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Since the 1st of January 1988, the establishment of International Atomic Time, TAI, and of Coordinated Universal Time, UTC (with the exception of the determination and the announcement of 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 determination and announcement of the dates of leap seconds of UTC are among the tasks of the International Earth Rotation Service (IERS), which is responsible for Earth rotation determination and maintainance of the related celestial and terrestrial reference systems.

Information on IERS can be obtained from

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PRACTICAL INFORMATION ABOUT THE BIPM TIME SECTION

The periodic publications on Time of the BIPM are the monthly Circulars T and the Annual Report of the BIPM Time Section. Some information on Time is also available by telephone line, either through the BIPM data service or through the General Electric Mark III system. The monthly Circulars T are now also sent via BITNET/INTERNET on request.

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Guest workers in 1991 :

Mrs Patrizia Tavella (March and October 1991), from the Istituto Elettrotecnico Nazionale Galileo Ferraris, Torino, Italy.

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 de la rotation terrestre et de la conservation des systèmes de référence terrestre et céleste associés.

Les renseignements sur l'IERS et ses publications peuvent être obtenus à l'adresse suivante :

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RENSEIGNEMENTS PRATIQUES SUR LA SECTION DU TEMPS DU BIPM

Les publications périodiques du BIPM concernant le temps sont la Circulaire T, mensuelle, et le Rapport annuel de la Section du temps du BIPM. Certaines autres informations sur le temps sont aussi disponibles par ligne téléphonique, soit par le service de données propre à la Section du temps du BIPM, soit par le système informatique General Electric Mark III. La Circulaire T est aussi maintenant envoyée par BITNET/INTERNET sur simple demande.

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* Mr MOUSSAY a été engagé au BIPM le 1er octobre 1991.

Stagiaires en 1991 :

Mme Patrizia Tavella (mars et octobre 1991) de l'Istituto Elettrotecnico Nazionale Galileo Ferraris, Turin, Italie.

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by the BIPM

PARTIE A

Echelles de temps atomique etablies

par le BIPM

1 - ESTABLISHMENT OF INTERNATIONAL ATOMIC TIME AND COORDINATED UNIVERSAL TIME IN 1991

International Atomic Time (TAI) and Coordinated Universal Time (UTC) are obtained from a combination of the readings of atomic clocks and frequency standards spread worldwide.

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 two-month blocks of data [1] [2]. 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.

The duration of the scale interval of EAL is evaluated by comparison with the data of primary cesium standards. 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 "steering" of TAI.

TAI and UTC are made available in the form of time differences with respect to time scales kept by national laboratories "k": UTC(k), approximation to UTC, and TA(k), independent local atomic time.

These differences UTC - UTC(k), TAI - TA(k), are computed at 10-day intervals for Modified Julian Dates (MJD) ending in 9, at 0h UTC, and designated here as "standard dates".

The computation of TAI has a basic periodicity of two months. However a provisional computation is made every other month (January, March, etc.) with the data which is available. The following month, TAI is recomputed for the whole span of two months. The deviations between the provisional one-month and complete two-month solutions are usually smaller than 10 ns. This organization allows the monthly publication of results in the BIPM Circular T.

When preparing the Annual Report, the results of Circular T are revised taking into account some improvement in the data made known after the publication of Circular T. The computation is then strictly made for the six two-month intervals of the year.

In the following, and everywhere in this Report, the laboratories are designated by the acronyms explained in Table 1 of Part B.

2 - TIME LINKS USED BY THE BIPM IN 1991

The network of time links used by the BIPM in 1991 is non-redundant and mainly relies on the observation of GPS satellites.

2.1 GPS LINKS

GPS time comparisons are computed using strict common views (same start time and same track length) in order to remove the on-board clock noise brought about by Selective Availability. It is then more than ever necessary to follow strictly the international GPS common view schedules established and proposed to contributing laboratories by the BIPM. Two schedules were issued in 1991: schedule n°17 (see Table A) implemented on 27 June 1991 (MJD 48434) and schedule n°18 (see Table B) implemented on 13 December 1991 (MJD 48603).

In TAI computation, the following GPS links are used (end 1991):

Link	Computed by
AOS - OP	BIPM
CAO - OP	BIPM
CH - OP	BIPM
DPT - OP	BIPM
IEN - OP	BIPM
IFAG - OP	BIPM
INPL - OP	BIPM
LDS - OP	BIPM
NPL - OP	BIPM
NPLI - OP	BIPM
ORB - OP	BIPM
PKNM - OP	BIPM
PTB - OP	BIPM
ROA - OP	BIPM
SNT - OP	BIPM
TAO - OP	BIPM
TP - OP	BIPM
TUG - OP	BIPM
USNO - OP	BIPM
VSL - OP	BIPM
CRL - TAO	BIPM
CSAO - TAO	BIPM
KRIS - TAO	BIPM
NAOM - TAO	BIPM
NRLM - TAO	BIPM
PEL - TAO	BIPM
TL - TAO	BIPM
NRC - NIST	NIST
USNO - NIST	NIST
APL - USNO	APL
IGMA - USNO	IGMA
ONRJ - USNO	ONRJ and BIPM

Measurements of ionospheric delays obtained from dual-frequency GPS receivers are now available. Current measurements performed at the CRL and the BIPM with realtime TECmeters, developed by the CRL in early 1989, allow the correction of the time link TAO - OP for the whole year 1991. Some other ionospheric measurements, obtained at OP and NIST from prototypes of the Ionospheric Measurement System, developed in 1990 by the NIST, are used for experimental purposes, but are not yet introduced on a regular basis into the TAI computation.

The quality of GPS time links is greatly improved by the use of accurate antenna coordinates. On 1990 June 12 at 0h00 UTC, the BIPM proposed the introduction of new coordinates into the GPS time receivers. There were obtained by a combination of two techniques: geodetic methods which give the relative position of the antenna with respect to the nearest IERS site, and the BIPM method of differential positioning [3] between GPS antennas. This action, which has ensured the worldwide homogeneity in the IERS Terrestrial Reference Frame (ITRF) of the coordinates of all national laboratories equipped with GPS receivers, is now continued for newly equipped laboratories.

Two sets of precise ephemerides of GPS satellites, computed by the US Defense Mapping Agency and the National Geodetic Survey, were regularly received at the BIPM in 1991. They are used experimentally to correct time comparisons for the satellites position. In 1991, the delay of access (6 weeks) to precise ephemerides was too long to introduce this correction in current TAI computation.

2.2 LORAN-C LINKS

The laboratories where only LORAN-C is received are preferably linked to laboratories where both LORAN-C and GPS are received. Simultaneous receptions of the LORAN-C signals have been organized.

The time differences of the UTC(k)'s of the laboratories are computed daily, then the values at the standard dates are evaluated by linear fit over 10 days (5 before and 5 after the standard date), except when time or frequency steps of the UTC(k)'s are reported or found.

The following LORAN-C time comparisons are evaluated by the BIPM and used in TAI computation (end 1991):

NMC - IEN
YUZM - IEN
BEV - OP
FTZ - PTB
NIM - TAO
SO - TAO
RC - USNO

2.3 GLONASS LINKS

From his current observations of both the GPS and GLONASS satellite systems Prof. P. Daly, University of Leeds, establishes and reports GPS time - GLONASS time, as well as UTC(USNO) - UTC(SU) at ten-day intervals. This data was used in 1991 in TAI computation for linking SU to the international network.

2.4 Television links

The simultaneous reception of public television signals provides the links

OMH - TP
ZIPE - PTB (end 1991).

2.5 Two-way time transfer via geostationary satellites

For experimental purposes, two-way time transfers via geostationary satellites have been carried out in 1990 and 1991, on the one hand between NIST, NRC and USNO in North America, and on the other hand between TUG and OCA in Europe. These experimental results were not used for TAI computation in 1991.

3. Accuracy of the TAI scale interval

Table C (page A-19) gives the normalized frequency offsets between EAL and TAI. The relationship TAI-EAL was modified four times in 1991, twice by frequency offsets of 0.75×10^{-14} and twice by frequency offsets of 0.5×10^{-14}, in order to compensate a frequency drift of EAL with respect to the primary standards of the PTB.

4. Time scales established in retrospect

For the most demanding applications, such as millisecond pulsar timing, the BIPM issues atomic time scales in retrospect designated as TT(BIPMxx) where 1900 + xx is the year of computation [4]. 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.

References

[1] B. Guinot and C. Thomas, 'Establishment of the International Atomic Time', Annual Report of the BIPM Time Section, 1988, pp. D3-D22.

[2] P. Tavella and C. Thomas, 'Comparative study of time scale algorithms', Metrologia 28, 1991, pp. 57-63.

[3] B. Guinot and W. Lewandowski, 'Improvement of the GPS time comparisons by simultaneous relative positioning of the antennas', Bull. Géod. 63, 1989, pp. 371-386.

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

TABLE A. INTERNATIONAL GPS TRACKING SCHEDULE N° 17, FOR MJD = 48434 (1991 JUNE 27) AT 0hUTC

This is a suggested tracking schedule for international time comparisons in common view of GPS satellites between ten areas of the globe.

Area		Participating laboratories
Europe	E	AOS, CAO, CH, FTZ, IEN, IFAG, LDS, Mad*, NPL, OP, ORB, PKNM, PTB, ROA, RGO, SNT, SU, TP, TUG, VSL
East North America	ENA	AO*, APL, NRC, USNO
West North America	WNA	Gold*, NIST, WWV*
East Asia	EA	CRL, CSAO, KRIS, NAOM, NRLM, SO, TAO, TL
Middle East	ME	INPL
South Africa	SAF	DPT, RAO, SAAO
South America	SAM	IGMA, ONRJ, Kou*
Hawaii	H	WWVH*
Australia and New Zealand	A	Can*, ATC, ORR, NML, PEL
India	I	NPLI

* Mad, Gold, Can : JPL Deep Space Network, Madrid, Goldstone, Canberra.
WWV, WWVH : NIST stations in Colorado and Hawaii.
AO : Arecibo Observatory.
Kou: CNES Kourou Center

Other laboratories are designated by their usual acronyms.

The suggested track duration is 15 minutes. Data taking is to start 2 minutes after the start of the track to allow time to lock on to the satellite signal. The data length is therefore 13 minutes; it has been chosen in order to ensure use of the ionospheric correction which is transmitted every 12.5 min. All the track times should be decremented 4 minutes each day to account for the GPS sidereal orbits. The track times are chosen to maximize elevation angles between pairs of stations. The class bytes are such that in association with the satellite number they form a unique identifyer for each common view.

The European area having numerous possible connections has a heavy schedule. The establishment of sub-schedules permits the sharing of the work. European laboratories are contacted to ensure the coordination of sub-schedules.

TABLE A. SCHEDULE N° 17, 1991 JUNE 27 (CONT.)

*** Europe ***

Class	PRN	Start h	Start m	Connects	Subschedules E1	E2	E3	E4
00	18	00	16	ENA,ME	*	*	*	*
10	14	00	32	EA,ME,I			*	
4C	19	01	04	SAF,ME				*
4C	14	01	20	SAF				*
08	3	02	40	WNA,ENA		*		
10	18	02	56	EA,ME,I			*	
CA	6	03	12	SAF,SAM,ME				*
08	16	03	28	WNA,ENA	*	*	*	*
10	19	04	00	EA,ME,I	*	*	*	*
00	6	05	04	ENA,ME	*	*	*	*
68	12	06	08	ENA,SAM		*		
10	2	06	40	EA,ME,I	*	*	*	*
00	23	07	12	ENA,WNA		*		
10	6	07	28	EA,I			*	
4C	13	07	44	SAF,ME,I				*
08	12	08	00	WNA,ENA,ME		*		
E4	12	09	04	E	*	*	*	*
48	13	09	20	ME,I,EA	*	*	*	*
19	20	09	52	ENA,WNA,ME,SAM	*	*	*	*
4C	12	11	12	SAF,ME,I				*
4C	3	11	28	SAF,ME				*
00	3	12	48	ENA,ME	*	*	*	*
10	16	13	52	EA,ME,I			*	
A0	3	14	40	ME,I,EA			*	
4C	23	15	44	SAF,ME,I			*	
10	17	16	16	EA,ME,I	*	*	*	*
4C	21	17	04	SAF,ME	*	*	*	*
00	11	17	20	ENA,WNA,ME	*	*	*	*
10	23	18	08	EA,ME,I	*	*	*	*
08	15	18	40	WNA,ENA,SAM	*	*	*	*
18	2	19	12	ENA,WNA,H		*		
10	21	20	00	EA,ME,I			*	
BC	11	20	32	ME,SAF,I			*	
00	14	21	36	ENA,WNA,SAM	*	*	*	*
54	18	22	24	SAM,SAF,ME				*
4C	15	22	56	SAF,ME,I				*
08	13	23	28	WNA,ENA,SAM,ME		*		

TABLE A. SCHEDULE N° 17, 1991 JUNE 27 (CONT.)

*** E. North America ***

Class	PRN	Start h	m	Connects
00	18	00	16	E,ME
20	3	01	36	EA,WNA,H
18	16	01	52	WNA
28	17	02	24	WNA,EA,H
08	3	02	40	E,WNA
08	16	03	28	E,WNA
68	3	04	48	SAM,WNA
00	6	05	04	E,ME
68	12	06	08	SAM,E
18	17	06	24	WNA,SAM
28	11	06	56	EA,WNA,H
00	23	07	12	E,WNA
18	21	07	28	WNA,H
08	12	08	00	E,WNA,ME
20	15	09	04	EA,WNA,H
19	20	09	52	WNA,E,ME,SAM
28	14	10	56	EA,WNA,H
00	3	12	48	E,ME
28	18	13	04	EA,WNA,H
18	18	14	56	WNA
18	19	15	12	WNA,H
68	18	16	48	SAM,WNA
00	11	17	20	E,WNA,ME
28	6	17	36	WNA,EA,H
08	15	18	40	E,WNA,SAM
18	2	19	12	WNA,H,E
34	13	20	48	WNA,H
68	6	21	04	SAM,WNA
20	12	21	20	EA,WNA,H
00	14	21	36	E,WNA,SAM
28	20	23	12	WNA,EA,H
08	13	23	28	E,WNA,SAM,ME

*** W. North America ***

Class	PRN	Start h	m	Connects
20	3	01	36	ENA,EA,H
18	16	01	52	ENA
28	17	02	24	EA,H,ENA
08	3	02	40	E,ENA
08	16	03	28	E,ENA
68	3	04	48	ENA,SAM
18	17	06	24	ENA,SAM
28	11	06	56	EA,ENA,H
00	23	07	12	E,ENA
18	21	07	28	ENA,H
08	12	08	00	E,ENA,ME
20	15	09	04	EA,ENA,H
19	20	09	52	ENA,E,ME,SAM
28	14	10	56	EA,ENA,H
28	18	13	04	EA,ENA,H
18	18	14	56	ENA
18	19	15	12	ENA,H
68	18	16	48	ENA,SAM
00	11	17	20	E,ENA,ME
28	6	17	36	EA,ENA,H
08	15	18	40	E,ENA,SAM
18	2	19	12	ENA,H,E
34	13	20	48	H,ENA
68	6	21	04	SAM,ENA
20	12	21	20	ENA,EA,H
00	14	21	36	E,ENA,SAM
28	20	23	12	EA,H,ENA
08	13	23	28	E,ENA,SAM,ME

*** East Asia ***

Class	PRN	Start h	m	Connects
10	14	00	32	E,ME,I
20	3	01	36	ENA,WNA,H
28	17	02	24	WNA,H,ENA
10	18	02	56	E,ME,I
10	19	04	00	E,ME,I
10	2	06	40	E,ME,I
28	11	06	56	WNA,ENA,H
98	19	07	12	A,I
10	6	07	28	E,I
98	14	08	00	A
20	15	09	04	ENA,WNA,H
48	13	09	20	E,ME,I
36	14	09	52	H
98	2	10	08	A
28	14	10	56	WNA,ENA,H
ED	13	11	44	EA
28	18	13	04	WNA,ENA,H
98	13	13	20	A
10	16	13	52	E,ME,I
A0	3	14	40	ME,I,E
3C	6	15	28	A,H
10	17	16	16	E,ME,I
28	6	17	36	WNA,ENA,H
98	12	17	52	A
10	23	18	08	E,ME,I
10	21	20	00	E,ME,I
98	20	20	16	A
20	12	21	20	ENA,WNA,H
28	20	23	12	WNA,H,ENA

TABLE A. SCHEDULE N° 17, 1991 JUNE 27 (CONT.)

