	0.700	0.700	0.700	0.700
NRC	90	61	0.700	0.700	0.700	0.700	0.700	0.700
NRLM	35	224	0.700	0.700	0.700	0.700	0.700	0.700
NRLM	35	459	0.700	0.700	0.700	0.700	0.700	0.700
NRLM	35	523	0.700	0.700	0.700	0.700	0.700	0.700
NRLM	35	1466	*****	*****	*****	*****	*****	*****
OMH	36	849	*****	0.000	0.000	0.000	0.000	0.603
ONRJ	35	903	*****	0.000	0.000	0.000	0.000	*****
ORB	35	201	0.000	0.508	0.688	0.700	0.700	0.700
ORB	35	202	0.000	0.372	0.433	0.533	0.624	0.501
ORB	35	593	0.000	0.022	0.015	0.011	0.010	0.009
ORB	40	2601	0.000	0.161	0.077	0.073	0.063	0.058
PSB	35	277	0.000	0.700	0.700	0.700	0.700	0.700
PSB	35	1035	*****	*****	*****	*****	*****	*****
PTB	35	128	*****	*****	*****	*****	*****	*****
PTB	35	271	0.700	*****	*****	*****	*****	*****
PTB	35	415	0.700	0.700	0.700	0.700	0.700	0.700
PTB	35	1072	*****	0.000	0.000	0.000	0.000	0.700
PTB	40	502	0.000	0.000	0.000	0.000	0.700	0.700
PTB	40	505	0.505	0.442	0.468	0.479	0.490	0.468
PTB	40	537	*****	*****	0.000	0.000	0.000	0.000
PTB	92	1	0.700	0.700	0.700	0.700	0.700	0.700
PTB	92	2	0.700	0.700	0.700	0.700	0.700	0.700
PTB	92	3	*****	*****	*****	0.000	0.000	0.000

Table 9A. (Cont.)

LAB.	CLOCK		51754	51784	51814	51844	51874	51909
NIM	35	479	0.000	*****	0.000	0.000	0.000	0.000
NIM	35	1238	0.000	*****	0.000	0.000	0.000	0.000
NIM	35	1239	0.000	*****	0.000	0.000	0.000	0.000
NIST	35	132	0.000	0.000	0.000	0.700	0.700	0.700
NIST	35	182	*****	*****	*****	*****	*****	0.000
NIST	35	408	*****	*****	*****	*****	*****	*****
NIST	35	1074	0.700	0.700	0.700	0.700	0.700	0.700
NIST	40	201	0.700	0.700	0.700	0.700	0.598	0.700
NIST	40	203	0.700	0.700	0.700	0.602	0.478	*****
NIST	40	204	0.000	0.000	0.000	0.700	0.622	0.700
NIST	40	205	0.662	0.600	0.534	0.461	0.425	0.656
NIST	40	222	0.700	0.700	*****	0.000	0.000	0.000
NIST	50	2008	*****	*****	*****	*****	*****	*****
NPL	35	784	0.700	0.700	0.700	0.700	0.700	0.700
NPL	35	1275	*****	*****	0.000	0.000	0.000	0.000
NPL	36	404	0.700	0.700	0.700	0.700	0.700	0.700
NPL	40	1701	0.700	0.700	0.700	0.700	0.700	0.700
NPL	40	1708	0.700	0.700	0.700	0.700	0.700	0.700
NRC	35	234	0.094	0.092	0.083	0.076	0.071	0.317
NRC	35	372	*****	*****	*****	*****	*****	*****
NRC	40	303	0.106	*****	*****	*****	*****	*****
NRC	40	304	0.700	0.700	0.700	0.700	0.700	0.700
NRC	90	61	0.700	0.700	0.700	0.700	0.700	0.700
NRLM	35	224	0.700	0.700	*****	*****	*****	*****
NRLM	35	459	0.700	0.700	0.700	0.700	0.700	*****
NRLM	35	523	0.700	0.700	0.700	0.700	0.700	*****
NRLM	35	1466	*****	*****	*****	*****	0.000	*****
OMH	36	849	0.463	0.418	0.419	0.408	0.363	0.518
ONRJ	35	903	0.000	0.000	0.000	0.000	0.000	0.127
ORB	35	201	0.700	0.700	0.700	0.700	0.700	0.700
ORB	35	202	0.700	0.700	0.700	0.548	0.589	0.700
ORB	35	593	*****	*****	*****	*****	*****	*****
ORB	40	2601	0.088	0.084	0.081	0.068	0.047	0.070
PSB	35	277	0.700	*****	*****	*****	*****	*****
PSB	35	1035	*****	*****	0.000	0.000	0.000	0.000
PTB	35	128	*****	0.000	0.000	0.000	0.000	0.700
PTB	35	271	*****	*****	*****	*****	*****	*****
PTB	35	415	0.700	0.000	*****	*****	*****	*****
PTB	35	1072	0.700	0.700	0.700	0.700	0.700	0.700
PTB	40	502	0.700	0.700	0.700	0.700	0.689	0.700
PTB	40	505	0.632	0.480	0.368	0.312	0.288	0.419
PTB	40	537	0.085	0.076	0.062	0.051	0.043	0.062
PTB	92	1	0.700	0.700	0.700	0.700	0.700	0.700
PTB	92	2	0.700	0.700	0.700	0.700	0.700	0.700
PTB	92	3	0.000	0.700	0.700	0.700	0.700	0.700

Table 9A. (Cont.)

LAB.	CLOCK		51574	51599	51634	51664	51694	51724
ROA	14	896	0.036	0.034	0.046	0.051	0.050	0.048
ROA	14	1569	0.009	0.011	0.014	0.016	0.017	0.013
ROA	31	422	0.115	0.085	0.086	0.079	0.073	0.041
ROA	35	583	0.700	0.700	0.700	0.700	0.700	0.700
ROA	35	718	0.700	0.700	0.700	0.700	0.700	0.700
ROA	36	1488	*****	*****	*****	*****	*****	0.000
ROA	36	1490	*****	*****	*****	*****	*****	0.000
SCL	35	764	0.700	0.700	0.700	0.700	0.700	0.700
SMU	36	1063	*****	0.000	0.000	0.000	0.000	0.700
SP	16	137	0.024	0.021	0.020	0.018	0.016	0.013
SP	35	641	0.700	0.700	0.700	0.700	0.700	0.700
SP	35	1188	0.700	0.700	0.700	0.700	0.700	0.700
SP	36	1175	*****	*****	*****	*****	*****	*****
SU	40	3802	*****	*****	*****	*****	0.000	0.000
SU	40	3803	*****	*****	*****	*****	*****	*****
SU	40	3805	*****	*****	*****	*****	0.000	0.000
SU	40	3806	*****	0.000	0.000	0.000	0.000	0.700
SU	40	3807	*****	0.000	0.000	0.000	0.000	0.700
SU	40	3808	*****	0.000	*****	*****	*****	*****
SU	40	3809	*****	0.000	0.000	0.000	0.000	0.700
SU	40	3810	*****	0.000	*****	*****	*****	0.000
SU	40	3811	*****	0.000	0.000	0.000	0.000	0.189
SU	40	3812	*****	0.000	0.000	0.000	0.000	*****
TL	34	438	0.002	0.001	0.001	0.001	0.001	0.001
TL	35	160	0.674	0.700	0.700	0.700	0.700	*****
TL	35	300	0.700	0.700	0.700	0.700	0.700	0.700
TL	35	474	0.700	0.700	0.700	0.700	0.700	0.700
TL	35	809	0.700	0.700	0.700	0.700	0.700	0.663
TL	35	1012	0.700	0.700	0.700	0.700	0.483	*****
TL	35	1498	*****	*****	*****	*****	*****	*****
TL	35	1500	*****	*****	*****	*****	*****	*****
TL	40	3052	0.278	0.234	0.231	0.151	0.113	0.081
TL	40	3053	0.000	0.000	0.594	0.304	0.213	0.155
TP	35	1227	0.700	0.700	0.700	0.700	0.700	0.700
TP	36	154	0.700	0.700	0.700	0.700	0.700	0.700
TP	36	163	0.700	0.700	0.700	0.700	0.440	0.368
TP	36	326	0.700	0.700	0.700	0.700	0.700	0.700
TUG	14	1654	0.064	0.057	0.057	0.046	0.040	0.033
TUG	35	247	0.700	0.700	0.700	0.700	0.700	0.700
UME	35	252	0.000	0.700	*****	0.000	0.000	0.000
UME	35	872	0.000	0.349	*****	0.000	0.000	0.000
USNO	35	101	0.700	0.700	0.700	0.700	0.700	0.700
USNO	35	104	0.700	0.700	0.700	0.700	0.700	0.700
USNO	35	106	0.700	0.700	0.700	0.700	0.700	0.700
USNO	35	108	0.700	0.700	0.700	0.700	0.000	0.346