*** Middle East ***

Class	PRN	Start h m	Connects
00	18	00 16	E,ENA
10	14	00 32	E,EA,I
4C	19	01 04	E,SAF
BC	14	02 08	SAF
10	18	02 56	E,EA,I
CA	6	03 12	SAF,SAM,E
10	19	04 00	E,EA,I
00	6	05 04	E,ENA
10	2	06 40	E,EA,I
4C	13	07 44	E,SAF,I
08	12	08 00	E,WNA,ENA
48	13	09 20	E,I,EA
19	20	09 52	ENA,WNA,E,SAM
4C	12	11 12	E,SAF,I
4C	3	11 28	E,SAF
00	3	12 48	E,ENA
10	16	13 52	E,EA,I
A0	3	14 40	I,E,EA
4C	23	15 44	E,SAF,I
10	17	16 16	E,EA,I
4C	21	17 04	E,SAF
00	11	17 20	E,ENA,WNA
10	23	18 08	E,EA,I
10	21	20 00	E,EA,I
BC	11	20 32	SAF,E,I
54	18	22 24	E,SAM,SAF
4C	15	22 56	E,SAF,I
08	13	23 28	E,WNA,ENA,SAM

*** South Africa ***

Class	PRN	Start h m	Connects
CC	11	00 00	A
4C	19	01 04	E,ME
4C	14	01 20	E
BC	14	02 08	ME
CA	6	03 12	SAM,E,ME
4C	13	07 44	E,ME,I
4C	12	11 12	E,ME,I
4C	3	11 28	E,ME
4C	23	15 44	E,ME,I
4C	21	17 04	E,ME
BC	11	20 32	ME,E,I
CA	19	21 20	SAM
54	18	22 24	E,SAM,ME
4C	15	22 56	E,ME,I

*** South America ***

Class	PRN	Start h m	Connects
F8	13	01 20	SAM
CA	6	03 12	SAF,E,ME
68	3	04 48	ENA,WNA
F8	12	05 04	SAM
68	12	06 08	ENA,E
18	17	06 24	ENA,WNA
19	20	09 52	ENA,WNA,E,ME
F8	11	14 08	SAM
68	18	16 48	ENA,WNA
08	15	18 40	E,WNA,ENA
68	6	21 04	ENA,WNA
CA	19	21 20	SAF
00	14	21 36	E,ENA,WNA
54	18	22 24	E,SAF,ME
08	13	23 28	E,WNA,ENA,ME

TABLE A. SCHEDULE N° 17, 1991 JUNE 27 (CONT.)

*** Hawaii ***					*** Australia ***					*** India ***				
Class	PRN	Start h	Start m	Connects	Class	PRN	Start h	Start m	Connects	Class	PRN	Start h	Start m	Connects
20	3	01	36	ENA,EA,WNA	CC	11	00	00	SAF	10	14	00	32	E,EA,ME
28	17	02	24	WNA,EA,ENA	98	19	07	12	EA,I	10	18	02	56	E,EA,ME
28	11	06	56	EA,WNA,ENA	98	14	08	00	EA	10	19	04	00	E,EA,ME
18	21	07	28	ENA,WNA	F9	19	09	20	A	10	2	06	40	E,EA,ME
20	15	09	04	EA,ENA,WNA	98	2	10	08	EA	98	19	07	12	A,EA
36	14	09	52	EA	3C	19	12	00	H	10	6	07	28	E,EA
28	14	10	56	EA,WNA,ENA	F9	6	13	04	A	4C	13	07	44	E,SAF,ME
3C	19	12	00	A	98	13	13	20	EA	48	13	09	20	E,ME,EA
28	18	13	04	EA,WNA,ENA	F9	13	14	24	A	4C	12	11	12	E,SAF,ME
18	19	15	12	ENA,WNA	3C	6	15	28	H,EA	10	16	13	52	E,EA,ME
3C	6	15	28	A,EA	F9	12	16	16	A	A0	3	14	40	ME,E,EA
28	6	17	36	WNA,EA,ENA	98	12	17	52	EA	4C	23	15	44	E,SAF,ME
18	2	19	12	ENA,WNA,E	98	20	20	16	EA	10	17	16	16	E,EA,ME
34	13	20	48	WNA,ENA	F9	3	21	20	A	10	23	18	08	E,EA,ME
20	12	21	20	ENA,EA,WNA	F9	23	22	56	A	10	21	20	00	E,EA,ME
28	20	23	12	WNA,EA,ENA						BC	11	20	32	ME,SAF,E
										4C	15	22	56	E,SAF,ME

TABLE B. INTERNATIONAL GPS TRACKING SCHEDULE N° 18, FOR MJD = 48603 (1991 DECEMBER 13) AT 0hUTC

This is a suggested tracking schedule for international time comparisons in common view of GPS satellites between ten areas of the globe.

Area		Participating laboratories
Europe	E	AOS, CAO, CH, FTZ, IEN, IFAG, LDS, Mad*, NPL, OP, ORB, PKNM, PTB, ROA, RGO, SNT, SU, TP, TUG, VSL
East North America	ENA	AO*, APL, NRC, USNO
West North America	WNA	Gold*, NIST, WWV*
East Asia	EA	CRL, CSAO, KRIS, NAOM, NRLM, SO, TAO, TL
Middle East	ME	INPL
South Africa	SAF	DPT, RAO, SAAO
South America	SAM	IGMA, ONRJ, Kou*
Hawaii	H	WWVH*
Australia and New Zealand	A	Can*, ATC, ORR, NML, PEL
India	I	NPLI

* Mad, Gold, Can : JPL Deep Space Network, Madrid, Goldstone, Canberra.
WWV, WWVH : NIST stations in Colorado and Hawaii.
AO : Arecibo Observatory.
Kou: CNES Kourou Center

Other laboratories are designated by their usual acronyms.

The suggested track duration is 15 minutes. Data taking is to start 2 minutes after the start of the track to allow time to lock on to the satellite signal. The data length is therefore 13 minutes; it has been chosen in order to ensure use of the ionospheric correction which is transmitted every 12.5 min. All the track times should be decremented 4 minutes each day to account for the GPS sidereal orbits. The track times are chosen to maximize elevation angles between pairs of stations. The class bytes are such that in association with the satellite number they form a unique identifyer for each common view.

The European area having numerous possible connections has a heavy schedule. The establishment of sub-schedules permits the sharing of the work. European laboratories are contacted to ensure the coordination of sub-schedules.

TABLE B. SCHEDULE N° 18, 1991 DECEMBER 13 (CONT.)

*** Europe ***

Class	PRN	Start h	m	Connects	Subschedules E1	E2	E3	E4
4C	3	00	00	SAF,ME				*
00	3	01	20	ENA,ME	*	*	*	*
10	16	02	24	EA,ME,I			*	
A0	3	03	28	ME,I,EA			*	
4C	23	04	00	SAF,ME,I			*	
10	17	04	48	EA,ME,I	*	*	*	*
4C	21	05	04	SAF,ME	*	*	*	*
00	11	05	52	ENA,WNA,ME	*	*	*	*
10	23	06	24	EA,ME,I	*	*	*	*
08	15	06	56	WNA,ENA,SAM	*	*	*	*
18	2	07	44	ENA,WNA,H		*		
10	21	08	00	EA,ME,I			*	
BC	11	09	04	ME,SAF,I			*	
00	14	09	52	ENA,WNA,SAM	*	*	*	*
54	18	10	56	SAM,SAF,ME				*
4C	15	11	12	SAF,ME,I				*
08	13	11	44	WNA,ENA,SAM,ME		*		
10	14	12	32	EA,ME,I			*	
00	18	12	48	ENA,ME	*	*	*	*
08	24	13	20	WNA,ENA	*	*	*	*
4C	19	13	36	SAF,ME				*
08	3	14	56	WNA,ENA		*		
CA	6	15	28	SAF,SAM,ME				*
08	16	15	44	WNA,ENA	*	*	*	*
10	19	16	32	EA,ME,I	*	*	*	*
00	6	17	20	ENA,ME	*	*	*	*
68	12	18	56	ENA,SAM		*		
10	2	19	12	EA,ME,I	*	*	*	*
10	6	19	44	EA,I			*	
4C	13	20	00	SAF,ME,I				*
08	12	20	16	WNA,ENA,ME		*		
00	23	20	32	ENA,WNA		*		
E4	12	21	36	E	*	*	*	*
48	13	21	52	ME,I,EA	*	*	*	*
19	20	22	24	ENA,WNA,ME,SAM	*	*	*	*
10	24	22	56	EA,ME,I			*	
4C	12	23	28	SAF,ME,I				*

TABLE B. SCHEDULE N° 18, 1991 DECEMBER 13 (CONT.)

*** E. North America ***

Class	PRN	Start h	Start m	Connects
00	3	01	20	E,ME
28	18	01	36	EA,WNA,H
18	18	03	28	WNA
18	19	04	00	WNA,H
68	18	05	20	SAM,WNA
00	11	05	52	E,WNA,ME
28	6	06	08	WNA,EA,H
08	15	06	56	E,WNA,SAM
18	2	07	44	WNA,H,E
68	6	09	04	SAM,WNA
34	13	09	20	WNA,H
20	12	09	36	EA,WNA,H
00	14	09	52	E,WNA,SAM
18	24	10	56	WNA,H
08	13	11	44	E,WNA,SAM,ME
28	20	12	00	WNA,EA,H
00	18	12	48	E,ME
08	24	13	20	E,WNA
18	16	13	52	WNA
20	3	14	08	EA,WNA,H
28	17	14	40	WNA,EA,H
08	3	14	56	E,WNA
08	16	15	44	E,WNA
00	6	17	20	E,ME
68	3	17	36	SAM,WNA
18	17	18	40	WNA,SAM
68	12	18	56	SAM,E
28	11	19	28	EA,WNA,H
18	21	19	44	WNA,H
08	12	20	16	E,WNA,ME
00	23	20	32	E,WNA
20	15	21	20	EA,WNA,H
19	20	22	24	WNA,E,ME,SAM
28	14	23	12	EA,WNA,H

*** W. North America ***

Class	PRN	Start h	Start m	Connects
28	18	01	36	EA,ENA,H
18	18	03	28	ENA
18	19	04	00	ENA,H
68	18	05	20	ENA,SAM
00	11	05	52	E,ENA,ME
28	6	06	08	EA,ENA,H
08	15	06	56	E,ENA,SAM
18	2	07	44	ENA,H,E
68	6	09	04	SAM,ENA
34	13	09	20	H,ENA
20	12	09	36	ENA,EA,H
00	14	09	52	E,ENA,SAM
18	24	10	56	ENA,H
08	13	11	44	E,ENA,SAM,ME
28	20	12	00	EA,H,ENA
08	24	13	20	E,ENA
18	16	13	52	ENA
20	3	14	08	ENA,EA,H
28	17	14	40	EA,H,ENA
08	3	14	56	E,ENA
08	16	15	44	E,ENA
68	3	17	36	ENA,SAM
18	17	18	40	ENA,SAM
28	11	19	28	EA,ENA,H
18	21	19	44	ENA,H
08	12	20	16	E,ENA,ME
00	23	20	32	E,ENA
20	15	21	20	EA,ENA,H
19	20	22	24	ENA,E,ME,SAM
28	14	23	12	EA,ENA,H

*** East Asia ***

Class	PRN	Start h	Start m	Connects
ED	13	00	16	EA
28	18	01	36	WNA,ENA,H
98	13	01	52	A
10	16	02	24	E,ME,I
A0	3	03	28	ME,I,E
3C	6	03	44	A,H
10	17	04	48	E,ME,I
98	12	05	52	A
28	6	06	08	WNA,ENA,H
10	23	06	24	E,ME,I
10	21	08	00	E,ME,I
98	20	08	32	A
20	12	09	36	ENA,WNA,H
28	20	12	00	WNA,H,ENA
10	14	12	32	E,ME,I
20	3	14	08	ENA,WNA,H
28	17	14	40	WNA,H,ENA
10	19	16	32	E,ME,I
10	2	19	12	E,ME,I
28	11	19	28	WNA,ENA,H
10	6	19	44	E,I
98	14	20	16	A
20	15	21	20	ENA,WNA,H
48	13	21	52	E,ME,I
36	14	22	08	H
98	2	22	40	A
10	24	22	56	E,ME,I
28	14	23	12	WNA,ENA,H

TABLE B. SCHEDULE N° 18, 1991 DECEMBER 13 (CONT.)

*** Middle East ***				*** South Africa ***				*** South America ***			
Class	PRN	Start	Connects	Class	PRN	Start	Connects	Class	PRN	Start	Connects
		h m				h m				h m	
4C	3	00 00	E,SAF	4C	3	00 00	E,ME	F8	11	02 56	SAM
00	3	01 20	E,ENA	4C	23	04 00	E,ME,I	68	18	05 20	ENA,WNA
10	16	02 24	E,EA,I	4C	21	05 04	E,ME	08	15	06 56	E,WNA,ENA
A0	3	03 28	I,E,EA	BC	11	09 04	ME,E,I	68	6	09 04	ENA,WNA
4C	23	04 00	E,SAF,I	CA	19	10 08	SAM	00	14	09 52	E,ENA,WNA
10	17	04 48	E,EA,I	54	18	10 56	E,SAM,ME	CA	19	10 08	SAF
4C	21	05 04	E,SAF	4C	15	11 12	E,ME,I	54	18	10 56	E,SAF,ME
00	11	05 52	E,ENA,WNA	CC	11	12 16	A	08	13	11 44	E,WNA,ENA,ME
10	23	06 24	E,EA,I	4C	19	13 36	E,ME	F8	13	13 52	SAM
10	21	08 00	E,EA,I	BC	14	14 08	ME	CA	6	15 28	SAF,E,ME
BC	11	09 04	SAF,E,I	CA	6	15 28	SAM,E,ME	68	3	17 36	ENA,WNA
54	18	10 56	E,SAM,SAF	4C	13	20 00	E,ME,I	F8	12	17 52	SAM
4C	15	11 12	E,SAF,I	4C	12	23 28	E,ME,I	18	17	18 40	ENA,WNA
08	13	11 44	E,WNA,ENA,SAM					68	12	18 56	ENA,E
10	14	12 32	E,EA,I					19	20	22 24	ENA,WNA,E,ME
00	18	12 48	E,ENA								
4C	19	13 36	E,SAF								
BC	14	14 08	SAF								
CA	6	15 28	SAF,SAM,E								
10	19	16 32	E,EA,I								
00	6	17 20	E,ENA								
10	2	19 12	E,EA,I								
4C	13	20 00	E,SAF,I								
08	12	20 16	E,WNA,ENA								
48	13	21 52	E,I,EA								
19	20	22 24	ENA,WNA,E,SAM								
10	24	22 56	E,EA,I								
4C	12	23 28	E,SAF,I								

TABLE 8. SCHEDULE N° 18, 1991 DECEMBER 13 (CONT.)

*** Hawaii ***

Class	PRN	Start h m	Connects
3C	19	00 32	A
28	18	01 36	EA,WNA,ENA
3C	6	03 44	A,EA
18	19	04 00	ENA,WNA
28	6	06 08	WNA,EA,ENA
18	2	07 44	ENA,WNA,E
34	13	09 20	WNA,ENA
20	12	09 36	ENA,EA,WNA
18	24	10 56	ENA,WNA
28	20	12 00	WNA,EA,ENA
20	3	14 08	ENA,EA,WNA
28	17	14 40	WNA,EA,ENA
28	11	19 28	EA,WNA,ENA
18	21	19 44	ENA,WNA
20	15	21 20	EA,ENA,WNA
36	14	22 08	EA
28	14	23 12	EA,WNA,ENA

*** Australia ***

Class	PRN	Start h m	Connects
3C	19	00 32	H
F9	6	01 36	A
98	13	01 52	EA
F9	13	02 56	A
3C	6	03 44	H,EA
F9	12	04 48	A
98	12	05 52	EA
98	20	08 32	EA
F9	3	09 52	A
F9	23	11 12	A
CC	11	12 16	SAF
98	14	20 16	EA
F9	19	21 52	A
98	2	22 40	EA

*** India ***

Class	PRN	Start h m	Connects
10	16	02 24	E,EA,ME
A0	3	03 28	ME,E,EA
4C	23	04 00	E,SAF,ME
10	17	04 48	E,EA,ME
10	23	06 24	E,EA,ME
10	21	08 00	E,EA,ME
BC	11	09 04	ME,SAF,E
4C	15	11 12	E,SAF,ME
10	14	12 32	E,EA,ME
10	19	16 32	E,EA,ME
10	2	19 12	E,EA,ME
10	6	19 44	E,EA
4C	13	20 00	E,SAF,ME
48	13	21 52	E,ME,EA
10	24	22 56	E,EA,ME
4C	12	23 28	E,SAF,ME

TABLE C - DIFFERENCES BETWEEN THE NORMALIZED FREQUENCIES OF EAL AND TAI
(until January 1992)

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	48559	7,45

As the time scales UTC and TAI differ by an integral number of seconds (see Tables 2 and 3 of Part B), UTC is necessarily subjected to the same intentional frequency adjustement as TAI.

1. Etablissement du Temps atomique international et du Temps universel coordonne en 1991

Le Temps atomique international (TAI) et le Temps universel coordonné (UTC) sont obtenus par une combinaison des lectures de données d'horloges atomiques et d'étalons primaires de fréquence répartis dans le monde entier.

Un algorithme itératif qui traite en temps différé des blocs de 2 mois de données [1] [2], produit une "échelle atomique libre", EAL définie comme étant une moyenne pondérée de lectures d'horloges. 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.

La durée de l'intervalle unitaire de l'EAL est évaluée par comparaison aux données d'étalons de fréquence à césium primaires. 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 TAI et l'UTC sont disponibles sous forme de différences de temps avec les échelles de temps conservées par des laboratoires horaires nationaux "k" : UTC(k), approximation de UTC, et TA(k), temps atomique local indépendant.

Les différences UTC - UTC(k), TAI - TA(k), sont calculées de 10 jours en 10 jours pour les dates juliennes modifiées (MJD) se terminant par 9, à 0h UTC, "dates normales".

Le calcul du TAI doit être fait, en principe, tous les deux mois. Mais un calcul provisoire est fait un mois sur deux (pour janvier, mars, ...) avec les données disponibles. Le mois suivant, le calcul du TAI est repris pour une durée de deux mois. L'écart entre les résultats des calculs provisoire et complet est ordinairement inférieur à 10 ns. Cette organisation permet la publication mensuelle des résultats dans la Circulaire T du BIPM.

Quand le Rapport annuel est préparé, les résultats de la circulaire T sont révisés, compte-tenu des améliorations de données, connues après la publication de la Circulaire T. Les calculs sont alors strictement faits par période de deux mois.

Dans la suite et dans tout ce rapport, les laboratoires sont désignés par les sigles explicités dans la table 1 de la partie B.

2. LIAISONS HORAIRES UTILISEES PAR LE BIPM EN 1991

Le système des liaisons horaires utilisé par le BIPM en 1991 est non-redondant. Il repose principalement sur l'observation des satellites du GPS, cependant d'autres techniques sont aussi utilisées:

- le LORAN-C,
- le GLONASS,
- la réception d'impulsions de la télévision publique.

Dans toutes ces méthodes on fait appel généralement à la réception simultanée des signaux et l'on recherche la meilleure estimation des différences des UTC(k) aux dates normales. Pour les liaisons horaires par le GPS, le calcul est réalisé à l'aide de vues simultanées strictes (même heure de départ et même durée de poursuite), ceci afin de supprimer la dégradation des signaux des horloges embarquées, due à l'implantation de "l'accés sélectif". Il est donc plus que jamais nécessaire de suivre strictement les programmes internationaux de vues simultanées du GPS, établis et proposés par le BIPM aux laboratoires participant au TAI, tels que le programme n°17 (voir le tableau A), mis en oeuvre le 27 juin 1991, et le programme n°18 (voir le tableau B) mis en oeuvre le 13 décembre 1991.

L'ensemble des liaisons utilisées est donné dans le texte anglais qui précède.

On dispose maintenant de mesures du retard ionosphérique obtenues à partir de récepteurs GPS double-fréquence. Des mesures régulières au CRL et au BIPM, réalisées avec l'équipement développé par le CRL, ont été utilisées pour corriger la liaison TAO-OP en 1991. Les systèmes de mesures ionosphériques, développés par le NIST, et en fonctionnement à l'OP et au NIST, ne sont utilisés qu'à but expérimental. Les mesures qu'ils délivrent ne sont pas encore introduites dans les calculs courants du TAI.

La qualité des comparaisons horaires par le GPS est largement améliorée si les coordonnées d'antenne sont connues avec précision. Le BIPM a suggéré de corriger les coordonnées d'antennes introduites dans les récepteurs GPS le 12 juin 1990, à 0h00 UTC. Ces coordonnées plus exactes avaient été obtenues grâce à deux techniques : des méthodes géodésiques qui donnent la position de l'antenne par rapport au site IERS le plus proche, et la méthode de positionnement différentiel développée par le BIPM [3]. On continue cette homogénéisation mondiale des coordonnées d'antennes, réalisée dans le système de référence terrestre de l'IERS, pour les laboratoires nouvellement équipés de récepteurs de temps du GPS.

Le BIPM reçoit régulièrement deux ensembles d'éphémérides précises des satellites du GPS, produites par la DMA et le NGS. Elles permettent d'améliorer les comparaisons horaires par correction de la position du satellite. A cause du délai d'accès (6 semaines), ce travail reste à un niveau expérimental et les données d'éphémérides précises ne sont pas introduites dans les calculs courants du TAI.

Des comparaisons de temps par la méthode des deux voies utilisant un satellite géostationnaire ont été réalisées à titre expérimental, d'une part entre le NIST, le NRC et l'USNO en Amérique du Nord, d'autre part entre le TUG et l'OCA en Europe. Les résultats de ces expériences n'ont pas été utilisés pour le calcul du TAI en 1991.

3. Exactitude de l'intervalle unitaire du TAI

Le tableau C (texte anglais) donne le décalage de fréquence entre le TAI et l'EAL. La relation entre le TAI et l'EAL a été modifiée quatre fois en 1991, deux fois par un décalage de fréquence de 0,75 x 10^{-14} et deux fois par un décalage de fréquence de 0,5 x 10^{-14}, afin de compenser une dérive de fréquence de l'EAL par rapport aux étalons primaires de la PTB.

4. Echelles de temps etablies retrospectivement

Pour les applications les plus exigeantes, comme le chronométrage des pulsars milliseconde, le BIPM produit des échelles de temps rétrospectivement, désignées par TT(BIPMxx), 1900 + xx étant l'année du calcul [4]. 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.

Les références sont données dans le texte anglais.

PART B

TABLE OF RESULTS

PARTIE B

TABLEAUX DE RESULTATS

TABLE 1. ACRONYMS AND LOCATIONS OF THE COLLABORATING LABORATORIES TO TAI

AOS	Astronomiczne Obserwatorium Szerokościowe, Borowiec, Polska
APL	Applied Physics Laboratory, Laurel, MA, USA
ATC	Australian Telecommunications Commission, Melbourne, Australia
AUS	Consortium of laboratories in Australia
BEV	Bundesamt für Eich - und Vermessungswesen, Wien, Oesterreich
BAO	Beijing Astronomical Observatory, Beijing, P.R. China
CAO	Cagliari Astronomical Observatory , Cagliari, Italia
CH	Consortium of laboratories in Switzerland
CRL	Communications Research Laboratory, Tokyo, Japan
CSAO	Shaanxi Astronomical Observatory, Lintong, P.R. China
DPT	Division of Production Technology, CSIR, Pretoria, South Africa
F	Commission Nationale de l'Heure, Paris, France
FTZ	Fernmeldetechnisches Zentralamt, Darmstadt, Deutschland
IEN	Istituto Elettrotecnico Nazionale Galileo Ferraris, Torino, Italia
IFAG	Institut für Angewandte Geodäsie, Frankfurt am Main, Deutschland
IGMA	Instituto Geografico Militar, Buenos-Aires, Argentina
INPL	National Physical Laboratory, Jerusalem, Israel
INTI	Instituto Nacional de Tecnologia Industrial, Buenos-Aires, Argentina
JATC	Joint Atomic Time Commission, Lintong, P.R. China
KRIS(1)	Korea Research Institute of Standards and Science, Taejon, Rep. of Korea
LDS	The University of Leeds, Leeds, United Kingdom
NAOM	National Astronomical Observatory, Misuzawa, Japan
NIM	National Institute of Metrology, Beijing, P.R. China
NIST	National Institute of Standards and Technology, Boulder, CO, USA
NMC	National Metrological Center, Sofiya, Bulgaria
NML	National Measurement Laboratory, CSIRO, 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
ONRJ	Observatorio Nacional, Rio de Janeiro, Brazil
OP	Observatoire de Paris, Paris, France
ORB	Observatoire Royal de Belgique, Bruxelles, Belgique
ORR	Orroral Observatory, Belconnen, Australia
PEL	Physics and Engineering Laboratory, Lower Hutt, New Zealand
PKNM	Polski Komitet Normalizacji Miar i Jakości, Warszawa, Polska

TABLE 1. ACRONYMS AND LOCATIONS OF THE COLLABORATING LABORATORIES TO TAI (CONT.)

PTB	Physikalisch-Technische Bundesanstalt, Braunschweig, Deutschland
RAO	Radio Astronomical Observatory, Johannesburg, South Africa
RC	Comité Estatal de Normalizacion, Habana, Cuba
RGO	Royal Greenwich Observatory, Cambridge, United Kingdom
ROA	Real Instituto y Observatorio de la Armada, San Fernando, España
SAAO	South African Astronomical Observatory, Cape Town, South Africa
SNT(2)	Swedish National Time and Frequency Laboratory, Stockholm, Sweden
SO	Shanghai Observatory, Shanghai, P.R. China
SU	National Scientific and Research Institute for Physical and Radiotechnical Measurements, VNIIFTRI, Mendeleevo, Federation of Russia
TAO	Tokyo Astronomical Observatory, Tokyo, Japan
TID	Deep Space Communications Center, Tidbinbilla, Australia
TL	Telecommunication Laboratories, Chung-Li, Taiwan, China
TP	Ústav Radiotechniky a Elektroniky ČSAV, Praha, Československo Astronomický ústav ČSAV, Praha, Československo
TUG	Technische Universität, Graz, Oesterreich
USNO	U.S. Naval Observatory, Washington D.C., USA
VSL	Van Swinden Laboratorium, Delft, Nederland
YUZM	Bureau Fédéral des Mesures et Métaux Précieux, Beograd, Yougoslavia
ZIPE(3)	Zentralinstitut Physik der Erde, Potsdam, Deutschland

(1) Formely KSRI
(2) Formely STA
(3) As a consequence of the unification of Germany, the ZIPE stopped its activities on 31 December 1991.

TABLE 2. FREQUENCY OFFSETS AND STEP ADJUSTEMENTS OF UTC, UNTIL 1992 JUNE 30

DATE (AT 0hUTC)	OFFSETS	STEPS	DATE (AT 0hUTC)	OFFSETS	STEPS
1961 Jan. 1	-150×10^{-10}		1972 Jan. 1	0	-0.107 7580 s
1961 Aug. 1	"	+0.050 s	1972 Jul. 1	"	-1 s
	----------		1973 Jan. 1	"	-1 s
1962 Jan. 1	-130×10^{-10}		1974 Jan. 1	"	-1 s
1963 Nov. 1	"	-0.100 s	1975 Jan. 1	"	-1 s
	----------		1976 Jan. 1	"	-1 s
1964 Jan. 1	-150×10^{-10}		1977 Jan. 1	"	-1 s
1964 Apr. 1	"	-0.100 s	1978 Jan. 1	"	-1 s
1964 Sep. 1	"	-0.100 s	1979 Jan. 1	"	-1 s
1965 Jan. 1	"	-0.100 s	1980 Jan. 1	"	-1 s
1965 Mar. 1	"	-0.100 s	1981 Jul. 1	"	-1 s
1965 Jul. 1	"	-0.100 s	1982 Jul. 1	"	-1 s
1965 Sep. 1	"	-0.100 s	1983 Jul. 1	"	-1 s
	----------		1985 Jul. 1	"	-1 s
1966 Jan. 1	-300×10^{-10}		1988 Jan. 1	"	-1 s
1968 Feb. 1	"	+0.100 s	1990 Jan. 1	"	-1 s
			1991 Jan. 1	"	-1 s

TABLE 3. RELATIONSHIP BETWEEN TAI AND UTC, UNTIL 1992 JUNE 30

LIMITS OF VALIDITY (AT 0hUTC)	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 -	26

TABLE 4. LABORATORIES CONTRIBUTING TO TAI IN 1991 : INDEPENDENT LOCAL TIME SCALE TA(K),

(Ind. Cs : industrial Cs Standard, Lab. Cs : laboratory Cs standard,

		Information on TA(k) - UTC(k)	
Laboratory (k)	Equipment in atomic standards	Interval of validity (in MJD at 0hUTC)	TA(k) - UTC(k) in s
AOS	1 Ind. Cs	48257-48285	26.000 040 000
APL	2 Ind. Cs 4 H-Masers	year 1991	26.000 000 507
ATC	7 Ind. Cs		
AUS	Ind.Cs,H-Masers in different australian labs	year 1991	TA(AUS)-UTC(AUS) is sent to the BIPM by ORR
BEV	1 Ind. Cs		
CAO	2 Ind. Cs		
CH	13 Ind. Cs (4)	year 1991	TA(CH)-UTC(CH) is sent to the BIPM
CRL	1 Lab. Cs 11 Ind. Cs 3 H-Masers	year 1991	TA(CRL)-UTC(CRL) is published in CRL Standards Frequency and Time Bulletin
CSAO	5 Ind. Cs 3 H-Masers	year 1991	TA(CSAO)-UTC(CSAO) is published in CSAO Time and Frequency Services Bulletin

EQUIPMENT, SOURCE OF UTC(K) AND RECEPTION OF TIME SIGNALS

H-Maser : Hydrogen Maser)

	Information on time links				
Source of UTC(k) (1)	GPS reception	GLONASS reception	LORAN-C reception (2)	Television link with	Two-way satellite time transfer
1 Cs	*		7970-W	PKNM	
1 H-Maser	*				in a planning stage
1 Cs + microstepper	*			other labs in Australia	in a planning stage
(3)	*			other labs in Australia	in a planning stage
1 Cs			7970-W	OMH, TUG, SU other labs in Czechoslovakia	
1 Cs	*		7990-M 7990-X 7990-Z	IEN, other labs in Italy	
all the Cs	*		7970-W 7990-Z	PTT (4)	
6 Cs	*		9970-M	NRLM, TAO	in a planning stage
all the Cs	*		9970-Y	other labs in China	

TABLE 4. LABORATORIES CONTRIBUTING TO TAI IN 1991 : INDEPENDENT LOCAL TIME SCALE TA(K).

(Ind. Cs : industrial Cs Standard, Lab. Cs : laboratory Cs standard,

		Information on TA(k) - UTC(k)	
Laboratory (k)	Equipment in atomic standards	Interval of validity (in MJD at 0hUTC)	TA(k) - UTC(k) in s
DPT	1 Ind. Cs		
F	23 Ind. Cs (5)	year 1991	TA(F)-UTC(OP) is published in bulletin H by OP (LPTF)
FTZ	5 Ind. Cs		
IEN	5 Ind. Cs		
IFAG	4 Ind. Cs 2 H-Masers		
IGMA	4 Ind. Cs		
INPL	5 Ind. Cs		
JATC	1 Lab. Cs 14 Ind. Cs 6 H-Masers (6)	year 1991	TA(JATC)-UTC(JATC) is sent to the BIPM
KRIS (7)	4 Ind. Cs	year 1991	TA(KRIS)-UTC(KRIS) is sent to the BIPM
LDS	2 Ind. Cs		
NAOM	4 Ind. Cs		

EQUIPMENT, SOURCE OF UTC(K) AND RECEPTION OF TIME SIGNALS (CONT.)

H-Maser : Hydrogen Maser)

	Information on time links				
source of UTC(k) (1)	GPS reception	GLONASS reception	LORAN-C reception (2)	Television link with	Two-way satellite time transfer
1 Cs	*			other labs in South Africa	
see OP					
1 Cs			7970-W		
1 Cs + microstepper	*		7990-Z	CAO, other labs in Italy	
1 Cs + microstepper	*		7970-W		
1 Cs + microstepper	*			ONBA, other labs in Argentina	
4 Cs	*				
1 Cs + microstepper			9970-Y		
all the Cs	*		9970-Y		
1 Cs	* (8)	* (8)			
1 Cs + microstepper	*		9970-M 9970-X		

TABLE 4. LABORATORIES CONTRIBUTING TO TAI IN 1991 : INDEPENDENT LOCAL TIME SCALE TA(K),

(Ind. Cs : industrial Cs Standard, Lab. Cs : laboratory Cs standard,

		Information on TA(k) - UTC(k)	
Laboratory (k)	Equipment in atomic standards	Interval of validity (in MJD at 0hUTC)	TA(k) - UTC(k) in s
NIM	3 Ind. Cs	year 1991	TA(NIM)-UTC(NIM) is sent to the BIPM
NIST	1 Lab. Cs 20 Ind. Cs 1 H-Maser(pas.) 1 H-Maser(act.) (9)	year 1991	TA(NIST)-UTC(NIST) is published in the NIST Time and Frequency Bulletin
NMC	1 Ind. Cs		
NML	3 Ind. Cs 2 H-Masers		
NPL	7 Ind. Cs 1 H-Maser		
NPLI	5 Ind. Cs		
NRC	3 Lab. Cs 1 Ind. Cs	year 1991	25.999 983 931
NRLM	5 Ind. Cs 2 Lab. Cs		
OMH	1 Ind. Cs		
ONBA	2 Ind. Cs		
ONRJ	5 Ind. Cs		

EQUIPMENT, SOURCE OF UTC(K) AND RECEPTION OF TIME SIGNALS (CONT.)

H-Maser : Hydrogen Maser)

	Information on time links				
Source of UTC(k) (1)	GPS reception	GLONASS reception	LORAN-C reception (2)	Television link with	Two-way satellite time transfer
1 Cs + microstepper			9970-Y	other labs in China	
10 Cs 1 Lab. Cs 1 H-Maser	*		9940-M 8970-M		* (10)
1 Cs			7990-Z		
see note (3)	*			other labs in Sydney region	
1 Cs + microstepper	*		7970-W	transmitting station at Rugby	
1 Cs	*				
1 Lab. Cs (11)	*		9960-M		* (10)
1 Cs	*		9970-M 9970-X	CRL, TAO	
1 Cs				BEV, SU, TP	
2 Cs				IGMA other labs in Argentina	
5 Cs	*			other labs in Brasil	

TABLE 4. LABORATORIES CONTRIBUTING TO TAI IN 1991 : INDEPENDENT LOCAL TIME SCALE TA(K),

(Ind. Cs : industrial Cs Standard, Lab. Cs : laboratory Cs standard,

		Information on TA(k) - UTC(k)	
Laboratory (k)	Equipment in atomic standards	Interval of validity (in MJD at 0hUTC)	TA(k) - UTC(k) in s
OP	5 Ind. Cs		see F
ORB	3 Ind. Cs		
ORR	5 Ind. Cs		
PEL	3 Ind. Cs		
PKNM	3 Ind. Cs		
PTB	2 Lab. Cs 9 Ind. Cs 2 H-Masers	year 1991	26.000 363 400
RAO	1 H-Maser		
RC	6 H-Masers	year 1991	TA(RC)-UTC(RC) is sent to the BIPM
ROA	7 Ind. Cs		
SAAO	1 Ind. Cs		

EQUIPMENT, SOURCE OF UTC(K) AND RECEPTION OF TIME SIGNALS (CONT.)