Table 9A. (Cont.)

LAB.	CLOCK		51754	51784	51814	51844	51874	51909
ROA	14	896	0.064	0.052	0.039	0.028	0.014	*****
ROA	14	1569	0.017	0.016	0.013	0.013	0.011	0.015
ROA	31	422	*****	*****	*****	*****	*****	*****
ROA	35	583	0.700	0.700	0.700	0.700	0.668	0.700
ROA	35	718	0.700	0.700	0.700	0.700	0.700	0.700
ROA	36	1488	0.000	0.000	0.000	0.107	0.132	0.239
ROA	36	1490	0.000	0.000	0.000	0.117	0.146	0.244
SCL	35	764	0.700	0.700	0.700	0.700	*****	*****
SMU	36	1063	0.700	0.700	0.700	0.695	0.700	0.700
SP	16	137	0.022	0.021	0.023	0.022	0.017	0.018
SP	35	641	0.700	0.700	0.700	0.700	0.700	0.700
SP	35	1188	0.700	0.700	0.700	0.700	0.700	0.700
SP	36	1175	*****	*****	*****	*****	0.000	0.000
SU	40	3802	0.000	0.000	0.120	0.095	0.076	0.094
SU	40	3803	*****	*****	*****	*****	*****	0.000
SU	40	3805	0.000	0.000	0.161	0.108	0.076	0.080
SU	40	3806	0.700	0.700	0.700	0.700	0.700	0.700
SU	40	3807	0.700	0.700	0.700	0.700	0.700	0.700
SU	40	3808	*****	*****	*****	*****	*****	*****
SU	40	3809	0.700	0.700	0.700	0.700	0.700	*****
SU	40	3810	0.000	0.000	0.000	0.040	0.025	0.027
SU	40	3811	0.340	0.359	0.324	0.289	0.274	0.414
SU	40	3812	*****	*****	*****	*****	*****	*****
TL	34	438	*****	*****	*****	*****	*****	*****
TL	35	160	*****	*****	*****	*****	*****	*****
TL	35	300	*****	*****	*****	*****	*****	*****
TL	35	474	*****	*****	*****	*****	*****	*****
TL	35	809	0.700	0.700	0.520	0.700	0.700	*****
TL	35	1012	*****	0.000	0.000	*****	*****	0.000
TL	35	1498	*****	0.000	0.000	0.000	0.000	0.280
TL	35	1500	*****	0.000	0.000	0.000	0.000	0.013
TL	40	3052	0.098	0.077	0.058	0.039	0.031	0.039
TL	40	3053	0.198	0.144	0.104	0.079	0.062	*****
TP	35	1227	0.700	0.700	0.700	0.700	0.700	0.700
TP	36	154	0.700	0.700	0.700	0.700	0.700	0.700
TP	36	163	0.622	0.572	0.422	0.326	0.297	0.377
TP	36	326	0.700	0.700	0.700	0.700	0.700	0.700
TUG	14	1654	*****	*****	*****	*****	*****	*****
TUG	35	247	*****	*****	*****	*****	*****	*****
UME	35	252	0.000	0.040	0.044	0.017	0.019	0.032
UME	35	872	*****	*****	0.000	0.000	0.000	0.000
USNO	35	101	0.700	0.700	0.700	0.700	0.700	0.700
USNO	35	104	0.700	0.700	0.700	0.700	0.557	0.595
USNO	35	106	0.700	0.700	0.700	0.700	0.700	0.700
USNO	35	108	0.418	0.361	0.280	0.249	0.227	0.335

Table 9A. (Cont.)

LAB.	CLOCK		51574	51599	51634	51664	51694	51724
USNO	35	114	0.700	0.700	0.700	0.700	0.700	0.700
USNO	35	120	*****	*****	*****	0.000	0.000	0.000
USNO	35	142	*****	*****	*****	0.000	*****	*****
USNO	35	146	*****	*****	*****	0.000	0.000	0.000
USNO	35	148	0.000	0.700	0.700	0.700	*****	*****
USNO	35	150	0.000	0.000	*****	0.000	*****	*****
USNO	35	152	0.700	0.700	0.700	0.700	0.700	0.700
USNO	35	153	0.599	0.454	0.485	0.480	0.481	0.667
USNO	35	156	*****	0.000	0.000	0.000	*****	*****
USNO	35	161	0.700	0.700	0.700	0.700	0.700	0.700
USNO	35	164	0.700	0.700	0.700	0.700	0.700	0.700
USNO	35	165	0.700	0.700	0.700	0.700	0.700	0.700
USNO	35	166	0.700	0.700	0.700	0.700	0.700	0.700
USNO	35	167	0.700	0.700	0.700	0.700	0.700	0.700
USNO	35	169	0.700	0.700	0.700	0.700	0.700	0.700
USNO	35	171	*****	*****	*****	*****	0.000	0.000
USNO	35	213	0.700	0.700	0.700	0.700	0.700	0.700
USNO	35	217	0.700	0.700	0.700	0.700	0.700	0.700
USNO	35	225	*****	*****	*****	0.000	0.000	0.000
USNO	35	226	0.700	0.700	*****	*****	0.000	0.000
USNO	35	227	0.000	0.000	0.700	0.700	0.700	0.700
USNO	35	229	0.000	0.000	0.000	0.700	0.700	0.700
USNO	35	233	*****	*****	*****	0.000	0.000	0.000
USNO	35	242	0.000	0.000	0.000	0.700	0.700	0.700
USNO	35	244	*****	*****	*****	0.000	0.000	0.000
USNO	35	249	0.000	0.700	0.700	0.700	0.700	0.700
USNO	35	253	*****	*****	*****	0.000	0.000	0.000
USNO	35	254	0.700	0.700	0.700	0.700	0.700	0.700
USNO	35	255	0.000	0.000	0.000	0.700	0.700	*****
USNO	35	256	0.700	*****	*****	0.000	0.000	0.000
USNO	35	260	0.700	0.700	0.700	0.700	0.700	0.700
USNO	35	270	0.700	*****	*****	0.000	0.000	0.000
USNO	35	279	0.700	0.700	0.700	0.700	0.700	0.700
USNO	35	392	0.000	0.000	0.700	0.700	0.700	0.700
USNO	35	394	0.700	0.700	0.700	0.700	0.700	0.700
USNO	35	417	0.700	0.700	0.700	0.700	0.700	0.700
USNO	35	1096	0.454	0.491	0.645	0.700	0.700	0.700
USNO	35	1097	0.700	0.700	0.700	0.700	0.700	0.700
USNO	35	1125	0.000	0.000	*****	0.000	*****	*****
USNO	35	1438	*****	*****	*****	0.000	0.000	0.000
USNO	35	1459	*****	*****	*****	*****	*****	0.000
USNO	35	1462	*****	*****	*****	0.000	0.000	0.000
USNO	35	1463	*****	*****	*****	0.000	0.000	0.000
USNO	35	1468	*****	*****	*****	0.000	0.000	0.000
USNO	35	1481	*****	*****	*****	*****	0.000	0.000