H-Maser : Hydrogen Maser)

	Information on time links				
Source of UTC(k) (1)	GPS reception	GLONASS reception	LORAN-C reception (2)	Television link with	Two-way satellite time transfer
1 Cs	*		7970-W 7990-Z 8940-M	18 labs in France.	
3 Cs (12)	*		7970-W		
	*			other labs in Australia	
1 Cs	*			other labs in New Zealand	
1 Cs + microstepper	*		7970-W (13)	AOS	
1 Cs + microstepper (14)	*		7970-W	TP, ZIPE and other labs	
				DPT	
3 H-Masers			7980-M 7980-Y		
al the Cs	*		7990-Z		
1 Cs	*			other labs in South Africa	

TABLE 4. LABORATORIES CONTRIBUTING TO TAI IN 1991 : INDEPENDENT LOCAL TIME SCALE TA(K),

(Ind. Cs : industrial Cs Standard, Lab. Cs : laboratory Cs standard,

		Information on TA(k) - UTC(k)	
Laboratory (k)	Equipment in atomic standards	Interval of validity (in MJD at 0hUTC)	TA(k) - UTC(k) in s
SNT (15)	3 Ind. Cs		
SO	1 Lab. Cs 3 Ind. Cs 3 H-Masers	year 1991	TA(SO)-UTC(SO) is published in SO Atomic Time Bulletin
SU	2 Lab. Cs 8 H-Masers	year 1991	23.172 750 000
TAO	6 Ind. Cs		
TL	5 Ind. Cs		
TP	2 Ind. Cs		
TUG	3 Ind. Cs		
USNO	45 Ind. Cs 10 H-Masers 3 Prototype Mercury Ion Freq. Std. (18)	year 1991	A.1(MEAN)-UTC(USNO,MC) is sent to the BIPM (19)

EQUIPMENT, SOURCE OF UTC(K) AND RECEPTION OF TIME SIGNALS (CONT.)

H-Maser : Hydrogen Maser)

	Information on time links				
Source of UTC(k) (1)	GPS reception	GLONASS reception	LORAN-C reception (2)	Television link with	Two-way satellite time transfer
1 Cs	*		7970-W	other labs in Sweden	
1 Cs + microstepper	*		9970-Y	other labs in China	
2 Lab. Cs 8 H-Masers	* (16)	*	7990-Y 9970-X	TP, OMH	
1 Cs + microstepper	*		9970-M 9970-Y	CRL, NAOM NRLM	
1 Cs + microstepper	*		9970-Y		
1 Cs + microstepper	*		7970-W	PTB, SU ZIPE,OMH	
1 Cs	*		7970-W 7990-M	BEV	* (17)
UTC(USNO,MC) is an H-Maser + Freq. synthesizer steered to UTC(USNO)	* (20)		(20)	(20)	* (10)

TABLE 4. LABORATORIES CONTRIBUTING TO TAI IN 1991 : INDEPENDENT LOCAL TIME SCALE TA(K),

(Ind. Cs : industrial Cs Standard, Lab. Cs : laboratory Cs standard,

		Information on TA(k) - UTC(k)	
Laboratory (k)	Equipment in atomic standards	Interval of validity (in MJD at 0hUTC)	TA(k) - UTC(k) in s
VSL	4 Ind. Cs		
YUZM	1 Ind. Cs		
ZIPE	1 Ind. Cs		

EQUIPMENT, SOURCE OF UTC(K) AND RECEPTION OF TIME SIGNALS (CONT.)

H-Maser : Hydrogen Maser)

	Information on time links				
Source of UTC(k) (1)	GPS reception	GLONASS reception	LORAN-C reception (2)	Television link with	Two-way satellite time transfer
1 Cs + microstepper	*		7970-M 7970-W 9980-X	15 Labs in Netherlands	* (21)
1 Cs			7990-M		
1 Cs + microstepper	*		7970-W	AOS, TP, PTB	

NOTES

(1) When several clocks are indicated as "source of UTC(k)", laboratory k generally computes a software clock, steered to UTC. Often a physical realization of UTC(k) is obtained using a Cs clock and a microphase-stepper.

(2) LORAN-C stations :

7970-M	Norwegian Sea chain,	Ejde, Denmark
7970-W	" "	Sylt, Germany
7980-M	Southeast USA chain	Malone, Florida, USA
7980-Y	" "	Jupiter,Florida, USA
7990-M	Mediterranean chain,	Sellia Marina, Italy
7990-X	" "	Lampedusa, Italy
7990-Y	" "	Kargabarun, Turkey
7990-Z	" "	Estartit, Spain
8940-M	French chain,	Lessay, France
8970-M	Great Lakes chain,	Dana, Indiana, USA
9940-M	West Coast chain,	Fallon, Nevada, USA
9960-M	Northeast Coast chain,	Seneca, New York, USA
9970-M	Northwest Pacific chain,	Iwo Jima, Japan
9970-X	" "	Hokkaido, Japan
9970-Y	" "	Gesashi, Japan
9980-X	North Atlantic chain	Ejde, Denmark.

(3) UTC(AUS) is the output from a GPS receiver, located at NML, corrected for GPS time (as published by USNO) in order to get UTC(AUS) = UTC(USNO,MC).

(4) The standards are located as follows (at the end of 1991) :

Office Fédéral de Métrologie (Bern)	(OFM)	8 Cs
Observatoire de Neuchâtel (Neuchâtel)	(ON)	3 Cs
Direction Générale des PTT (Bern)	(PTT)	2 Cs.

They are intercompared by LORAN-C (OFM-ON) and TV method (OFM-PTT) and linked to the foreign laboratories through the Swiss Federal Office of Metrology.

NOTES (CONT.)

(5) The standards are located as follows (at the end of 1991) :

Centre Electronique de l'Armement (Rennes)	2 Cs
Centre National d'Etudes Spatiales (CNES)	2 Cs
Centre National d'Etudes des Télécommunications	3 Cs
Observatoire de la Côte d'Azur (OCA)	3 Cs
Electronique Serge Dassault (Trappes)	1 Cs
Hewlett-Packard (Orsay)	2 Cs
Observatoire de Paris : Laboratoire Primaire du Temps et des Fréquences (LPTF)	5 Cs
Observatoire de Besançon (OB)	2 Cs
Laboratoire de Physique et de Métrologie des Oscillateurs (Besançon) (LPMO)	1 Cs
Ecole Nationale Supérieure de Mécanique et des Microtechniques (Besançon) (ENSMM)	1 Cs
Société d'Etudes, Recherches et Constructions Electroniques (Carquefou) (SERCEL).	1 Cs

Links by GPS : OP-OB, OP-SERCEL, OP-OCA, OP-CNES.
Cable links : OB-LPMO, OB-ENSMM.
Other national links by the TV method.

(6) The standards are located at
Shaanxi Astronomical Observatory (CSAO)
Shanghai Astronomical Observatory (SO)
Beijing Astronomical Observatory
Wuhan Time Observatory and
Beijing Institute of Radio Metrology and Measurement.
The time link UTC(JATC)-UTC(CSAO) is obtained by internal connection.

(7) Korea Research Institute of Standards and Science, Taejon Republic of Korea. Formerly KSRI.

(8) Reception of GPS and GLONASS signals on a common receiver.

(9) The laboratory primary standard controls TA(NIST) via an accuracy algorithm. Five of the commercial standards provide the reference for WWV and WWVB and two for GOES satellite time but do not contribute directly to TA(NIST); they are available for NIST time scales back-up and are compared to TA(NIST) to within 0.01 μs. An other independent local time is evaluated by a different algorithm, it is designated as AT1 and appears in the BIPM publications as TA(NISA).

(10) For experimental purposes, two-way satellite time transfer operates between NIST and NRC, and between NIST and USNO.

(11) NRC Cs V was the source of UTC(NRC) in 1991. The relationship between UTC(NRC) and NRC Cs V, with PT designating proper time, is in microseconds :

$$\text{UTC(NRC)} = \text{PT(NRC Cs V)} - 0.00097 \times (\text{MJD}-48043) + 26.854.$$

(12) The source of UTC(ORB) is a Rb clock kept in phase with a mathematical clock, this latter being the mean of 3 Cs corrected for their drift.

NOTES (CONT.)

(13) Reception of Russian LORAN chain 8000.

(14) The two Lab. Cs are operated continuously (primary clocks). TA(PTB) and UTC(PTB) are derived directly from a local oscillator monitored by one of the primary clocks.

(15) Swedish National Time and Frequency Laboratory, Stockholm, Sweden. Formerly STA.

(16) The GPS time receiver located in SU is on loan from the BIPM and was used for experimental purposes in 1991.

(17) For experimental purposes two-way satellite time transfer operated between TUG and OCA (Observatoire de la Côte d'Azur, Grasse, France) till April 1991.

(18) The time scales UTC(USNO) and A.1(MEAN) are computed by USNO. They rely on 20 Cs clocks and 5 H-Masers (used to improve short-term stability).

(19) The time scale A.1(MEAN) computed by USNO is designated as TA(USNO) in the BIPM publications.

(20) The daily time differences (published weekly, Series 4 of USNO) gives the values of UTC(USNO,MC) - transmitting station for :
the LORAN-C chains,
the Washington D.C. TV Station WTTG,
the GPS satellite system.
These data are also available via the Automated Data Service (ADS) and the General Electric Mark III international computer network (RC28 catalog).
The ADS may be accessed on :
202-653-0155 and 202-653-0068,
1200/2400/9600 baud, 8 bits, 1 stop, no parity
modem password : CESIUM133.
Instructions for Internet access :
Telnet to "tycho.usno.navy.mil (192.5.41.239)". Login: "ads".

(21) Two-way satellite time transfer experimental set-up is available at VSL, but was not used in 1991.

TABLE 5. ABSOLUTE TIME COMPARISONS BETWEEN LABORATORIES

5A. CLOCK TRANSPORTATION

Date 1991	MJD	Time Comparison (1 microsecond)	Uncert.	Source of report
Feb 12	48299.07	UTC(CRL)-UTC(TAO) = -0.868	0.005	CRL
Apr 11	48357.05	UTC(CRL)-UTC(TAO) = -0.899	0.005	CRL
May 5	48381.05	UTC(SU)-UTC(RC) = -9.138		SU
Jul 2	48439.04	UTC(CRL)-UTC(TAO) = -1.005	0.005	CRL
Sep 24	48523.15	UTC(SU)-UTC(RC) = -8.361		SU
Oct 30	48559.05	UTC(CRL)-UTC(TAO) = -1.077	0.005	CRL

5B. GPS TIME RECEIVER TRANSPORTATION

Date 1991	MJD	Time Comparison (1 microsecond)	Uncert.	Source of report
Apr 23	48369.00	UTC(OP)-UTC(TUG) = 2.790	0.001	BIPM

TABLE 6. INDEPENDANT LOCAL ATOMIC TIME SCALES

The following table gives the values of TAI-TA(k), where TA(k) denotes the independent atomic time scale established by laboratory k. The values are rounded to 10 ns for the laboratories linked via LORAN-C or television.

Unit is one microsecond.

DATE 1991 0hUTC	MJD	TAI - TA(k)				
		AOS	APL	AUS	CH	CRL
Jan 3	48259	-37.19	-1.191	-32.256	-68.816	1.441
Jan 13	48269	-38.49	-1.275	-32.426	-68.938	1.625
Jan 23	48279	-39.52	-1.269	-32.614	-69.052	1.767
Feb 2	48289	-	-1.309	-32.786	-69.154	1.923
Feb 12	48299	-	-1.321	-32.919	-69.256	2.081
Feb 22	48309	-	-1.325	-33.063	-69.356	2.232
Mar 4	48319	-	-1.311	-33.204	-69.459	2.394
Mar 14	48329	-	-1.326	-33.358	-69.571	2.556
Mar 24	48339	-	-1.398	-33.518	-69.641	2.725
Apr 3	48349	-	-1.427	-33.650	-69.678	2.881
Apr 13	48359	-	-1.458	-33.774	-69.720	3.012
Apr 23	48369	-	-1.480	-33.930	-69.808	3.192
May 3	48379	-	-1.498	-34.090	-69.825	3.344
May 13	48389	-	-1.559	-34.273	-69.830	3.523
May 23	48399	-	-1.590	-34.403	-69.924	3.693
Jun 2	48409	-	-1.628	-34.611	-70.003	3.860
Jun 12	48419	-	-1.607	-34.771	-70.093	4.021
Jun 22	48429	-	-1.606	-34.985	-70.199	4.171
Jul 2	48439	-	-1.626	-35.306	-70.316	4.330
Jul 12	48449	-	-1.631	-35.532	-70.429	4.479
Jul 22	48459	-	-1.702	-35.837	-70.519	4.638
Aug 1	48469	-	-1.713	-35.988	-70.639	4.783
Aug 11	48479	-	-1.654	-36.207	-70.754	4.943
Aug 21	48489	-	-1.601	-36.449	-70.856	5.100
Aug 31	48499	-	-1.669	-36.648	-70.962	5.254
Sep 10	48509	-	-1.698	-36.810	-71.070	5.431
Sep 20	48519	-	-1.688	-37.002	-71.168	5.591
Sep 30	48529	-	-1.683	-37.293	-71.241	5.784
Oct 10	48539	-	-1.724	-37.441	-71.336	6.000
Oct 20	48549	-	-1.703	-37.565	-71.394	6.189
Oct 30	48559	-	-1.706	-37.727	-71.485	6.426
Nov 9	48569	-	-1.665	-37.950	-71.588	6.653
Nov 19	48579	-	-1.631	-38.133	-71.726	6.904
Nov 29	48589	-	-1.626	-38.271	-71.871	7.134
Dec 9	48599	-	-1.592	-38.437	-71.988	7.385
Dec 19	48609	-	-1.568	-38.570	-72.075	7.647
Dec 29	48619	-	-1.516	-38.598	-72.153	7.907

TABLE 6. (CONT.)

Unit is one microsecond.

DATE 1991 0hUTC	MJD	TAI - TA(k) CSAO (1)	F	JATC (2)	KRIS	NIM
Jan 3	48259	26.60	87.598	-0.39	-0.220	-11.56
Jan 13	48269	26.16	87.899	-0.32	-1.220	-11.59
Jan 23	48279	26.00	88.191	-0.25	-2.182	-11.20
Feb 2	48289	25.86	88.476	-0.06	-3.125	-11.14
Feb 12	48299	25.70	88.745	0.14	-4.071	-11.19
Feb 22	48309	25.55	89.020	0.41	-4.969	-11.19
Mar 4	48319	26.164	89.322	0.37	-5.884	-11.28
Mar 14	48329	26.043	89.612	0.51	-6.661	-11.17
Mar 24	48339	25.906	89.941	0.66	-7.351	-11.18
Apr 3	48349	25.758	90.239	0.87	-8.108	-11.18
Apr 13	48359	25.665	90.533	1.16	-8.863	-11.12
Apr 23	48369	25.639	90.815	1.36	-9.625	-10.96
May 3	48379	25.522	91.103	1.49	-10.337	-10.90
May 13	48389	25.445	91.397	1.52	-11.018	-10.82
May 23	48399	25.398	91.683	1.60	-11.754	-10.70
Jun 2	48409	25.375	91.973	1.64	-12.471	-10.72
Jun 12	48419	25.236	92.275	1.98	-13.142	-10.74
Jun 22	48429	25.114	92.582	2.04	-13.847	-10.68
Jul 2	48439	24.988	92.889	2.00	-14.522	-10.78
Jul 12	48449	24.887	93.200	2.06	-15.183	-10.86
Jul 22	48459	24.785	93.519	2.20	-15.841	-10.83
Aug 1	48469	24.706	93.812	2.22	-16.483	-10.75
Aug 11	48479	24.563	94.094	2.33	-17.153	-10.70
Aug 21	48489	24.445	94.381	2.43	-17.785	-10.62
Aug 31	48499	24.457	94.682	2.54	-18.444	-10.56
Sep 10	48509	24.393	94.987	-1.44	-19.111	-10.54
Sep 20	48519	24.231	95.292	-1.34	-19.818	-10.66
Sep 30	48529	24.091	95.618	-1.37	-20.393	-10.56
Oct 10	48539	24.124	95.926	-1.10	-21.000	-10.39
Oct 20	48549	24.004	96.239	-0.91	-21.599	-10.37
Oct 30	48559	23.844	96.545	-0.84	-22.145	-10.26
Nov 9	48569	23.653	96.851	-0.75	-22.697	-10.23
Nov 19	48579	23.551	97.163	-0.54	-23.192	-10.22
Nov 29	48589	23.466	97.450	-0.46	-23.487	-10.07
Dec 9	48599	23.354	97.751	-0.22	-23.800	-10.06
Dec 19	48609	23.140	98.071	-0.25	-24.188	-10.04
Dec 29	48619	23.004	98.387	-0.19	-24.567	-10.09

TABLE 6. (CONT.)

Unit is one microsecond.

DATE 1991 0hUTC	MJD	TAI - TA(k) NISA (3)	NIST	NRC	PTB
Jan 3	48259	-45070.206	-45157.185	16.758	-359.762
Jan 13	48269	-45070.499	-45157.844	16.819	-359.775
Jan 23	48279	-45070.771	-45158.477	16.944	-359.792
Feb 2	48289	-45071.066	-45159.119	16.963	-359.820
Feb 12	48299	-45071.339	-45159.738	16.998	-359.837
Feb 22	48309	-45071.617	-45160.376	17.053	-359.841
Mar 4	48319	-45071.881	-45160.957	17.168	-359.839
Mar 14	48329	-45072.165	-45161.575	17.189	-359.866
Mar 24	48339	-45072.440	-45162.196	17.298	-359.867
Apr 3	48349	-45072.728	-45162.823	17.403	-359.897
Apr 13	48359	-45073.026	-45163.453	17.498	-359.923
Apr 23	48369	-45073.326	-45164.089	17.622	-359.953
May 3	48379	-45073.605	-45164.714	17.761	-359.951
May 13	48389	-45073.891	-45165.350	17.889	-359.954
May 23	48399	-45074.192	-45165.998	17.965	-359.961
Jun 2	48409	-45074.499	-45166.652	17.992	-359.976
Jun 12	48419	-45074.799	-45167.302	18.037	-359.982
Jun 22	48429	-45075.093	-45167.945	18.043	-359.990
Jul 2	48439	-45075.393	-45168.598	18.039	-360.004
Jul 12	48449	-45075.688	-45169.239	18.118	-359.982
Jul 22	48459	-45075.986	-45169.880	18.157	-359.966
Aug 1	48469	-45076.301	-45170.536	18.159	-359.967
Aug 11	48479	-45076.600	-45171.190	18.191	-359.971
Aug 21	48489	-45076.922	-45171.863	18.164	-359.994
Aug 31	48499	-45077.230	-45172.508	18.159	-360.009
Sep 10	48509	-45077.553	-45173.159	18.155	-360.025
Sep 20	48519	-45077.867	-45173.807	18.126	-360.030
Sep 30	48529	-45078.182	-45174.454	18.110	-360.038
Oct 10	48539	-45078.519	-45175.128	18.039	-360.055
Oct 20	48549	-45078.853	-45175.786	18.027	-360.046
Oct 30	48559	-45079.211	-45176.472	17.996	-360.058
Nov 9	48569	-45079.533	-45177.134	17.936	-360.069
Nov 19	48579	-45079.867	-45177.800	17.826	-360.077
Nov 29	48589	-45080.224	-45178.481	17.720	-360.101
Dec 9	48599	-45080.574	-45179.153	17.630	-360.121
Dec 19	48609	-45080.918	-45179.807	17.549	-360.126
Dec 29	48619	-45081.260	-45180.464	17.467	-360.139

TABLE 6. (CONT.)

Unit is one microsecond.

DATE 1991 0hUTC	MJD	TAI - TA(k) RC	SO	SU	USNO (4)
Jan 3	48259	17999725.08	-45.31	2827257.823	-34616.166
Jan 13	48269	-	-45.26	2827257.883	-34616.859
Jan 23	48279	-	-45.24	2827257.778	-34617.524
Feb 2	48289	-	-45.10	2827257.622	-34618.188
Feb 12	48299	17999722.75	-44.88	2827257.451	-34618.905
Feb 22	48309	17999722.05	-44.74	2827257.434	-34619.609
Mar 4	48319	17999721.14	-44.72	2827257.515	-34620.296
Mar 14	48329	17999720.36	-44.69	2827257.396	-34620.964
Mar 24	48339	17999719.91	-44.72	2827257.298	-34621.614
Apr 3	48349	17999718.75	-44.76	2827257.201	-34622.295
Apr 13	48359	17999718.51	-44.60	2827257.085	-34622.941
Apr 23	48369	17999717.80	-44.48	2827256.992	-34623.584
May 3	48379	17999717.32	-44.51	2827256.922	-34624.241
May 13	48389	17999716.80	-44.60	2827256.782	-34624.907
May 23	48399	17999716.05	-44.58	2827256.699	-34625.578
Jun 2	48409	17999715.31	-44.67	2827256.569	-34626.241
Jun 12	48419	17999714.54	-44.50	2827256.485	-34626.905
Jun 22	48429	17999714.01	-44.57	2827256.368	-34627.565
Jul 2	48439	17999713.06	-44.70	2827256.265	-34628.226
Jul 12	48449	17999712.22	-44.70	2827256.130	-34628.895
Jul 22	48459	17999711.42	-44.66	2827256.037	-34629.562
Aug 1	48469	17999710.61	-44.77	2827255.925	-34630.235
Aug 11	48479	17999709.70	-44.85	2827255.762	-34630.908
Aug 21	48489	17999708.84	-44.86	2827255.634	-34631.563
Aug 31	48499	17999707.90	-44.91	2827255.523	-34632.219
Sep 10	48509	17999707.07	-44.93	2827255.473	-34632.891
Sep 20	48519	17999706.01	-45.04	2827255.325	-34633.573
Sep 30	48529	17999705.05	-45.07	2827255.253	-34634.236
Oct 10	48539	17999704.79	-45.01	2827255.152	-34634.922
Oct 20	48549	17999704.61	-45.00	2827255.010	-34635.589
Oct 30	48559	17999704.21	-45.06	2827254.937	-34636.284
Nov 9	48569	17999703.58	-45.10	2827254.854	-34636.951
Nov 19	48579	17999703.39	-45.15	2827254.731	-34637.618
Nov 29	48589	17999703.07	-44.98	2827254.617	-34638.285
Dec 9	48599	17999702.58	-44.86	2827254.551	-34638.953
Dec 19	48609	17999702.42	-44.96	2827254.450	-34639.632
Dec 29	48619	17999702.14	-45.03	2827254.394	-34640.307

TABLE 6. (CONT.)

NOTES

(1) CSAO. Time step of TAI-TA(CSAO) of + 0.791 µs between MJD=48309 and MJD=48319 due to introduction of GPS time link.

(2) JATC. Time step of TAI-TA(JATC) of - 4.115 µs between MJD=48499 and MJD=48509 due to change of time transfer method.

(3) TA(NISA) designates the scale AT1 of NIST.

(4) TA(USNO) designates the scale A1(MEAN) of USNO.

TABLE 7. PRIMARY FREQUENCY STANDARDS USED AS CLOCKS

Five primary frequency standards were used as clocks in 1991: NRC CsV, NRC CsVI A and C, and PTB CS1 and CS2. The following table gives the time differences in microseconds, between TAI and these laboratory standards.

TAI-LAB.STD.

DATE 1991 0hUTC	MJD	PTB (1)		NRC (2)		
		CS1	CS2	CsV	CsVI A	CsVI C
Jan 3	48259	3.637	-0.104	27.333	19.061	16.836
Jan 13	48269	3.623	-0.109	27.384	19.076	16.683
Jan 23	48279	3.608	-0.132	27.500	18.916	16.562
Feb 2	48289	3.581	-0.173	27.509	18.604	16.469
Feb 12	48299	3.561	-0.228	27.534	18.478	16.373
Feb 22	48309	3.557	-0.281	27.579	18.351	16.346
Mar 4	48319	3.559	-0.317	27.684	18.269	16.046
Mar 14	48329	3.532	-0.360	27.694	18.230	15.801
Mar 24	48339	3.531	-0.398	27.796	18.249	15.628
Apr 3	48349	3.501	-0.440	27.891	18.269	15.547
Apr 13	48359	3.476	-0.503	27.976	19.150	15.444
Apr 23	48369	3.445	-0.555	28.090	19.281	15.371
May 3	48379	3.447	-0.571	28.219	19.640	15.304
May 13	48389	3.444	-0.584	28.336	19.691	15.240
May 23	48399	3.437	-0.603	28.403	20.150	15.187
Jun 2	48409	3.422	-0.637	28.421	20.194	15.122
Jun 12	48419	3.416	-0.641	28.458	20.410	15.085
Jun 22	48429	3.408	-0.628	28.453	20.544	15.056
Jul 2	48439	3.394	-0.647	28.443	20.670	15.077
Jul 12	48449	3.416	-0.656	28.512	20.785	15.070
Jul 22	48459	3.432	-0.667	28.541	20.885	14.992
Aug 1	48469	3.431	-0.687	28.534	21.014	14.994
Aug 11	48479	3.427	-0.712	28.555	21.074	14.984
Aug 21	48489	3.404	-0.758	28.519	21.125	14.903
Aug 31	48499	3.389	-0.803	28.504	21.223	14.882
Sep 10	48509	3.373	-0.849	28.490	21.276	14.841
Sep 20	48519	3.368	-0.890	28.452	21.317	14.835
Sep 30	48529	3.360	-0.917	28.426	21.385	14.780
Oct 10	48539	3.343	-0.942	28.346	21.441	14.719
Oct 20	48549	3.352	-0.965	28.323	21.500	14.657
Oct 30	48559	3.355	-0.996	28.283	21.544	14.559
Nov 9	48569	3.362	-1.007	28.214	21.618	14.577
Nov 19	48579	3.346	-1.016	28.094	21.705	14.591
Nov 29	48589	3.333	-1.039	27.978	21.790	14.569
Dec 9	48599	3.336	-1.059	27.879	21.886	14.540
Dec 19	48609	3.349	-1.065	27.789	22.022	14.544
Dec 29	48619	3.347	-1.078	27.696	22.135	14.558

TABLE 7. (CONT.)

NOTES

(1) The time scales under the headings PTB CS1, CS2 are coordinate time scales on the rotating geoid derived from the scales of proper time produced by standards CS1 and CS2 of PTB. The gravitational correction is -0.00066μs/d .

(2) The time scales under the headings NRC Cs V, Cs VI A, Cs VI C, are the scales of proper time PT(NRC Cs V), PT(NRC Cs VI A), PT(NRC Cs VI C), produced directly by primary frequency standards Cs V, Cs VI A and Cs VI C of NRC used as clocks. The gravitational frequency correction to these time scales of proper time to obtain coordinate times on the rotating geoid is -0.00097μs/d .

TABLE 8A. UTC - UTC(k)

The following table gives the values of UTC-UTC(k), where UTC(k) denotes the approximation to UTC kept by laboratory k. The values are rounded to 10 ns for laboratories linked via LORAN-C or television.

Unit is one microsecond.

DATE 1991 0hUTC	MJD	UTC - UTC(k)					
		AOS (1)	APL (2)	AUS	BEV (3)	CAO (4)	CH (5)
Jan 3	48259	2.81	-0.684	0.135	-3.66	1.72	0.671
Jan 13	48269	1.51	-0.768	0.137	-4.33	1.78	0.742
Jan 23	48279	0.48	-0.762	0.123	-5.03	1.75	0.823
Feb 2	48289	-	-0.802	0.096	-5.67	1.64	0.916
Feb 12	48299	-	-0.814	0.083	-6.48	1.62	1.011
Feb 22	48309	-1.12	-0.818	0.074	-7.18	1.71	1.114
Mar 4	48319	-1.46	-0.804	0.090	6.90	1.58	1.212
Mar 14	48329	-2.24	-0.819	0.086	5.44	1.25	1.302
Mar 24	48339	-3.041	-0.891	0.105	-	0.94	1.429
Apr 3	48349	-3.258	-0.920	0.122	2.68	0.42	1.595
Apr 13	48359	-2.315	-0.951	0.127	1.96	-0.35	1.732
Apr 23	48369	-2.947	-0.973	0.154	1.26	-9.923	1.805
May 3	48379	-2.855	-0.991	0.201	0.56	-10.706	1.948
May 13	48389	-2.945	-1.052	0.264	-0.22	-11.000	2.069
May 23	48399	-3.260	-1.083	0.299	-1.00	-11.233	2.080
Jun 2	48409	-3.747	-1.121	0.327	-1.89	-1.666	2.110
Jun 12	48419	-4.261	-1.100	0.351	-2.72	-1.874	2.101
Jun 22	48429	-4.767	-1.099	0.359	-3.53	-2.236	2.051
Jul 2	48439	-	-1.119	0.337	-4.41	-2.596	1.993
Jul 12	48449	-0.824	-1.124	0.309	-5.26	-3.098	1.941
Jul 22	48459	-0.503	-1.195	0.289	-6.09	-3.550	1.911
Aug 1	48469	1.282	-1.206	0.264	-6.82	-4.004	1.848
Aug 11	48479	2.320	-1.147	0.237	-7.58	-4.415	1.788
Aug 21	48489	0.127	-1.094	0.204	-8.52	-4.735	1.743
Aug 31	48499	-0.161	-1.162	0.191	-9.34	-	1.697
Sep 10	48509	-0.384	-1.191	0.163	9.80	-	1.647
Sep 20	48519	-0.677	-1.181	0.144	8.94	-	1.606
Sep 30	48529	-0.562	-1.176	0.139	8.08	-	1.589
Oct 10	48539	-0.377	-1.217	0.128	7.20	-	1.545
Oct 20	48549	-0.341	-1.196	0.143	6.29	-	1.534
Oct 30	48559	0.093	-1.199	0.125	5.52	2.41	1.490
Nov 9	48569	0.613	-1.158	0.154	4.67	1.68	1.442
Nov 19	48579	0.578	-1.124	0.167	3.79	0.82	1.365
Nov 29	48589	0.419	-1.119	0.163	3.06	0.04	1.283
Dec 9	48599	-1.142	-1.085	0.176	2.77	-0.08	1.235
Dec 19	48609	-1.439	-1.061	0.189	2.02	-0.87	1.217
Dec 29	48619	-2.180	-1.009	0.196	1.22	-1.61	1.211

TABLE 8A - (CONT.)

Unit is one microsecond.

DATE 1991 0hUTC	MJD	UTC - UTC(k) CRL	CSAO (6)	DPT	FTZ	IEN (7)	IFAG (8)
Jan 3	48259	1.413	-6.24	-23.563	18.48	0.422	2.687
Jan 13	48269	1.498	-6.48	-23.803	18.68	0.282	2.895
Jan 23	48279	1.564	-6.44	-24.032	18.94	0.150	2.937
Feb 2	48289	1.633	-6.38	-24.294	19.09	0.009	3.012
Feb 12	48299	1.672	-6.34	-24.486	19.23	-0.127	3.310
Feb 22	48309	1.672	-6.29	-24.684	19.40	-0.108	3.694
Mar 4	48319	1.696	-5.477	-24.773	19.56	-0.091	3.982
Mar 14	48329	1.713	-5.398	-24.967	19.62	-0.092	4.265
Mar 24	48339	1.742	-5.335	-25.136	19.72	-0.069	4.427
Apr 3	48349	1.758	-5.282	-25.331	19.83	-0.048	4.842
Apr 13	48359	1.747	-5.176	-25.403	19.95	-0.073	5.142
Apr 23	48369	1.787	-5.001	-25.423	20.11	-0.092	5.370
May 3	48379	1.790	-4.918	-25.492	20.26	-0.090	5.599
May 13	48389	1.828	-4.796	-25.467	20.39	-0.068	5.787
May 23	48399	1.855	-4.642	-25.487	20.56	-0.152	6.042
Jun 2	48409	1.883	-4.466	-25.475	20.69	-0.279	6.253
Jun 12	48419	1.910	-4.405	-25.465	20.78	-0.400	0.595
Jun 22	48429	1.952	-4.327	-25.466	20.89	-0.508	0.953
Jul 2	48439	1.981	-4.253	-25.473	21.01	-0.636	1.288
Jul 12	48449	2.000	-4.154	-25.409	21.14	-0.766	1.318
Jul 22	48459	2.030	-4.056	-25.290	21.30	-0.868	1.342
Aug 1	48469	2.045	-3.935	-25.061	21.51	-0.971	1.566
Aug 11	48479	2.074	-3.878	-24.892	21.68	-1.000	1.408
Aug 21	48489	2.082	-3.796	-24.784	21.78	-0.955	1.534
Aug 31	48499	2.081	-3.584	-24.805	21.90	-0.965	1.614
Sep 10	48509	2.105	-3.448	-24.709	22.17	-0.980	1.671
Sep 20	48519	2.113	-3.410	-24.669	22.42	-1.001	1.739
Sep 30	48529	2.159	-3.350	-24.599	22.44	-1.021	1.749
Oct 10	48539	2.189	-3.097	-24.540	22.59	-1.091	1.782
Oct 20	48549	2.198	-3.017	-24.526	22.77	-1.146	1.760
Oct 30	48559	2.246	-2.977	-24.563	22.91	-1.229	1.588
Nov 9	48569	2.287	-2.988	-24.640	23.00	-1.277	1.519
Nov 19	48579	2.358	-2.890	-24.636	23.06	-1.289	1.475
Nov 29	48589	2.399	-2.775	-24.602	23.22	-1.269	1.401
Dec 9	48599	2.462	-2.687	-24.603	23.18	-1.230	1.498
Dec 19	48609	2.526	-2.701	-24.585	23.18	-1.159	1.408
Dec 29	48619	2.503	-2.637	-24.528	23.31	-1.118	1.391

TABLE 8A - (CONT.)

Unit is one microsecond.