Table 9A. (Cont.)

LAB.	CLOCK		51754	51784	51814	51844	51874	51909
USNO	35	114	0.700	0.700	0.700	0.700	0.700	0.700
USNO	35	120	0.000	0.700	0.700	0.700	0.700	0.700
USNO	35	142	0.000	0.000	0.000	0.000	0.700	0.700
USNO	35	146	0.000	0.700	0.700	0.700	0.700	0.700
USNO	35	148	0.000	0.000	0.000	0.000	0.700	0.700
USNO	35	150	0.000	0.000	0.000	0.000	0.700	0.515
USNO	35	152	0.700	0.700	0.700	0.700	0.700	0.700
USNO	35	153	0.700	0.700	0.700	0.700	0.700	0.700
USNO	35	156	0.000	0.000	0.000	0.000	0.700	0.700
USNO	35	161	0.700	0.700	0.700	0.700	0.700	0.700
USNO	35	164	0.700	0.700	0.700	0.700	0.700	0.700
USNO	35	165	0.700	0.700	0.700	0.700	0.700	0.700
USNO	35	166	0.700	0.700	0.700	0.700	0.700	0.700
USNO	35	167	0.700	0.700	0.700	0.700	0.700	0.700
USNO	35	169	0.700	0.700	0.700	0.700	0.700	0.700
USNO	35	171	0.000	0.000	0.700	0.700	0.700	0.700
USNO	35	213	0.700	0.700	0.700	0.700	0.700	0.700
USNO	35	217	0.700	0.700	0.700	0.700	0.700	0.700
USNO	35	225	0.000	0.172	0.187	0.190	0.195	0.330
USNO	35	226	0.000	0.000	0.625	0.434	0.398	0.561
USNO	35	227	0.700	0.000	0.000	0.000	0.065	0.071
USNO	35	229	0.000	0.168	0.162	0.155	0.150	0.197
USNO	35	233	0.000	0.700	0.700	0.700	0.700	0.700
USNO	35	242	0.700	0.700	0.700	0.700	0.700	0.700
USNO	35	244	0.000	0.229	0.172	0.173	0.158	0.262
USNO	35	249	*****	*****	*****	0.000	0.000	0.000
USNO	35	253	0.000	0.262	0.224	0.219	0.229	0.321
USNO	35	254	0.700	0.700	0.700	*****	*****	*****
USNO	35	255	*****	0.000	0.000	0.000	0.000	0.700
USNO	35	256	0.000	0.401	0.479	0.506	0.378	0.473
USNO	35	260	0.700	0.700	0.700	0.700	0.700	0.700
USNO	35	270	0.000	0.700	0.700	0.700	0.700	0.700
USNO	35	279	0.700	0.700	0.700	*****	*****	0.000
USNO	35	392	0.700	0.700	0.700	0.700	0.700	0.700
USNO	35	394	0.700	0.700	0.700	0.700	0.700	0.700
USNO	35	417	0.700	0.700	0.700	0.700	0.611	0.694
USNO	35	1096	0.700	0.700	0.700	0.700	0.700	0.700
USNO	35	1097	0.700	0.700	0.700	0.700	0.700	0.700
USNO	35	1125	0.000	0.000	0.000	0.000	0.700	0.700
USNO	35	1438	0.000	0.118	0.138	0.147	0.149	0.239
USNO	35	1459	0.000	0.000	0.000	0.492	0.342	0.561
USNO	35	1462	0.000	0.700	0.700	0.700	0.700	0.700
USNO	35	1463	0.000	0.700	0.700	0.700	0.700	0.700
USNO	35	1468	0.000	0.700	0.700	0.700	0.700	0.700
USNO	35	1481	0.000	0.000	0.700	0.700	0.700	0.700

Table 9A. (Cont.)

LAB.	CLOCK		51574	51599	51634	51664	51694	51724
USNO	40	701	0.700	0.700	0.700	0.700	0.700	0.700
USNO	40	702	0.174	0.205	0.266	0.300	*****	0.000
USNO	40	703	0.700	0.700	0.700	0.700	0.700	0.700
USNO	40	704	0.206	0.179	0.188	0.197	0.221	0.267
USNO	40	705	0.700	0.700	*****	0.000	0.000	0.000
USNO	40	708	0.700	0.700	0.700	0.700	0.700	0.700
USNO	40	709	0.657	0.644	0.700	0.700	0.675	0.581
USNO	40	710	0.700	0.700	0.700	0.700	0.700	0.576
USNO	40	711	0.088	0.077	0.077	0.070	0.062	0.049
USNO	40	712	0.700	0.700	0.700	0.700	0.700	0.700
USNO	40	715	0.700	0.700	0.700	0.700	0.700	0.700
USNO	40	722	0.000	0.000	0.000	0.000	0.044	*****
USNO	40	723	0.000	0.000	0.000	0.000	0.104	*****
VSL	35	179	0.000	0.000	0.000	0.414	0.494	0.465
VSL	35	456	0.700	0.700	0.700	0.700	0.700	0.700
VSL	35	548	0.700	0.700	0.700	0.700	0.700	0.700
VSL	35	731	0.700	0.700	0.700	0.700	0.700	0.700

Table 9A. (Cont.)