DATE 1991 0hUTC	MJD	UTC - UTC(k)					
		IGMA (9)	INPL (10)	INTI (11)	JATC (12)	KRIS (13)	LDS
Jan 3	48259	0.342	-12.903	-	-19.51	-0.220	-28.896
Jan 13	48269	0.316	-14.023	-	-20.12	-0.340	-30.482
Jan 23	48279	0.247	-15.170	-	-21.49	-0.442	-31.988
Feb 2	48289	0.273	-16.349	-	-22.66	-0.525	-33.559
Feb 12	48299	0.282	-17.542	-	-23.92	-0.621	-35.013
Feb 22	48309	0.381	-18.719	-	-25.11	-0.639	-36.452
Mar 4	48319	0.343	-19.863	-	-25.74	-0.684	-37.861
Mar 14	48329	0.347	-21.030	-	-25.94	-0.511	-39.274
Mar 24	48339	0.377	-22.182	-	-26.20	-0.291	-40.677
Apr 3	48349	0.376	-23.350	-	-26.45	-0.098	-
Apr 13	48359	0.439	-24.534	-	-26.43	0.087	1.749
Apr 23	48369	0.521	-25.728	-	-26.12	0.295	1.008
May 3	48379	0.500	-26.913	-	-25.77	0.533	0.285
May 13	48389	0.462	-28.098	-	-25.32	0.772	-0.681
May 23	48399	0.420	-29.290	-	-25.09	0.926	-1.522
Jun 2	48409	0.365	-30.489	-	-24.99	1.069	-2.256
Jun 12	48419	0.336	-31.699	-	-24.93	1.218	-2.990
Jun 22	48429	0.244	-32.890	-	-24.70	1.233	-3.783
Jul 2	48439	0.120	-34.095	-	-24.70	1.208	-4.550
Jul 12	48449	0.015	-35.310	-	-24.53	1.207	-5.368
Jul 22	48459	-0.066	-36.532	-	-24.28	1.119	-5.953
Aug 1	48469	-0.238	-37.787	-	-24.05	1.027	-6.722
Aug 11	48479	-0.397	-39.038	-	-23.88	0.937	-7.331
Aug 21	48489	-0.534	-0.275	-	-23.64	0.855	-8.043
Aug 31	48499	-0.679	-0.352	-	-23.36	0.706	-8.835
Sep 10	48509	-0.834	-0.441	-	-27.19	0.629	-9.607
Sep 20	48519	-1.013	-0.545	-	-27.07	0.612	-10.399
Sep 30	48529	-1.190	-0.647	-	-26.91	0.627	-11.261
Oct 10	48539	-1.361	-0.762	-	-26.62	0.560	-12.044
Oct 20	48549	-1.443	-0.877	-	-26.57	0.561	-12.737
Oct 30	48559	-1.441	-0.995	-	-26.51	0.615	-13.525
Nov 9	48569	-1.396	-1.119	-	-26.55	0.643	-14.135
Nov 19	48579	-1.370	-1.117	-	-26.46	0.608	-14.694
Nov 29	48589	-1.400	-1.206	-	-26.46	0.563	-15.423
Dec 9	48599	-1.393	-1.329	-	-26.49	0.530	-
Dec 19	48609	-1.396	-1.463	-	-26.63	0.472	-
Dec 29	48619	-1.406	-1.590	-	-26.63	0.413	-

TABLE 8A - (CONT.)

Unit is one microsecond.

DATE 1991 0hUTC	MJD	UTC - UTC(k) NAOM (14)	NIM	NIST	NMC	NPL (15)	NPLI (16)
Jan 3	48259	-6.067	7.31	-0.622	-	-1.102	-30.521
Jan 13	48269	-6.190	7.26	-0.670	-	-1.204	-25.230
Jan 23	48279	-6.350	7.63	-0.697	-	-1.319	-25.016
Feb 2	48289	-6.497	7.66	-0.747	-	-1.467	-
Feb 12	48299	-6.627	7.59	-0.770	-	-1.667	-
Feb 22	48309	-6.762	7.57	-0.797	-	-1.741	-
Mar 4	48319	-6.869	7.46	-0.812	-	-1.778	-
Mar 14	48329	-6.974	7.54	-0.846	-	-1.719	-
Mar 24	48339	-7.071	7.51	-0.871	-	-1.609	-
Apr 3	48349	-7.187	7.49	-0.906	-	-1.559	-
Apr 13	48359	-7.343	7.54	-0.944	-	-1.430	-
Apr 23	48369	-7.467	7.67	-0.984	-	-1.282	-
May 3	48379	-7.580	7.72	-1.000	-	-1.113	-
May 13	48389	-7.686	7.78	-1.011	-	-0.968	-
May 23	48399	-7.803	7.88	-1.037	-	-0.797	-
Jun 2	48409	-7.941	7.85	-1.068	-	-0.634	-
Jun 12	48419	-8.035	7.80	-1.083	-	-0.615	-
Jun 22	48429	-8.160	7.84	-1.092	-	-0.647	-
Jul 2	48439	-8.271	7.73	-1.106	-	-0.626	-
Jul 12	48449	-8.388	7.64	-1.100	-	-0.540	-
Jul 22	48459	-8.509	7.65	-1.098	-	-0.434	-
Aug 1	48469	-8.641	7.71	-1.113	-	-0.349	-
Aug 11	48479	-8.765	7.74	-1.097	-	-0.297	-
Aug 21	48489	-8.914	7.79	-1.104	-	-0.278	-
Aug 31	48499	-9.058	7.83	-1.097	-	-0.173	-
Sep 10	48509	-9.214	7.83	-1.092	-	-0.270	-
Sep 20	48519	-9.323	7.69	-1.076	-	-0.304	-
Sep 30	48529	-9.427	7.77	-1.061	-	-0.403	-
Oct 10	48539	-9.390	7.92	-1.050	-	-0.522	-
Oct 20	48549	-9.187	7.91	-1.034	-	-0.509	4.908
Oct 30	48559	-8.926	8.00	-1.042	-3.96	-0.535	6.061
Nov 9	48569	-8.721	8.00	-0.998	-4.07	-0.449	6.996
Nov 19	48579	-8.514	7.99	-0.962	-4.17	-0.386	8.265
Nov 29	48589	-8.321	8.12	-0.949	-3.74	-0.312	9.945
Dec 9	48599	-8.126	8.12	-0.913	-3.02	-0.228	11.817
Dec 19	48609	-7.927	8.11	-0.867	-2.26	-0.145	13.717
Dec 29	48619	-7.737	8.04	-0.819	-0.91	-0.055	15.498

TABLE 8A - (CONT.)

Unit is one microsecond.

DATE 1991 0hUTC	MJD	UTC - UTC(k) NRC	NRLM	OMH	ONRJ	ONBA (17)	OP
Jan 3	48259	0.689	-22.922	2.22	-	-92.50	-0.289
Jan 13	48269	0.750	-23.605	2.42	-	-93.54	-0.307
Jan 23	48279	0.875	-24.348	2.76	-	-94.77	-0.378
Feb 2	48289	0.894	-25.234	2.29	10.061	-95.90	-0.474
Feb 12	48299	0.929	-26.235	2.21	10.204	-97.18	-0.565
Feb 22	48309	0.984	-27.328	2.21	10.807	-98.55	-0.596
Mar 4	48319	1.099	-28.424	2.34	11.204	-99.78	-0.614
Mar 14	48329	1.120	-29.559	2.38	11.241	-100.85	-0.638
Mar 24	48339	1.229	-30.796	2.61	11.202	-102.08	-0.632
Apr 3	48349	1.334	-32.024	3.52	11.189	-102.98	-0.659
Apr 13	48359	1.429	-33.436	3.75	11.408	-103.40	-0.701
Apr 23	48369	1.553	-34.942	3.90	11.381	-104.74	-0.758
May 3	48379	1.692	-36.627	3.84	11.846	-105.81	-0.801
May 13	48389	1.820	-37.931	3.55	12.590	-107.39	-0.857
May 23	48399	1.896	-39.264	3.35	13.085	-108.58	-0.922
Jun 2	48409	1.923	-40.652	3.34	13.639	-109.89	-0.948
Jun 12	48419	1.968	-42.004	3.21	14.017	-111.14	-0.944
Jun 22	48429	1.974	-43.556	3.21	13.785	-112.55	-0.944
Jul 2	48439	1.970	-45.171	3.30	13.726	-113.87	-0.944
Jul 12	48449	2.049	-46.849	3.22	14.077	-115.15	-0.910
Jul 22	48459	2.088	-48.583	3.12	14.158	-116.41	-0.886
Aug 1	48469	2.090	-50.468	3.15	13.680	-117.73	-0.886
Aug 11	48479	2.122	-52.559	3.09	13.306	-119.01	-0.893
Aug 21	48489	2.095	-54.677	3.38	12.857	-120.32	-0.877
Aug 31	48499	2.090	-56.910	3.21	12.647	-121.49	-0.838
Sep 10	48509	2.086	-59.180	3.16	12.390	-122.73	-0.830
Sep 20	48519	2.057	-61.581	2.88	11.909	-124.05	-0.802
Sep 30	48529	2.041	-64.159	2.84	11.516	-125.45	-0.759
Oct 10	48539	1.970	-67.719	2.93	-	-126.65	-0.712
Oct 20	48549	1.958	-74.474	2.94	-	-128.00	-0.653
Oct 30	48559	1.927	-80.961	2.89	-	-129.29	-0.651
Nov 9	48569	1.867	-87.070	2.78	-	-130.60	-0.675
Nov 19	48579	1.757	-93.232	2.94	-	-131.90	-0.653
Nov 29	48589	1.651	-99.491	2.98	-	-133.17	-0.671
Dec 9	48599	1.561	-106.014	2.65	-	-134.22	-0.709
Dec 19	48609	1.480	-112.622	2.49	-	-135.39	-0.704
Dec 29	48619	1.398	-119.478	-	-	-136.39	-0.679

TABLE 8A - (CONT.)

Unit is one microsecond.

DATE 1991 0hUTC	MJD	UTC - UTC(k) ORB (18)	PEL	PKNM	PTB	RC	ROA
Jan 3	48259	12.828	-	5.70	3.638	-2.75	7.879
Jan 13	48269	13.196	-	5.98	3.625	-	7.881
Jan 23	48279	13.508	-	6.30	3.608	-	7.839
Feb 2	48289	13.848	-	6.68	3.580	-2.96	7.777
Feb 12	48299	14.228	-	6.89	3.563	-2.65	7.668
Feb 22	48309	14.760	-	7.14	3.559	-2.51	7.541
Mar 4	48319	14.893	-	7.26	3.561	-2.56	7.494
Mar 14	48329	15.227	-	6.96	3.534	-2.45	7.436
Mar 24	48339	15.557	-	6.37	3.533	-2.13	7.346
Apr 3	48349	15.947	0.513	5.85	3.503	-2.56	7.247
Apr 13	48359	2.080	0.489	4.10	3.477	-2.19	7.135
Apr 23	48369	1.921	0.552	4.49	3.447	-2.24	7.066
May 3	48379	1.898	0.568	4.04	3.449	-2.05	7.019
May 13	48389	1.877	0.607	3.50	3.446	-1.87	6.929
May 23	48399	1.945	0.592	2.85	3.439	-1.99	6.844
Jun 2	48409	2.015	-	2.33	3.424	-2.05	6.732
Jun 12	48419	2.029	0.436	1.77	3.418	-2.12	6.669
Jun 22	48429	1.948	0.468	1.32	3.410	-1.96	6.588
Jul 2	48439	1.826	0.473	0.83	3.396	-2.22	6.490
Jul 12	48449	1.554	0.324	0.25	3.418	-2.28	6.363
Jul 22	48459	1.526	0.130	-0.33	3.434	-2.30	6.295
Aug 1	48469	1.859	0.055	-0.68	3.433	-2.34	6.276
Aug 11	48479	2.128	-	-0.86	3.429	-2.46	6.281
Aug 21	48489	2.168	-	-1.02	3.406	-2.54	6.242
Aug 31	48499	1.929	-	-0.93	3.391	-2.68	6.194
Sep 10	48509	1.610	-	-0.83	3.375	-2.69	6.039
Sep 20	48519	1.403	-0.752	-0.75	3.370	-2.93	5.944
Sep 30	48529	1.363	-0.810	-0.49	3.362	-3.07	5.870
Oct 10	48539	1.399	-0.984	-0.29	3.345	-3.07	5.828
Oct 20	48549	1.331	-1.042	-0.10	3.354	-2.86	5.533
Oct 30	48559	1.465	-1.118	0.04	3.342	-2.86	5.389
Nov 9	48569	1.502	-1.234	-0.02	3.331	-3.10	5.326
Nov 19	48579	1.615	-1.332	0.04	3.323	-2.68	5.222
Nov 29	48589	1.602	-1.437	-0.09	3.299	-2.35	5.099
Dec 9	48599	1.651	-1.437	0.04	3.279	-2.20	4.978
Dec 19	48609	1.709	-1.491	-0.02	3.274	-2.13	4.878
Dec 29	48619	1.470	-1.379	-0.01	3.261	-2.58	4.772

TABLE 8A - (CONT.)

Unit is one microsecond.

DATE 1991 0hUTC	MJD	UTC - UTC(k) SNT (19)	SO	SU (20)	TAO (21)	TL	TP (22)
Jan 3	48259	-0.154	2.05	7.82	0.758	1.775	1.21
Jan 13	48269	-0.121	2.11	7.88	0.800	1.576	1.26
Jan 23	48279	-0.609	2.12	7.78	0.826	1.339	1.21
Feb 2	48289	-0.833	2.25	7.62	0.833	1.157	1.08
Feb 12	48299	-0.731	2.44	7.45	0.860	0.958	0.80
Feb 22	48309	-0.569	2.57	7.43	0.861	0.966	0.51
Mar 4	48319	-0.368	2.58	7.515	0.898	0.993	0.43
Mar 14	48329	-0.212	2.60	7.396	0.898	1.032	0.38
Mar 24	48339	-0.020	2.61	7.298	0.918	1.099	0.37
Apr 3	48349	0.067	2.60	7.201	0.922	1.286	0.28
Apr 13	48359	0.047	2.77	7.085	0.914	1.478	0.23
Apr 23	48369	0.138	2.90	6.992	0.942	1.634	0.17
May 3	48379	0.218	2.88	6.922	0.951	1.781	0.13
May 13	48389	0.198	2.78	6.782	0.955	1.920	0.06
May 23	48399	0.084	2.78	6.699	0.989	1.943	0.04
Jun 2	48409	0.040	2.70	6.569	0.986	2.058	0.01
Jun 12	48419	0.119	2.89	6.485	1.007	2.100	-0.13
Jun 22	48429	0.254	2.80	6.368	1.012	2.133	-0.18
Jul 2	48439	0.288	2.66	6.265	1.037	2.174	-0.25
Jul 12	48449	0.279	2.67	6.130	1.043	2.266	-0.33
Jul 22	48459	0.335	2.71	6.037	1.066	2.349	-0.47
Aug 1	48469	0.235	2.59	5.925	1.074	2.372	-0.61
Aug 11	48479	0.163	2.52	5.762	1.098	2.402	-0.63
Aug 21	48489	0.174	2.51	5.634	1.122	2.508	-0.62
Aug 31	48499	0.173	2.43	5.523	1.158	2.702	-0.52
Sep 10	48509	0.148	2.44	5.473	1.181	2.831	-0.46
Sep 20	48519	0.052	2.34	5.325	1.183	2.940	-0.521
Sep 30	48529	0.024	2.31	5.253	1.197	2.945	-0.433
Oct 10	48539	-0.003	2.39	5.152	1.211	2.934	-0.435
Oct 20	48549	0.022	2.40	5.010	1.199	2.843	-0.446
Oct 30	48559	0.035	2.37	4.937	1.233	2.819	-0.547
Nov 9	48569	0.042	2.32	4.854	1.249	2.762	-0.630
Nov 19	48579	0.097	2.29	4.731	1.248	2.633	-0.695
Nov 29	48589	0.081	2.44	4.617	1.231	2.516	-0.801
Dec 9	48599	0.124	2.56	4.551	1.236	2.385	-0.949
Dec 19	48609	0.107	2.47	4.450	1.232	2.261	-1.118
Dec 29	48619	0.118	2.40	4.394	1.221	2.112	-1.297

TABLE 8A - (CONT.)

Unit is one microsecond.

DATE 1991 0hUTC	MJD	UTC - UTC(k) TUG (23)	USNO	VSL (24)	YUZM	ZIPE
Jan 3	48259	-4.234	0.135	0.089	27.34	-0.01
Jan 13	48269	-3.947	0.137	0.094	27.20	-0.04
Jan 23	48279	-3.735	0.123	0.211	27.17	-0.07
Feb 2	48289	-3.098	0.096	0.303	27.40	-0.09
Feb 12	48299	-2.522	0.083	0.284	27.43	0.10
Feb 22	48309	-1.814	0.074	0.290	28.14	0.04
Mar 4	48319	-1.209	0.090	0.407	30.88	-0.11
Mar 14	48329	-0.592	0.086	0.429	32.01	-0.23
Mar 24	48339	0.054	0.105	0.443	34.46	-0.41
Apr 3	48349	0.789	0.122	0.538	34.46	-0.41
Apr 13	48359	1.503	0.127	0.590	35.08	-0.31
Apr 23	48369	2.048	0.154	0.625	35.39	-0.18
May 3	48379	2.774	0.201	0.706	33.98	0.05
May 13	48389	3.486	0.264	0.758	33.25	0.16
May 23	48399	4.194	0.299	0.864	33.20	0.21
Jun 2	48409	-4.288	0.327	0.957	32.25	0.08
Jun 12	48419	-3.962	0.351	1.030	31.10	0.00
Jun 22	48429	-3.604	0.359	1.065	32.76	-0.02
Jul 2	48439	-3.286	0.337	1.143	32.52	0.00
Jul 12	48449	-2.942	0.309	1.289	41.78	-0.14
Jul 22	48459	-2.597	0.289	1.359	49.25	-0.29
Aug 1	48469	-2.292	0.264	1.438	48.94	-0.31
Aug 11	48479	-1.969	0.237	1.584	49.75	-0.27
Aug 21	48489	-1.611	0.204	1.684	49.05	-0.22
Aug 31	48499	-1.318	0.191	1.777	50.54	-0.22
Sep 10	48509	-0.984	0.163	1.883	51.72	-0.12
Sep 20	48519	-0.702	0.144	1.950	51.35	-0.11
Sep 30	48529	-0.344	0.139	1.948	51.07	-0.08
Oct 10	48539	-0.018	0.128	1.936	-	-0.10
Oct 20	48549	0.314	0.143	1.944	-	-0.11
Oct 30	48559	0.602	0.125	1.983	-	-0.20
Nov 9	48569	0.924	0.154	2.009	-	-0.14
Nov 19	48579	1.201	0.167	2.049	-	0.07
Nov 29	48589	1.512	0.163	2.113	-	0.25
Dec 9	48599	1.814	0.176	2.248	-	-
Dec 19	48609	2.158	0.189	2.373	-	-
Dec 29	48619	2.532	0.196	2.437	-	-

TABLE 8A. (CONT.)