LAB.	CLOCK		51754	51784	51814	51844	51874	51909
USNO	40	701	0.700	0.700	0.700	0.700	0.700	0.700
USNO	40	702	0.000	0.000	0.000	0.700	0.700	0.700
USNO	40	703	0.700	0.700	0.700	0.700	0.700	0.700
USNO	40	704	0.700	0.700	0.700	0.700	0.700	0.700
USNO	40	705	0.000	0.666	0.610	0.519	0.475	0.685
USNO	40	708	0.700	0.700	0.700	0.700	0.700	0.700
USNO	40	709	0.700	0.700	0.606	0.000	0.053	0.062
USNO	40	710	0.700	0.699	0.536	0.430	0.344	0.453
USNO	40	711	0.067	0.055	0.042	0.034	0.028	0.036
USNO	40	712	0.700	0.700	0.700	0.700	0.700	0.700
USNO	40	715	0.700	0.700	0.700	0.700	0.700	0.700
USNO	40	722	*****	*****	*****	*****	*****	*****
USNO	40	723	*****	*****	*****	*****	*****	*****
VSL	35	179	0.700	0.530	0.414	0.330	0.319	0.435
VSL	35	456	0.700	0.695	0.700	0.700	0.700	0.700
VSL	35	548	0.700	0.700	0.700	*****	*****	*****
VSL	35	731	0.700	0.700	0.700	0.700	0.700	0.700

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
18 FREQ. AND TIME SYSTEMS INC. 4000
4x HYDROGEN MASERS
9x PRIMARY CLOCKS AND PROTOTYPES
21 OSCILLOQUARTZ 3210
23 OSCILLOQUARTZ EUDICS 3020
30 HEWLETT-PACKARD 5061B
31 HEWLETT-PACKARD 5061B OPT. 4
34 H-P 5061A/B with 5071A tube
35 HEWLETT-PACKARD 5071A High perf.
36 HEWLETT-PACKARD 5071A Low perf.
50 FREQ. AND TIME SYSTEMS INC. 4065A

Table 9B. Statistical data on the weights attributed to the clocks in 2000

Interval	Number of clocks			Number of clock with a given weight								
				0* weight			0** weight			maximum weight		
2000	HM	5071A	total	HM	5071A	total	HM	5071A	total	HM	5071A	total
Jan.	35	132	203	7	26	34	2	0	2	17	97	128
Feb.	42	137	219	13	27	47	2	1	3	17	96	127
Mar.	41	130	209	10	23	38	2	0	2	17	95	124
Apr.	42	144	227	13	34	55	1	0	1	15	97	124
May	42	145	226	12	32	50	1	1	3	15	93	121
June	42	139	224	12	30	48	0	0	0	17	91	121
July	44	142	226	14	37	57	0	1	2	20	94	129
Aug.	43	139	221	12	29	46	0	2	2	21	88	125
Sep.	42	140	221	11	27	43	0	1	1	18	88	122
Oct.	44	143	226	7	29	37	1	2	4	20	86	117
Nov.	44	143	227	4	26	34	0	1	1	17	85	114
Dec.	41	138	216	6	24	33	0	0	2	19	86	119

* A priori null weight (test interval of new clocks).
** Null weight resulting from the statistics.
HM designates hydrogen masers and 5071A designates Hewlett-Packard 5071A units with high performance tube.
Clocks with missing data during a one-month interval of computation are excluded.

TIME SIGNALS

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

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

The following tables are based on information received at the BIPM in February and March 2001.

AUTHORITIES RESPONSIBLE FOR THE TIME SIGNAL EMISSIONS

Signal	Authority
ATA	National Physical Laboratory Dr. K.S. Krishnan Road New Delhi - 110012, India
BPM	Shaanxi Astronomical Observatory Chinese Academy of Sciences P.O. Box 18 - Lintong Shaanxi, China
BSF	National Standard Time and Frequency Laboratory Telecommunication Laboratories Chunghwa Telecom. Co., Ltd. No. 12, Ln.551, Ming-Tsu Road Sec. 5 Yang-Mei, Taoyuan, 326 Taiwan, Rep. of China
CHU	National Research Council of Canada Institute for National Measurement Standards - Time Standards Ottawa, Ontario, K1A OR6, Canada
DCF77	Physikalisch-Technische Bundesanstalt Lab. Zeit-und Frequenzuebertragung Bundesallee 100 D-38116 Braunschweig Germany
EBC	Real Instituto y Observatorio de la Armada Cecilio Pujazón s/n 11.110 San Fernando Cádiz, Spain
HBG	Swiss Federal Office of Metrology and Accreditation Electricity, Acoustic and Time Section Lindenweg 50 CH-3003 Bern-Wabern Switzerland

Signal	Authority
HLA	Time and Frequency Laboratory Korea Research Institute of Standards and Science Yusong P.O. Box 102, Taejon 305-600 Republic of Korea
IAM	Istituto Superiore delle Comunicazioni e delle Tecnologie dell'Informazione Viale America, 201 00144 - Roma, Italia
JJY	Standards and Measurements Division Communications Research Laboratory 2-1, Nukui-kitamachi 4-chome Koganei-shi, Tokyo 184-8795 Japan
LOL	Servicio de Hidrografia Naval Observatorio Naval Buenos Aires 1107 - Buenos Aires, Argentina
MSF	National Physical Laboratory Centre for Electromagnetic and Time Metrology Teddington, Middlesex TW11 0LW United Kingdom
RAB-99, RBU, RJH-63, RJH-69, RJH-77, RJH-86, RJH-90,RTZ, RWM, ULA-4	Institute of Metrology for Time and Space (IMVP), GP "VNIIFTRI" Mendeleevo, Moscow Region 141570 Russia
TDF	CNET Centre National d'Etudes des Télécommunications Laboratoire DTD/EDT/STF Technopôle ANTICIPA 2, avenue Pierre Marzin 22307 - Lannion Cedex, France

Signal	Authority
VNG	National Standards Commission P.O. Box 282 North Ryde NSW 1670 Australia
WWV, WWVB, WWVH	Time and Frequency Division, 847.00 National Institute of Standards and Technology - 325 Broadway Boulder, Colorado 80305, U.S.A.
YVTO	Direccion de Hidrografia y Navegacion Observatorio Cagigal Apartado Postal No 6745 Caracas, Venezuela

TIME SIGNALS EMITTED IN THE UTC SYSTEM

Station	Location Latitude Longitude	Frequency (kHz)	Schedule (UTC)	Form of the signal
ATA	Greater Kailash New Delhi India 28° 34'N 77° 19'E	10 000	continuous	Second pulses of 5 cycles of a 1 kHz modulation. Minute pulses of 100 ms duration. The time signals are advanced by 50 ms on UTC.
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	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.
BSF	Chung-Li Taiwan Rep. of China 24° 57'N 121° 09'E	5 000 15 000	continuous except interruption between minutes 35 and 40	From minute 5 to 10, 15 to 20, 25 to 30, 45 to 50, 55 to 60, second pulses of 5 ms duration without 1 kHz modulation. From minute 0 to 5, 10 to 15, ..., 50 to 55, second pulses of 5 ms duration with 1 kHz modulation. The 1 kHz modulation is interrupted 40 ms before and after the pulses. Minute pulses are extended to 300 ms duration. DUT1: ITU-R code by pulse lengthening.
CHU	Ottawa Canada 45° 18'N 75° 45'W	3 330 7 335 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 10th 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 summer 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.

Station	Location Latitude Longitude	Frequency (kHz)	Schedule (UTC)	Form of the signal
DCF77	Mainflingen Germany 50° 1'N 9° 0'E	77.5	continuous	At the beginning of each second (except the 59th second) the carrier amplitude is reduced to about 25 % for a duration of 0.1 s or 0.2 s. Coded transmission of year, month, day, hour, minute and day of the week in a BCD code from second marker No 21 to No 58 (The second marker durations of 0.1 s or 0.2 s correspond to a binary 0 or a binary 1 respectively). The coded time information is related to legal time of Germany and second markers 17 and 18 indicate if the transmitted time refers to UTC(PTB) + 2 h (summer time) or UTC(PTB) + 1 h (winter time). To achieve a more accurate time transfer and better use of the frequency spectrum available, an additional pseudo-random phase-shift keying of the carrier is superimposed to 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.
HBG	Prangins Switzerland 46° 24'N 6° 15'E	75	continuous	At the beginning of each second (except the 59th second), the carrier is interrupted for a duration of .1 or 0.2 s corresponding to "binary 0" or "binary 1", respectively, double pulse each minute. The number of the minute, hour, day of the month, day of the week, month and year are transmitted in BCD code from the 21st to the 58th second. The time signals are generated by the Swiss Federal Office of Metrology and in accordance with the legal time of Switzerland which is UTC(CH)+1h (Central European Time CET) or UTC(CH)+2h (Central European Summer Time CEST). In addition, CET and CEST are indicated by a binary 1 at the 18th or 17th second, respectively.
HLA	Taedok Science Town Rep. of Korea 36° 23'N 127° 22'E	5 000	continuous	Pulses of 9 cycles of 1 800 Hz modulation. 29th and 59th second pulses omitted. Hour identified by 0.8 s long 1 500 Hz tone. Beginning of each minute identified by a 0.8 s long 1 800 Hz tone. Voice announcement of hours and minutes each minute following the 52nd second pulse. BCD time code given on 100 Hz subcarrier. DUT1: ITU-R code by double pulse.

Station	Location Latitude Longitude	Frequency (kHz)	Schedule (UTC)	Form of the signal
IAM	Roma Italy 41° 47'N 12° 27'E	5 000	7 h 30 m to 8 h 30 m 10h 30 m to 11 h 30 m except Sunday and national holidays. Advanced by 1 hour in summer.	Second pulses of 5 cycles of 1 kHz modulation. Minute pulses of 20 cycles. Voice announcements every 15 minutes beginning at 0 h 0 m. DUT1: ITU-R code by double pulse.
JJY	Sanwa Ibaraki Japan 36° 11'N 139° 51'E	5 000 8 000 10 000	Continuous, except interruption between minutes 35 and 39.	Second pulses of 8 cycles of 1 600 Hz modulation. Minute pulses are preceded by a 600 Hz modulation. DUT1: ITU-R code by lengthening.
JJY	Miyakoji 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 annoucement of hour, minute, day of the year, year, day of the week and leap second. Fully operational since 10 June 1999.
LOL (1)	Buenos Aires Argentina 34° 37'S 58° 21'E	5 000 *10 000 **15 000	11 h to 12 h 14 h to 15 h 17 h to 18 h 20 h to 21 h 23 h to 24 h	Second pulses of 5 cycles of 1000 Hz modulation. Second 59 is omitted. Annoucement of hours and minutes every 5 minutes, followed by 3 minutes of 1000 Hz or 440 Hz modulation. DUT1: ITU-R code by lengthening.
MSF	Rugby United Kingdom 52° 22'N 1° 11'W	60	Continuous, except for interruptions for maintenance from 10 h 0 m to 14 h 0 m on the first Tuesday of January, April, July and October. A longer period of maintenance during the summer is announced annually.	Interruptions of the carrier of 100 ms for the second pulses and of 500 ms for the minute pulses. The signal is given by the beginning of the interruption. BCD NRZ code, 1 bit/s (year, month, day of the month, day of the week, hour, minute) from second 17 to 59 in each minute, following the seconds interruption. DUT1: ITU-R code by double pulse.
RAB-99	Khabarovsk Russia 48° 30'N 134° 50'E	25	Winter schedule 02 h 06 m to 02 h 20 m 06 h 06 m to 06 h 20 m Summer schedule 01 h 06 m to 01 h 20 m 05 h 06 m to 05 h 20 m	A1N type signals are transmitted between 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 duration and minute pulses of 10 s duration are transmitted between minutes 13 and 22.

(1) LOL. * irregular ** discontinued for maintenance

Station	Location Latitude Longitude	Frequency (KHz)	Schedule (UTC)	Form of the signal
RBU	Moscow 55° 59'N 38° 12'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	Winter schedule 11 h 06 m to 11 h 20 m Summer schedule 10 h 06 m to 10 h 20 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	Winter schedule 07 h 06 m to 07 h 22 m Summer schedule 06 h 06 m to 6 h 22 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	Winter schedule 09 h 06 m to 09 h 22 m Summer schedule 08 h 06 m to 08 h 22 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	Winter schedule 04 h 06 m to 04 h 22 m 10 h 06 m to 10 h 22 m Summer schedule 03 h 06 m to 03 h 22 m 09 h 06 m to 09 h 22 m	A1N type signals are transmitted between minutes 10 and 22 : 0.025 second pulses of 12.5 ms duration are transmitted between minutes 10 and 13; second pulses of 0.1 s duration, 10 second pulses of 1 s duration, 0.1 second pulses of 25 ms and minute pulses of 10 s duration are transmitted between minutes 13 and 22.
RJH-90	Nizhni Novgorod Russia 56° 11'N 43° 57'E	25	Winter schedule 05 h 06 m to 05 h 22 m Summer schedule 04 h 06 m to 04 h 22 m	A1N type signals are transmitted between minutes 10 and 22 : 0.025 second pulses of 12.5 ms duration are transmitted between minutes 10 and 13; second pulses of 0.1 s duration, 10 second pulses of 1 s duration, 0.1 second pulses of 25 ms and minute pulses of 10 s duration are transmitted between minutes 13 and 22.

Station	Location Latitude Longitude	Frequency (kHz)	Schedule (UTC)	Form of the signal
RTZ (2)	Irkutsk Russia 52° 32'N 103° 52'E	50	Winter schedule 22 h 00 m to 24 h 00 m 00 h 00 m to 21 h 00 m Summer schedule 21 h 00 m to 24 h 00 m 00 h 00 m to 20 h 00 m	A1X type second pulses of 0.1 s duration are transmitted between minutes 0 and 5. The pulses at the beginning of the minute prolonged to 0.5 s. A1N type 0.1 second pulses of 0.02 s duration are transmitted at 59^{th} minute. The pulses at the beginning of the second are prolonged to 40 ms and of the minute to 0.5 s. DUT1+dUT1: by double pulse.
RWM (2)	Moscow Russia 55° 44'N 38° 12'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 59^{th} 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 21^{st} to the 58^{th} 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 18^{th} second indicates that the local time is 1 hour ahead of UTC (winter time); a binary 1 at the 14^{th} second indicates that the current day is a public holiday (Christmas, 14 July, etc...); a binary 1 at the 13^{th} second indicates that the current day is a day before a public holiday.

(2) RTZ and RMW are the radiostations 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 21^{st} and 24^{th} second so that dUT1 = $+p \times 0.02$ s.
Negative values of dUT1 are transmitted by the marking of *q* second markers within the range between the 31^{st} and 34^{th} second, so that dUT1 = $-q \times 0.02$ s.