NOTES

(1) AOS . Introduction of GPS time link on MJD=48339. Change of master clock between MJD=48429 and MJD=48439.

(2) APL . Interpolated value on MJD=48479.

(3) BEV . Time steps of UTC(BEV) of - 15 μs and - 20 μs respectively on MJD=48316.35 and MJD=48508.50
The following table gives the corrected values of UTC-UTC(BEV) from MJD=47699 (1989 Jun 22) to MJD=48249 (1990 Dec 24).

MJD	UTC-UTC(BEV)	MJD	UTC-UTC(BEV)	MJD	UTC-UTC(BEV)
47699	3.56	47889	-	48079	2.48
47709	2.31	47899	-	48089	3.49
47719	1.29	47909	-	48099	-
47729	0.03	47919	-	48109	-
47739	-1.20	47929	-	48119	-
47749	-2.11	47939	-	48129	-
47759	-3.46	47949	-10.19	48139	-
47769	-4.29	47959	-10.53	48149	-
47779	-5.36	47969	-10.93	48159	3.36
47789	-6.56	47979	8.62	48169	2.64
47799	-7.60	47989	8.04	48179	1.93
47809	-8.53	47999	7.38	48189	1.32
47819	-	48009	6.76	48199	0.58
47829	-	48019	6.19	48209	-0.16
47839	-	48029	6.07	48219	-0.86
47849	-	48039	5.31	48229	-1.41
47859	-	48049	4.16	48239	-2.02
47869	-	48059	3.53	48249	-2.82
47879	-	48069	2.80		

(4) CAO . Time step of UTC-UTC(CAO) of - 8.7 μs between MJD=48359 and MJD=48369 due to introduction of GPS time link. Time step of UTC(CAO) of - 10 μs on MJD=48408.3

(5) CH . Change of master clock on MJD=48393.4

(6) CSAO. Time step of UTC-UTC(CSAO) of + 0.791 μs between MJD=48309 and MJD=48319 due to introduction of GPS time link.

(7) IEN . Change of master clock on MJD=48386.

(8) IFAG. Time step of UTC(IFAG) of + 6 μs on MJD=48410.

(9) IGMA. Time step of UTC(IGMA) of + 10 μs on MJD=48257.0

(10) INPL. Time step of UTC(INPL) of - 38.976 μs on MJD=48480.0
The following table gives the corrected values of UTC-UTC(INPL) from MJD=48109 (1990 Aug 6) to MJD=48249 (1990 Dec 24).

MJD	UTC-UTC(INPL)	MJD	UTC-UTC(INPL)	MJD	UTC-UTC(INPL)
48109	5.322	48159	-0.638	48209	-6.649
48119	4.163	48169	-1.859	48219	-7.859
48129	3.008	48179	-3.031	48229	-9.178
48139	1.841	48189	-4.215	48239	-
48149	0.651	48199	-5.425	48249	-

TABLE 8A. (CONT.)

(11) INTI. The following table gives the values of UTC-UTC(INTI) for 1990.
From MJD=47899 to MJD=48119, no data is available.

MJD	UTC-UTC(INTI)	MJD	UTC-UTC(INTI)	MJD	UTC-UTC(INTI)
48129	19.64	48179	-	48229	25.23
48139	20.24	48189	-	48239	27.05
48149	20.83	48199	-	48249	28.96
48159	21.43	48209	-		
48169	22.06	48219	-		

(12) JATC. Time step of UTC-UTC(JATC) of - 4.115 μs between MJD=48499 and MJD=48509 due to change of time transfer method.

(13) KRIS. Formerly KSRI. Change of the source of UTC(KRIS) on MJD=48254

(14) NAOM. Change of master clock on MJD=48529.1

(15) NPL . Change of master clock on MJD=48559.

(16) NPLI. Time step of UTC(NPLI) of - 5 μs on MJD=48259.2

(17) ONBA. The following table gives UTC-UTC(ONBA) for 1990.

MJD	UTC-UTC(ONBA)	MJD	UTC-UTC(ONBA)	MJD	UTC-UTC(ONBA)
47899	-52.37	48019	-66.64	48139	-79.75
47909	-53.86	48029	-68.01	48149	-80.50
47919	-55.22	48039	-69.33	48159	-81.27
47929	-56.29	48049	-70.61	48169	-81.98
47939	-57.44	48059	-72.05	48179	-83.02
47949	-58.35	48069	-72.25	48189	-84.18
47959	-59.59	48079	-73.00	48199	-85.24
47969	-60.73	48089	-74.20	48209	-86.31
47979	-61.80	48099	-75.37	48219	-87.38
47989	-63.04	48109	-76.64	48229	-88.43
47999	-64.09	48119	-77.84	48239	-89.83
48009	-65.37	48129	-79.20	48249	-91.11

(18) ORB . Time step of UTC(ORB) of 14 μs on MJD=48355.25

(19) SNT . Formerly STA.

(20) SU . Time transfer data obtained from GLONASS satellite trackings at the University of Leeds (U.K.) only till MJD=48309 and also at SU from MJD=48319.

(21) TAO . Change of master clock on MJD=48445.

(22) TP . Time step of UTC-UTC(TP) of - 0.108 μs between MJD=48509 and MJD=48519 due to introduction of GPS time link.

(23) TUG . Change of master clock on MJD=48270.651
Time step of UTC(TUG) of 8.938 μs and change of master clock on MJD=48403.50

(24) VSL . Time step of UTC(VSL) of 4 μs on MJD=48256.678

TABLE 8B. TAI - GPS TIME AND UTC - GPS TIME

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

TAI - GPS time = 19s + C0,

where the time difference of 19 seconds is kept constant and C0 is a quantity of the order of a few hundreds 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 1990 January 1, 0hUTC, until 1991 January 1, 0hUTC :

UTC - GPS time = -6s + C0,

from 1991 January 1, 0hUTC:

UTC - GPS time = -7s + C0.

Here C0 is given at 0hUTC every day.

C0 is computed as follows: the GPS data taken at OP are first corrected for the measured ionospheric delays. Then they are smoothed to obtain daily values of UTC(OP) - GPS time at 0hUTC (one different smoothing computation is done for each month). UTC - GPS time is derived from these daily values using linear interpolation of UTC - UTC(OP) from Table 8A.
The r values, also reported here, are the residuals to the smoothed data for the middle of the 13-minute tracking period. They show the quality of the synchronization.

UTC may be derived at any site from observation of any listed satellite, by interpolating C0 to the tracking time. The quality of access to UTC mainly depends upon local conditions of observation.

Notes:
The reference times reported in the following tables are given for the first date of the table only. They correspond to mid-points of 13-minute trackings.

- * corresponds to data rejected in the smoothing.
- \- corresponds to missing data.

TABLE 8B. (CONT.)

r(ns)

Date 1990/91 0hUTC	MJD	C0 (ns)	PRN 3 NAV11 0h56m	PRN11 NAV 8 5h44m	PRN 6 NAV 3 17h12m	PRN12 NAV10 21h12m	PRN13 NAV 9 21h28m
Dec 31	48256	124	-6	-11	7	10	3
Jan 1	48257	129	0	-2	4	-11	-33*
Jan 2	48258	140	-1	-2	-7	-15	16
Jan 3	48259	154	11	-14	1	6	8
Jan 4	48260	163	0	6	7	-16	-9
Jan 5	48261	166	4	-4	-4	-9	-10
Jan 6	48262	172	13	1	5	-2	-9
Jan 7	48263	178	6	4	4	12	-14
Jan 8	48264	179	8	-7	-7	21*	-7
Jan 9	48265	179	-7	-1	16	-14	9
Jan 10	48266	185	-4	5	17	31*	-23
Jan 11	48267	195	-3	1	1	0	-15
Jan 12	48268	203	1	16	14	-18	11
Jan 13	48269	202	-	5	-9	-4	-12
Jan 14	48270	190	-5	2	7	-1	-15
Jan 15	48271	179	-16	15	21	-6	-2
Jan 16	48272	162	4	-10	12	-34*	-22
Jan 17	48273	144	19	4	-16	-15	-11
Jan 18	48274	132	7	9	-4	-3	3
Jan 19	48275	114	6	-6	-9	17	-14
Jan 20	48276	94	-1	-15	9	34*	1
Jan 21	48277	77	7	-5	-8	3	-6
Jan 22	48278	63	1	6	1	2	-10
Jan 23	48279	48	-4	4	-9	6	3
Jan 24	48280	31	5	5	2	-18	-7
Jan 25	48281	22	-4	4	1	17	8
Jan 26	48282	17	2	-14	2	2	-28*
Jan 27	48283	15	5	-1	15	-7	-2
Jan 28	48284	8	7	-11	4	-16	-9
Jan 29	48285	0	4	-4	4	3	-14
Jan 30	48286	-2	5	7	9	-17	-11
Jan 31	48287	-1	-1	6	-3	-11	-2
Feb 1	48288	6	5	13	-5	-5	3

TABLE 8B. (CONT.)

Date 1991 0hUTC	MJD	C0 (ns)	PRN 3 NAV11 22h48m	PRN11 NAV 8 3h40m	PRN 6 NAV 3 15h 8m	PRN12 NAV10 19h 8m	PRN13 NAV 9 19h24m
			r(ns)				
Jan 31	48287	-1	0	6	-2	-11	-1
Feb 1	48288	5	6	14	-4	-5	4
Feb 2	48289	10	0	9	-1	-8	2
Feb 3	48290	10	6	-7	2	-1	6
Feb 4	48291	7	5	-4	-10	2	-10
Feb 5	48292	6	3	2	-7	8	2
Feb 6	48293	9	9	-5	12	-13	-12
Feb 7	48294	14	7	-3	-7	-1	-3
Feb 8	48295	22	10	7	23*	-13	-8
Feb 9	48296	35	8	-5	3	16*	-15
Feb 10	48297	51	7	10	-7	-11	7
Feb 11	48298	64	-2	1	12	-5	-15
Feb 12	48299	72	0	-5	9	8	-22*
Feb 13	48300	84	5	4	-2	23*	-11
Feb 14	48301	96	9	-11	5	-6	5
Feb 15	48302	110	-1	5	-9	-6	-8
Feb 16	48303	123	1	2	7	7	5
Feb 17	48304	129	9	4	-6	-14	1
Feb 18	48305	127	5	-5	9	-6	-22*
Feb 19	48306	129	0	-6	-2	-3	-8
Feb 20	48307	135	-3	7	6	-14	7
Feb 21	48308	141	4	7	0	2	-14
Feb 22	48309	146	2	0	-3	-5	0
Feb 23	48310	149	1	1	0	5	-1
Feb 24	48311	150	-2	8	-9	-10	-1
Feb 25	48312	150	8	6	-3	0	-2
Feb 26	48313	148	4	12	3	-14	-3
Feb 27	48314	146	4	-1	-5	-7	-30*
Feb 28	48315	149	11	-4	-5	0	9
Mar 1	48316	158	14	5	-5	-9	2

TABLE 8B. (CONT.)

Date 1991 0hUTC	MJD	C0 (ns)	r(ns) PRN 3 NAV11 20h56m	PRN11 NAV 8 1h48m	PRN 6 NAV 3 13h16m	PRN12 NAV10 17h16m	PRN13 NAV 9 17h32m
Feb 28	48315	149	11	-3	-5	-1	9
Mar 1	48316	158	13	5	-5	-10	2
Mar 2	48317	166	2	-2	-10	-2	1
Mar 3	48318	174	2	6	-5	-18	4
Mar 4	48319	184	7	6	6	-5	1
Mar 5	48320	190	12	11	-9	-11	-4
Mar 6	48321	187	5	1	-7	-	-12
Mar 7	48322	184	6	3	-6	-30*	9
Mar 8	48323	183	2	3	-9	24*	-6
Mar 9	48324	181	7	7	6	1	-6
Mar 10	48325	175	-3	2	-10	29*	-2
Mar 11	48326	166	7	-5	3	-1	9
Mar 12	48327	158	0	-4	-7	-18	5
Mar 13	48328	148	9	13	-8	-3	-15
Mar 14	48329	142	0	2	-2	-3	3
Mar 15	48330	139	8	3	1	10	-18
Mar 16	48331	134	6	5	0	23*	-18
Mar 17	48332	131	-2	-7	-4	9	-2
Mar 18	48333	130	14	4	2	-27*	-4
Mar 19	48334	125	4	3	-7	-13	-12
Mar 20	48335	115	2	5	5	26*	-15
Mar 21	48336	107	-2	13	-3	-7	0
Mar 22	48337	106	10	2	-7	-5	-3
Mar 23	48338	111	-6	4	6	6	-10
Mar 24	48339	116	5	-3	-4	11	-9
Mar 25	48340	111	2	3	-7	0	6
Mar 26	48341	102	-3	-	1	2	-9
Mar 27	48342	96	2	2	-2	37*	-6
Mar 28	48343	101	4	-8	8	-23*	-7
Mar 29	48344	112	4	5	10	1	-16
Mar 30	48345	120	6	12	-8	12	-4
Mar 31	48346	121	7	6	-12	-15	-8
Apr 1	48347	122	7	12	-1	-15	-25*

TABLE 8B. (CONT.)

Date 1991 0hUTC	MJD	C0 (ns)	PRN 3 NAV11 18h52m	PRN11 NAV 8 23h40m	PRN 6 NAV 3 11h12m	PRN12 NAV10 15h12m	PRN13 NAV 9 15h28m
			r(ns)				
Mar 31	48346	121	7	6	-12	-15	-8
Apr 1	48347	120	9	15	1	-13	-22
Apr 2	48348	128	8	0	-5	13	-8
Apr 3	48349	139	1	2	5	30*	-41*
Apr 4	48350	146	8	7	6	-14	-12
Apr 5	48351	148	1	7	0	-19	-4
Apr 6	48352	148	-5	13	8	-46*	-5
Apr 7	48353	145	-7	6	7	-4	-9
Apr 8	48354	143	9	12	10	-12	-16
Apr 9	48355	144	11	6	1	-2	-18
Apr 10	48356	146	-8	7	6	-12	-1
Apr 11	48357	149	7	4	9	-10	-36*
Apr 12	48358	152	3	-4	2	-42*	-11
Apr 13	48359	158	10	-2	-3	42*	-3
Apr 14	48360	164	2	6	2	9	-8
Apr 15	48361	168	-6	8	10	-10	-17
Apr 16	48362	170	8	2	3	13	-11
Apr 17	48363	176	-1	-4	-3	-29*	-11
Apr 18	48364	183	10	9	-1	-5	5
Apr 19	48365	188	4	-2	0	-1	-14
Apr 20	48366	190	9	2	7	4	-21
Apr 21	48367	191	0	8	6	31*	-15
Apr 22	48368	193	6	-3	-2	-25*	6
Apr 23	48369	193	5	2	4	-6	-9
Apr 24	48370	193	-1	19	-5	1	-18
Apr 25	48371	193	-22*	-11	-	-7	7
Apr 26	48372	194	13	-	5	-20	-3
Apr 27	48373	198	-	-	-	-	-
Apr 28	48374	202	-	-	-	-	-
Apr 29	48375	203	1	-6	7	5	-9
Apr 30	48376	205	14	-5	-1	-11	-6
May 1	48377	213	16	6	1	4	-15

TABLE 8B. (CONT.)

Date 1991 0hUTC	MJD	C0 (ns)	r(ns) PRN 3 NAV11 16h52m	PRN11 NAV 8 21h40m	PRN 6 NAV 3 9h12m	PRN12 NAV10 13h12m	PRN13 NAV 9 13h28m
Apr 30	48376	205	14	-5	0	-11	-6
May 1	48377	213	16	6	1	4	-15
May 2	48378	218	11	2	8	-10	-20
May 3	48379	221	2	6	-6	-4	-2
May 4	48380	223	9	8	-4	-8	-13
May 5	48381	230	-1	-2	0	-4	4
May 6	48382	240	11	8	5	-1	-11
May 7	48383	248	3	-1	-6	6	0
May 8	48384	255	-3	1	-11	-16	-11
May 9	48385	266	7	11	-1	15	6
May 10	48386	277	-4	-1	-6	-	-14
May 11	48387	282	1	10	-7	9	-21
May 12	48388	291	6	1	2	18	-16
May 13	48389	300	1	7	-5	-26*	-6
May 14	48390	307	3	-3	-16	17	13*
May 15	48391	308	8	12	-1	29*	-18
May 16	48392	304	4	-4	-7	6	2
May 17	48393	297	9	-10	-2	-10	-14
May 18	48394	297	4	12	4	-25*	5
May 19	48395	302	9	6	-5	-11	-15
May 20	48396	307	4	17	13	-12	-10
May 21	48397	306	-5	-1	2	-6	-10
May 22	48398	307	1	4	-12	15	0
May 23	48399	311	6	0	-14	13	-2
May 24	48400	317	-	-	-	-1	-1
May 25	48401	320	7	11	-15	-8	-16
May 26	48402	332	9	2	-6	14	-25
May 27	48403	347	-1	11	-7	-24*	-1
May 28	48404	355	6	2	-5	-9	5
May 29	48405	358	3	-	-	-4	-22
May 30	48406	366	8	3	6	27*	-1
May 31	48407	373	4	11	-4	-23*	-20
Jun 1	48408	377	8	5	7	-17	-9

TABLE 8B. (CONT.)