Station	Location Latitude Longitude	Frequency (kHz)	Schedule (UTC)	Form of the signal
VNG	Llandilo New South Wales Australia 33° 43'S 150° 48'E	2 500 5 000 8 638 12 984 16 000	continuous continuous continuous continuous 22 h to 10 h	Second pulses of 50 ms of 1 kHz modulation. Second pulses 55 to 58 of 5 ms of 1 kHz modulation. Second pulse at 59 is omitted. Minute pulses of 0.5 s of 1 kHz modulation. During minutes 5, 10, 15, ..., second pulses 50 to 58 are 5 ms long with 1 kHz modulation. BCD time code giving day of the year, hour and minute at the next minute is given between seconds 20 and 46. Voice announcement on 2 500, 5 000 and 16 000 kHz during minutes 15, 30, 45 and 60. Morse station identification on 8 638 and 12 984 kHz during minutes 15, 30, 45 and 60. DUT1: ITU-R code by double pulse.
WWV	Fort-Collins CO, USA 40° 41'N 105° 2'W	2 500 5 000 10 000 15 000 20 000	continuous	Pulses of 5 cycles of 1 kHz modulation. 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 tone. DUT1: ITU-R code by double pulse. BCD time code given on 100 Hz subcarrier, includes DUT1 correction.
WWVB	Fort-Collins CO, USA 40° 40'N 105° 3'W	60	continuous	Second pulses given by reduction of the amplitude of the carrier, 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	Pulses of 6 cycles of 1 200 Hz modulation. 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 tone. DUT1: ITU-R code by double pulse. BCD time code given on 100 Hz subcarrier, includes DUT1 correction.
YVTO	Caracas Venezuela 10° 30'N 66° 56'W	5 000	continuous	Second pulses of 1 kHz modulation with 0.1 s duration. The minute is identified by a 800 Hz tone and a 0.5 s duration. Second 30 is omitted. Between seconds 40 and 50 of each minute, voice announcement of the identification of the station. Between seconds 52 and 57 of each minute, voice announcement of hour, minute and second.

ACCURACY OF THE CARRIER FREQUENCY

Station	Relative uncertainty of the carrier frequency in 10^{-10}
ATA	0.1
BPM	0.01
BSF	0.1
CHU	0.05
DCF77	0.02
EBC	0.1
HBG	0.1
HLA	0.1
IAM	0.5
JJY	0.1
JJY(40)	0.01
LOL	0.1
MSF	0.02
RAB-99,RJH-63	0.05
RBU	0.02
RJH-69, RJH-77	0.05
RJH-86, RJH-90	0.05
RTZ	0.05
RWM	0.1
TDF	0.02
VNG	0.1
WWV	0.01
WWVB	0.01
WWVH	0.01

TIME DISSEMINATION SERVICES

The following tables are based on information received at the BIPM in February and March 2001.

AUTHORITIES RESPONSIBLE FOR THE TIME DISSEMINATION SERVICES

AOS	Astrogeodynamical Observatory Borowiec near Poznan Space Research Centre P.A.S. PL 62-035 Kornik Poland
AUS	Standards for Time and Fraquency Project CSIRO National Measurement Laboratory PO Box 218 Lindfield NSW 2070 AUSTRALIA
BEV	Bundesamt für Eich- und Vermessungswesen Arltgasse 35 A-1160 Wien Vienna Austria
CNM	Centro Nacional de Metrologia Km. 4.5 Carretera a Los Cués Municipio del Marqués C.P. 76900 Apdo. Postal 1-100 Centro, C.P. 76000 Querétaro, México MEXIQUE
CSIR	Time and Frequency Section Electromagnetic Metrology National Metrology Laboratory AEROTEK-CSIR, P.O. Box 395 Pretoria 0001 AFRIQUE du SUD
GUM	Time and Frequency Laboratory Glówny Urzad Miar Ul. Elektoralna 2 P.O. Box P-10 PL 00-950 Warszawa - Poland
IEN	Istituto Elettrotecnico Nazionale Galileo Ferraris Strada delle Cacce, 91 I - 10135 Torino Italie
METAS	Swiss Federal Office of Metrology and Accreditation Electricity, Acoustic and Time Section Lindenweg 50 CH-3003 Bern-Wabern Switzerland

NIST	National Institute of Standards and Technology Time and Frequency Division, 847.00 325 Broadway Boulder, Colorado 80305, USA
NPL	National Physical Laboratory Centre for Electromagnetic and Time Metrology Teddington, Middlesex TW11 0LW United Kingdom
NRC	National Research Council of Canada Institute for National Measurement Standards - Time Standards Ottawa, Ontario, K1A 0R6, Canada
ONRJ	Observatorio Nacional (CNPq) Departamento Serviço da Hora Rua General Bruce, 586, Sao Cristovao 20291- 030 - Rio de Janeiro, Brasil
ROA	Real Instituto y Observatorio de la Armada Cecilio Pujazón s/n 11.100 San Fernando Cádiz, Spain
PTB	Physikalisch-Technische Bundesanstalt Lab. Zeit-und Frequenzuebertragung Bundesallee 100 D-38116 Braunschweig Germany
TUG	Dept. of Communications and Wave Propagation Technical University Graz Inffeldgasse 12 A-8010 Graz Austria
USNO	U.S. Naval Observatory 3450 and Massachusetts Ave., N.W. Washington, D.C. 20392-5420 USA
VSL	Nmi Van Swinden Laboratorium 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/clock1.htm

AUS — Network Time Service
Computers connected to the Internet can be synchronized to UTC(AUS) using the NTP protocol. The NTP servers are either directly referenced to UTC(AUS) or via a GPS common view link.

There are presently three servers available to the general public:
ntp.nml.csiro.au Sydney
ntp.mel.nml.csiro.au Melbourne
ntp.per.nml.csiro.au Perth

Current information can be found on the web pages: www.nml.csiro.au

BEV — Provides a time dissemination service via phone and modem to synchronize PC clocks.
Uses the Time Distribution System from TUG, which produces the telephone time code mostly used in Europe. It has a baud rate of 1200 and everyone can use it with no cost.
Access phone number is +43 (0) 1 49110381
The system will be updated periodically (DUT1, Leap Second...).

CNM — CENAM operates a voice automatic system that provides the local time for three different time zones for North America; Central Time, Mountain Time and Pacific Time as well the UTC(CNM). The access numbers are:

+52 4 211 0506: Central Time	+52 4 211 0507: Monition Time
+52 4 211 0508: Pacific Time	+52 4 215 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

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://mensor.cenam.mx/site/InternetTime.htm

CSIR	Telephone Time Service (TTS) Provides digital time code accessable by computer for setting time in computers. Measurement of telephone transmission delay is included. Access phone numbers: + 27 12 349 1576, + 27 12 349 1577 More information and software for accessing the service is available at http://www.nml.csir.co.za/services/tts.stm Network Time Service Two NTP servers are available, tick.nml.csir.co.za and tock.nml.csir.co.za with an open access policy. More information is available at http://www.nml.csir.co.za/services/ntp.stm
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
IEN	CTD Telephone Time Code Time signals dissemination, according to the European Time code format, available via modem on regular dial-up connection. Access phone number : 166 11 4615. Provides a synchronization to UTC(IEN) for computer clocks within Italy. Software for the synchronization of computer clocks is available on IEN home page (www.ien.it).
METAS	Telephone Time Service The coded time information is referenced to UTC(CH) 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 numbers +41 31 323 32 25, +41 31 323 47 00. Network Time Protocol METAS operates a time server using the "Network Time Protocol"(NTP). Host name of the server : ntp.metas.ch Further information available at http://www.metas.ch
NIST	Automated Computer Time Service (ACTS) Provides digital time code by telephone modem for setting time in computers. Includes provision for calibration of telephone time delay. Access phone numbers : +1 303 494 4774 and +1 808 335 4721 Further information at http://www.boulder.nist.gov/timefreq/. Network Time Service (NTS) Provides digital time code across the Internet using three different protocols. Geographically distributed set of time servers within the

United States of America.
Further information at http://www.boulder.nist.gov/timefreq/.

NPL Telephone Time Service

A TUG time code generator provides the European Telephone Time Code, referenced to UTC(NPL), by telephone modem.
Access phone number: 0906 851 6333
Note: this is a premium rate number and can only be accessed from within the UK.

Internet Time Service

A service using the Network Time Protocol (NTP) will be established during 2001.

NRC Telephone Code

Provides digital time code by telephone modem for setting time in computers.
Access phone number : +1 613 745 3900

Network Time Protocol

Operates two time servers using the « National Time Protocol », each one being on different location and network.
Host names : time.nrc.ca
time.chu.nrc.ca
Further information at http://www.nrc.ca/inms/time/whatime.html.

ONRJ Telephone Voice Announcer (55) 21 5806037
Telephone Code (55) 21 5800677 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
SNTP at port 123
Time/UDP at port 37
Time/TCP at port 37
Daytime/TCP at port 13

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 two time servers using the « Network Time Protocol » (NTP). Software for the syncronization of computer clocks is available on the home pages of the PTB (www.ptb.de).
Host names of the servers : ptbtime1.ptb.de

ptbtime2.ptb.de

ROA	Telephone Code It operates the European Telephone Code. Access phone number : +34 956 599 429 Network Time Protocol Server : ntp.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 : free Note : server used as prototype to check new software, hardware, etc.
TUG	Telephone Time Service The coded time information is referenced to UTC(TUG) 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: +43 316 47 23 66
USNO	Telephone Voice Announcer +1 202 762-1401 Telephone Code +1 202 762-1594 provides digital time code at 1200 baud, 8 bits, no parity Automated data service for downloading files +1 202 762-1602 Web site for time and for data files: http://www.usno.navy.mil Network Time Protocal (NTP) see http://www.usno.navy.mil/ntp.html for software and site closest to you.
VSL	Telephone Time Service The coded time information is referenced to UTC(VSL) 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". The access phone number is 0900 6171819. This is a toll number and therefore can only be accessed in the Netherlands.

Director's Report on the Activity and Management of the BIPM, 2000, T. 1

(October 1999 – July 2000)

BIPM Publication

1 International Atomic Time (TAI) and Coordinated Universal Time (UTC)

Reference time scales TAI and UTC have been computed regularly and have been published in the monthly *Circular T*. Definitive results for 1999 have been available in the form of computer-readable files in the BIPM home page and on printed volumes of the *Annual Report of the BIPM Time Section for 1999*, Volume 12 [16]. Changes were introduced in this last issue with the aim of progressing towards a report in electronic form.

Work is in progress to automate the calculation of TAI and UTC, thus allowing a shorter delay in the publication of *Circular T* [17] and providing an increased reliability for the system.

2 Algorithms for time scales

Research concerning time-scale algorithms includes studies to improve the long-term stability of the free atomic time scale EAL and the accuracy of TAI. Studies are being undertaken to evaluate the feasibility of providing UTC in quasi-real time.

2.1 EAL stability

Some 80 % of the clocks are now either commercial caesium clocks of the type HP5071A or active, auto-tuned active hydrogen masers, and together they contribute 86 % of the total weight with consequent improvement in the stability of EAL. The medium-term stability of EAL, expressed in terms of an Allan deviation, is estimated to be 0.6×10^{-15} for averaging times of twenty to forty days over the period January 1998 to March 2000. This improves the predictability of UTC for averaging times of between one and two months.

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 frequency standards. Since October 1999, individual measurements of the TAI frequency have been provided by six primary frequency standards.

The global treatment of individual measurements led to a relative departure of the duration of the TAI scale unit from the SI second on the geoid ranging, since October 1999, from $+0.2 \times 10^{-14}$ to $+0.6 \times 10^{-14}$, with a standard uncertainty of 0.4×10^{-14}.

New procedures have been developed for using primary frequency standards to ensure the accuracy of TAI and for reporting the results [11]. Concerning the regular publication of results of the bilateral comparisons with TAI, a joint PTB/BIPM report has been submitted for publication. The new procedures have been in regular use since May 2000.

3 Time links

The classical GPS common-view technique based on C/A-code measurements obtained from single-channel receivers has been extended for use of multichannel dual-code dual-system (GPS and GLONASS) observations, with the aim of improving the accuracy of time transfer. Also the first TWSTFT links were introduced into computation of TAI. In addition, the BIPM Time section continues to test other time and frequency comparison methods, such as phase measurements.

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

i) Current work

The BIPM publishes an evaluation of the daily time differences [*UTC – GPS time*] and [*UTC – GLONASS time*] in its monthly *Circular T* and routinely issues GPS and GLONASS international common-view schedules. The international network of GPS single-time links used by the BIPM follows a pattern of local stars within a continent, together with long-distance links, for which data are corrected to take account of ionospheric measurements and post-processed precise satellite ephemerides. The first multi-channel GPS links were introduced into TAI.

ii) Determination of differential delays of GPS and GLONASS receivers

Part of our work is to check the differential delays between GPS receivers which operate on a regular basis in collaborating timing centres. A series of differential calibrations of GPS equipment involving the European time laboratories equipped with two-way time transfer stations began in June 1997. In December 1999 differential calibrations of GPS/GLONASS multichannel dual-code receivers were initiated involving laboratories in Australia, Europe, Japan, South Africa and the United States. The first trip ended in March 2000 and the results are under evaluation.

iii) Standards for GPS and GLONASS receivers

The Time section is actively involved in the work of the CCTF sub-group on GPS and GLONASS time-transfer standards, and several decisions made by the sub-group have their origins in studies initiated at the BIPM where a key role has been played in the adaptation of the standard GPS data format for use in dual-system, dual-frequency, dual-code observation. This format (CGGTTS Version 2) is now used in commercially available receivers.

iv) Multichannel GPS and GLONASS time links

The first multichannel GPS links were introduced into TAI at the beginning of 2000 [7]. The introduction of multichannel GPS+GLONASS links into TAI is also under study. Procedures for the use of multichannel GLONASS P-code [1] and GLONASS precise ephemerides were established.

v) IGS estimated ionospheric corrections

Ionospheric parameters estimated by the IGS are routinely used to correct several long- and medium-distance links for ionospheric delays in regular TAI calculations [15].

3.2 Phase measurements

GPS and GLONASS time and frequency transfer may also be carried out using dual-frequency carrier-phase measurements rather than code measurements. This technique, already in common use in the geodetic community, can be adapted to the needs of time and frequency transfer.

Studies using an Ashtech Z12T GPS receiver in operation at the BIPM have been conducted in close collaboration with the BNM-LPTF, which owns a similar receiver. It has been shown [3] that two distant H-masers may be compared with a relative frequency uncertainty of the order of 1×10^{-15} for an averaging time of one day, a promising step for confirming the capability of this technique for the comparison of new primary frequency standards. Experiments have been carried out to perform the differential calibration of the Z12T hardware delays by comparison with an NBS-type time transfer receiver at the BIPM [12]. A similar differential calibration has been performed for the BNM-LPTF unit. As a result, these two Ashtech receivers may be used for time transfer as an alternative to the classical common-view method with a much better relative precision and a comparable absolute uncertainty of a few nanoseconds. Work is under way to perform an absolute calibration of our Z12T receiver for studies being conducted in the framework of the IGS/BIPM Pilot Project with a view to providing accurate time and frequency comparisons using GPS phase and code measurements.

The 3S Navigation receivers in operation at the BIPM have the capability to provide GLONASS phase measurements; software has been installed to allow automatic data retrieval. One 3S receiver has been collecting data for IGEX'98 since October 1998. The objective of this project is, among others, to produce post-processed precise GLONASS satellite ephemerides. A new JPS Legacy GPS/GLONASS receiver has been acquired in 2000.

3.3 Two-way time transfer

Two meetings related to TWSTFT activities were held since September 1999. The BIPM collects two-way data from seven operational stations and undertakes treatment of some two-way links [4]. A staff member of the BIPM provides the secretariat of the CCTF Working Group on TWSTFT. The BIPM is also involved in the calibration of two-way time transfer links by comparison with GPS. Starting in January 2000, two new TWSTT links were introduced into the computation of TAI; two additional links are scheduled for July 2000. The Time section commenced the issue of BIPM TWSTFT monthly reports in May 1999.

4 Pulsars

Because millisecond pulsars have the potential to sense the very long-term stability of atomic time, collaboration is maintained with radio-astronomy groups observing pulsars and analysing pulsar data. The Time section provided these groups with the latest version of its post-processed realization of Terrestrial Time TT(BIPM2000) in March 2000.

The work on a new technique to search for pulsars in a sky survey has been completed. The Observatoire Midi-Pyrénées (OMP) is taking over the continuation of this project. A small programme of survey observations, which had been conducted at Nançay (France) in 1998, is currently being processed [13].

5 Space-time references

The BIPM/IAU Joint Committee on General Relativity for Space-time Reference Systems and Metrology (JCR) continued its work.. The website (http://www.bipm.org/WG/CCTF/JCR) provides general information on the JCR.

Two studies have been conducted at the BIPM in collaboration with other members of the JCR. One concerns the extension of the relativistic framework to allow a correct treatment for time transformations and the realization of barycentric coordinate time at the full post-Newtonian level [14]. The second concerns the realization of geocentric coordinate times. Following the report of the JCR [9], two Resolutions will be presented to the XXIVth IAU General Assembly.

Uniformity in the definition of space reference systems is becoming of importance to basic metrology. Such uniformity is essential for activities that use sets of measurements that are not local, as is the case of the astro-geodetic techniques contributing to the International Earth Rotation Service (IERS). Following a call for participation of the IERS, the BIPM has proposed to take part with the IERS in providing its Conventions Product Center.

6 Other studies

In collaboration with the BNM-LPTF, scientists of the section are involved in the evaluation of the possible use for international time keeping of highly stable and accurate space clocks, in particular those that will be operated within the ACES (Atomic Clock Ensemble in Space) experiment on board the international space station in 2003. Because of the micro-gravity environment such laser-cooled clocks are expected to reach relative uncertainties in the low 10^{-16} region, hence presenting an improvement by at least one order of magnitude with respect to current primary standards. They will therefore be of primordial interest for the establishment of TAI accuracy. Within this work an important part concerns the calculation, at the required accuracy, of relativistic corrections affecting the clocks themselves as well as the time transfer between the space and ground clocks. Detailed calculations of this type were carried out in collaboration with the Observatoire de Paris and the École Normale Supérieure (ENS).

More generally the active field of atomic interferometry using laser-cooled atoms on the ground and on-board satellites stimulates collaboration between the Time section and laboratories involved in these developments. As a consequence P. Wolf is on a one-year secondment to the BNM-LPTF on a CNES (Centre National d'Études Spatiales) grant to study possible applications of this technology in fundamental physics and metrology.

7 Publications

7.1 External publications

1. Azoubib J., Lewandowski W., A test of GLONASS P-Code Time Transfer, *Metrologia*, 2000, **37**, 55-59.
2. Azoubib J., Lewandowski W., Nawrocki J., Matsakis D., Continental and Intercontinental Tests of GLONASS P-Code Time Transfer, *Proc. ION-GPS*, 1999, 1053-1056.

3. Jiang Z., Petit G., Uhrich P., Taris F., Use of GPS carrier phase for high precision frequency (time) comparison, *Int. Assoc. Geodesy Symposia* (Vol. 121, K.P. Schwarz ed.)/Springer-Verlag, 2000, 41-46.
4. Lewandowski W., Azoubib J., Time Transfer and TAI, *Proc. IEEE/EIA Int. Frequency Control Symposium*, 2000, invited paper.
5. Lewandowski W., Azoubib J., Vers des tranferts de temps meilleurs que la nanoseconde, *Revue XYZ,* 1999, **81**, No. 4, 21-26.
6. Lewandowski W., Nawrocki J., Azoubib J., Recent Progress in Time Transfer and Use of IGEX GLONASS Precise Ephemerides, *J. Geodesy*, accepted for publication.
7. Nawrocki J., Lewandowski W., Azoubib J., GPS Multi-Channel Time Transfer Unit Based on a Motorola Receiver and Using CCTF Standards, *Metrologia*, 2000, **37**, accepted for publication.
8. Petit G., Importance of a common framework for the realization of space-time reference systems, *Proc. IAG Symposium Towards an Integrated Global Geodetic Observing System (IGGOS)*, International Association for Geodesy Symposia/Springer-Verlag, 2000, 3-7.
9. Petit G., Report of the BIPM/IAU Joint Committee on General Relativity for Space-time Reference Systems and Metrology, *Proc. IAU Colloquium 180*, accepted for publication.
10. Petit G., Terrestrial timescales, *Enc. Astron. Astrophys.*, IOP Pub., accepted for publication.
11. Petit G., Use of primary frequency standards for estimating the duration of the scale unit of TAI, *Proc. 31st PTTI*, accepted for publication.
12. Petit G., Jiang Z., Uhrich P., Taris F., Differential calibration of Ashtech Z12-T receivers for accurate time comparisons, *Proc. 14th EFTF*, accepted for publication.
13. Rougeaux B., Petit G., Fayard T., Davoust E., Experimental set-up for detecting very fast and dispersed millisecond pulsars, *Exper. Astron.*, accepted for publication.
14. Soffel M., Klioner S., Petit G., Wolf P., New relativistic framework for the realization of space-time reference frames and its application to time and frequency in the Solar System, *Journées 1999 Systèmes de Référence Spatio-Temporels and IX Lohrmann-Kolloquium*, 2000, 34-47.
15. Wolf P., Petit G., Use of IGS ionosphere products in TAI, *Proc. 31st PTTI*, accepted for publication.

7.2 BIPM publications

16. Annual Report of the BIPM Time Section (1999), 2000, **12**, 99 pp.
17. *Circular T* (monthly), 6 pp.

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