Date 1991 0hUTC	MJD	C0 (ns)	r(ns) PRN 3 NAV11 14h48m	PRN11 NAV 8 19h36m	PRN 6 NAV 3 7h 8m	PRN12 NAV10 11h 8m	PRN13 NAV 9 11h24m
May 31	48407	371	6	13	-2	-21	-18
Jun 1	48408	375	8	5	8	-16	-9
Jun 2	48409	376	6	8	-5	9	-18
Jun 3	48410	374	4	9	-6	-22	3
Jun 4	48411	370	4	7	-3	21*	-8
Jun 5	48412	365	8	11	-9	2	-14
Jun 6	48413	362	2	31*	-10	-13	-10
Jun 7	48414	359	6	8	-9	-36*	12
Jun 8	48415	355	-4	23	-11	-9	-19
Jun 9	48416	356	2	11	-7	0	-13
Jun 10	48417	360	2	6	-12	4	6
Jun 11	48418	365	7	2	-4	-34*	-42*
Jun 12	48419	369	1	0	-4	-14	-4
Jun 13	48420	374	0	1	12	8	-10
Jun 14	48421	379	-7	10	-3	-15	-2
Jun 15	48422	383	4	-4	6	11	3
Jun 16	48423	382	1	17	13	-22	-20
Jun 17	48424	381	0	-18*	3	22*	-7
Jun 18	48425	382	0	1	1	-1	2
Jun 19	48426	380	-9	20	-8	24*	-11
Jun 20	48427	379	5	8	1	-20	3
Jun 21	48428	378	-3	13	9	-14	-10
Jun 22	48429	376	-1	2	32*	-5	-4
Jun 23	48430	375	-3	10	0	9	-3
Jun 24	48431	373	-4	6	-	-7	-
Jun 25	48432	370	5	4	-	5	-
Jun 26	48433	369	1	-	-	-	-19

Date 1991 0hUTC	MJD	C0 (ns)	r(ns) PRN 6 NAV 3 7h36m	PRN12 NAV10 9h12m	PRN 3 NAV11 12h56m	PRN11 NAV 8 17h28m	PRN13 NAV 9 23h36m
Jun 27	48434	380	-	-	2	-3	-7
Jun 28	48435	374	-	-	5	1	9
Jun 29	48436	362	-	15	-	-19	-13
Jun 30	48437	351	-9	4	7	-14	8
Jul 1	48438	347	-15	15	2	12	2

TABLE 8B. (CONT.)

Date 1991 0hUTC	MJD	C0 (ns)	r(ns) PRN 6 NAV 3 7h24m	PRN12 NAV10 9h 0m	PRN 3 NAV11 12h44m	PRN11 NAV 8 17h16m	PRN13 NAV 9 23h24m
Jun 30	48437	353	-11	3	6	-15	8
Jul 1	48438	347	-15	16	3	13	3
Jul 2	48439	347	14	-23	6	2	-3
Jul 3	48440	349	9	-5	-4	7	-14
Jul 4	48441	352	21	20	-3	4	-9
Jul 5	48442	353	19	3	-4	10	-9
Jul 6	48443	354	45*	-24	5	-4	-1
Jul 7	48444	357	23	12	-10	-4	-
Jul 8	48445	360	35*	-30*	0	12	-
Jul 9	48446	358	15	-15	-6	-8	-8
Jul 10	48447	351	9	23*	-1	-4	-7
Jul 11	48448	346	31	12	-5	10	-18
Jul 12	48449	341	23	-22	-7	-9	-2
Jul 13	48450	347	24	-6	24	-7	-4
Jul 14	48451	361	-21*	-43*	0	-18	1
Jul 15	48452	374	11	-	6	-7	-2
Jul 16	48453	384	-1	-	9	8	0
Jul 17	48454	385	9	-	4	-9	-12
Jul 18	48455	383	40*	-11	4	9	0
Jul 19	48456	386	6	1	2	2	-4
Jul 20	48457	390	5	-7	12	-8	-10
Jul 21	48458	395	14	8	-3	8	-2
Jul 22	48459	396	-	5	-7	-6	5
Jul 23	48460	390	-	-	-3	13	7
Jul 24	48461	377	-	-21	-1	6	-3
Jul 25	48462	365	-	1	-2	-1	-3
Jul 26	48463	356	-	5	0	2	-6
Jul 27	48464	350	-	-12	11	10	-6
Jul 28	48465	343	-	-13	12	-	-10
Jul 29	48466	334	-	-18	-3	5	1
Jul 30	48467	326	1	12	9	3	-17
Jul 31	48468	317	-	-	5	6	-14
Aug 1	48469	307	-9	14	-8	3	-3

TABLE 8B. (CONT.)

r(ns)

Date 1991 0hUTC	MJD	C0 (ns)	PRN 6 NAV 3 5h20m	PRN12 NAV10 6h56m	PRN 3 NAV11 10h40m	PRN11 NAV 8 15h12m	PRN13 NAV 9 21h20m
Jul 31	48468	317	-	-	5	6	-14
Aug 1	48469	306	-9	14	-8	3	-3
Aug 2	48470	298	-	-10	10	5	-4
Aug 3	48471	289	-28*	-5	-2	1	7
Aug 4	48472	279	8	22*	-	2	-15
Aug 5	48473	269	-2	-27*	-9	15	11
Aug 6	48474	262	6	-26*	4	2	-9
Aug 7	48475	254	8	-11	1	9	5
Aug 8	48476	243	-17	8	-5	4	-4
Aug 9	48477	234	-6	-4	5	6	-21
Aug 10	48478	227	-3	4	10	11	1
Aug 11	48479	223	1	-18	1	1	-2
Aug 12	48480	227	-7	-2	3	1	-4
Aug 13	48481	235	-14	-10	4	9	-6
Aug 14	48482	248	8	16	1	-5	-9
Aug 15	48483	254	15	7	-4	2	-6
Aug 16	48484	257	-9	31*	4	8	-10
Aug 17	48485	259	10	-6	7	-2	4
Aug 18	48486	258	0	-22*	3	6	-4
Aug 19	48487	255	-2	-15	-5	9	-2
Aug 20	48488	250	10	-12	5	2	0
Aug 21	48489	245	-3	9	-3	-4	3
Aug 22	48490	240	2	-33*	3	8	-15
Aug 23	48491	234	-	-	-	9	-5
Aug 24	48492	230	7	33*	-2	8	-1
Aug 25	48493	223	-9	2	2	9	4
Aug 26	48494	212	-9	-6	-9	11	-7
Aug 27	48495	204	-1	32*	7	9	-15
Aug 28	48496	205	-12	-1	6	11	-15
Aug 29	48497	211	12	4	10	2	-3
Aug 30	48498	212	-8	10	7	-7	-3
Aug 31	48499	208	-5	-6	-5	0	-4
Sep 1	48500	207	-8	-27*	5	4	-3

TABLE 8B. (CONT.)

r(ns)

Date 1991 0hUTC	MJD	C0 (ns)	PRN 6 NAV 3 3h16m	PRN12 NAV10 4h52m	PRN 3 NAV11 8h36m	PRN11 NAV 8 13h 8m	PRN13 NAV 9 19h16m
Aug 31	48499	208	-5	-6	-5	0	-5
Sep 1	48500	208	-9	-28*	4	3	-4
Sep 2	48501	215	5	20*	6	2	-3
Sep 3	48502	218	5	-29*	-1	8	-8
Sep 4	48503	219	-4	-2	-1	3	-8
Sep 5	48504	221	-2	-21*	11	-5	-8
Sep 6	48505	227	-3	8	4	7	-12
Sep 7	48506	231	-4	2	1	-1	4
Sep 8	48507	231	-16	-20*	5	0	-20*
Sep 9	48508	229	-2	3	-1	14	2
Sep 10	48509	224	-11	-15*	11	-8	-10
Sep 11	48510	219	-15	-32*	3	3	-3
Sep 12	48511	214	-14	-2	11	0	0
Sep 13	48512	209	3	40*	1	3	-18
Sep 14	48513	205	-1	23*	12	11	-17
Sep 15	48514	203	4	-45*	8	-2	-6
Sep 16	48515	200	4	-26*	-1	4	-1
Sep 17	48516	195	6	24*	5	6	-8
Sep 18	48517	185	0	-1	-1	-1	-11
Sep 19	48518	177	-3	12	4	-3	-13
Sep 20	48519	171	-2	4	7	4	4
Sep 21	48520	164	-4	22*	2	7	-13
Sep 22	48521	155	-12	-2	-6	2	2
Sep 23	48522	150	5	8	9	0	-9
Sep 24	48523	148	11	7	-2	3	-3
Sep 25	48524	150	-3	-4	-3	5	-4
Sep 26	48525	155	9	-30*	5	-4	-9
Sep 27	48526	164	0	-1	-1	6	-7
Sep 28	48527	172	3	15	6	-5	-6
Sep 29	48528	177	-5	-49*	5	-11	-11
Sep 30	48529	179	-3	-2	5	10	-1
Oct 1	48530	179	0	5	2	-7	-6

TABLE 8B. (CONT.)

Date 1991 0hUTC	MJD	C0 (ns)	r(ns) PRN 6 NAV 3 1h16m	PRN12 NAV10 2h52m	PRN 3 NAV11 6h36m	PRN11 NAV 8 11h 8m	PRN13 NAV 9 17h16m
Sep 30	48529	179	-3	-2	5	10	-1
Oct 1	48530	179	0	5	2	-7	-6
Oct 2	48531	176	-6	-32*	3	-6	-2
Oct 3	48532	177	-3	3	3	5	-4
Oct 4	48533	178	-9	29*	8	-4	-8
Oct 5	48534	175	3	-4	5	4	-5
Oct 6	48535	167	0	12	-2	7	-8
Oct 7	48536	159	-5	-15	-1	2	-9
Oct 8	48537	155	3	18*	11	-1	-5
Oct 9	48538	151	8	-25*	6	12	-11
Oct 10	48539	146	2	-15	4	-1	-14
Oct 11	48540	143	-12	11	3	7	0
Oct 12	48541	141	-6	-13	8	7	-2
Oct 13	48542	137	5	-13	7	-8	-7
Oct 14	48543	137	-3	8	-1	0	-1
Oct 15	48544	141	-4	-45*	-4	2	1
Oct 16	48545	143	-2	6	8	9	1
Oct 17	48546	143	-	-	-6	-10	14*
Oct 18	48547	148	-	-	-	6	-
Oct 19	48548	162	-	-	-	-6	5
Oct 20	48549	180	-	-	-27*	-	-
Oct 21	48550	187	-	-	-	-	-
Oct 22	48551	189	-	-	-1	-	-
Oct 23	48552	191	-	-	4	9	-
Oct 24	48553	191	7	-	-5	30*	6
Oct 25	48554	192	6	29*	-10	13	-11
Oct 26	48555	194	-4	-3	14	5	-8
Oct 27	48556	193	-6	-39*	8	-12	10
Oct 28	48557	190	3	-32*	-5	-6	-2
Oct 29	48558	186	-12	-1	9	8	-9
Oct 30	48559	184	6	-9	3	-3	-3
Oct 31	48560	182	5	-7	3	2	-2
Nov 1	48561	179	3	13	6	0	-6

TABLE 8B. (CONT.)

r(ns)

Date 1991 0hUTC	MJD	C0 (ns)	PRN 6 NAV 3 23h 8m	PRN12 NAV10 0h48m	PRN 3 NAV11 4h32m	PRN11 NAV 8 9h 4m	PRN13 NAV 9 15h12m
Oct 31	48560	182	5	-7	3	2	-2
Nov 1	48561	179	2	13	6	-1	-6
Nov 2	48562	175	3	-18	9	2	-1
Nov 3	48563	172	2	-12	1	3	-2
Nov 4	48564	170	-8	-8	11	4	-5
Nov 5	48565	165	5	-16	7	-5	-5
Nov 6	48566	162	-7	14	-6	-6	-6
Nov 7	48567	166	2	-33*	3	-3	-1
Nov 8	48568	171	-2	2	7	6	3
Nov 9	48569	176	-6	-20	-4	0	4
Nov 10	48570	189	1	-16	10	-4	4
Nov 11	48571	205	-7	-	4	-2	1
Nov 12	48572	219	11	-42*	7	-2	-1
Nov 13	48573	225	5	-27*	0	-6	5
Nov 14	48574	226	-8	-9	9	-8	-2
Nov 15	48575	228	-2	-11	4	9	-7
Nov 16	48576	231	-7	-1	14	5	5
Nov 17	48577	232	5	-7	6	1	-8
Nov 18	48578	228	-12	-23*	3	-7	2
Nov 19	48579	224	-6	11	5	3	7
Nov 20	48580	217	18*	-8	4	-11	-11
Nov 21	48581	215	-1	-4	-1	10	9
Nov 22	48582	218	0	-30*	-3	-5	6
Nov 23	48583	217	-3	9	7	-1	-12
Nov 24	48584	210	5	-5	0	-2	2
Nov 25	48585	199	-	-34*	-3	-3	-4
Nov 26	48586	192	-29*	-8	5	7	6
Nov 27	48587	191	-2	6	-10	2	-7
Nov 28	48588	193	-9	10	2	8	1
Nov 29	48589	195	-10	-33*	-6	-16	-23*
Nov 30	48590	195	-9	10	8	-28*	-3
Dec 1	48591	194	-11	-27*	-2	6	-2

TABLE 8B. (CONT.)

Date 1991 0hUTC	MJD	C0 (ns)	r(ns) PRN 6 NAV 3 21h 8m	PRN12 NAV10 22h44m	PRN 3 NAV11 2h32m	PRN11 NAV 8 7h 4m	PRN13 NAV 9 13h12m
Nov 30	48590	195	-9	10	8	-28*	-2
Dec 1	48591	194	-11	-26*	-2	7	-2
Dec 2	48592	193	1	6	-3	-1	-3
Dec 3	48593	197	-8	-11	3	-4	-1
Dec 4	48594	207	-1	-7	2	12	18
Dec 5	48595	219	-11	-47*	1	-1	-4
Dec 6	48596	228	15*	-38*	-4	10	1
Dec 7	48597	234	-6	-32*	9	-4	-4
Dec 8	48598	239	0	8	-11	0	11
Dec 9	48599	244	-7	6	-1	8	8
Dec 10	48600	251	-14	-3	-2	-9	-11
Dec 11	48601	253	2	-33*	6	-9	17
Dec 12	48602	252	-	-	8	-5	-6

Date 1991/92 0hUTC	MJD	C0 (ns)	r(ns) PRN 3 NAV11 1h28m	PRN11 NAV 8 6h 0m	PRN13 NAV 9 11h52m	PRN 6 NAV 3 17h28m	PRN12 NAV10 20h24m
Dec 13	48603	247	-5	10	-7	7	-16
Dec 14	48604	248	-6	4	4	3	1
Dec 15	48605	246	1	1	-36*	-2	-29*
Dec 16	48606	243	-10	-9	4	10	28*
Dec 17	48607	240	-2	-1	-2	0	-6
Dec 18	48608	242	-1	8	4	-2	-18
Dec 19	48609	242	-4	-1	13	8	-8
Dec 20	48610	241	1	-3	4	13	-18
Dec 21	48611	236	-1	-4	-9	7	4
Dec 22	48612	233	-7	2	0	23*	18*
Dec 23	48613	231	4	8	-1	0	-10
Dec 24	48614	229	-2	-5	14	7	-22
Dec 25	48615	228	-5	0	9	2	-18
Dec 26	48616	232	2	-5	1	-5	2
Dec 27	48617	237	5	-7	19	4	-4
Dec 28	48618	241	-11	4	-26*	-3	-51*
Dec 29	48619	240	6	-9	3	2	27*
Dec 30	48620	236	-4	-1	-2	-5	12
Dec 31	48621	235	0	2	19	-12	3
Jan 1	48622	234	-3	-15	2	8	-30*

TABLE 8C. COMPLEMENT TO TABLE 8B

The following tables give the residuals r computed from the observation of Block II satellites, with respect to the smoothed data UTC - GPS time obtained from Block I satellites only. The C0 values reported here, are already given in Table 8B.

The following tables give the evidence of the turning on or off of Selective Availability on Block II satellites.

Note: all Block II satellites were declared unusable for two testing periods, from 22 Nov 91 0hUTC to 25 Nov 91 0hUTC, and from 29 Nov 91 0hUTC to 1 Dec 91 0hUTC.

			r(ns)				
Date 1990/91 0hUTC	MJD	C0 (ns)	PRN17 NAV17 4h40m	PRN21 NAV21 5h12m	PRN15 NAV15 7h20m	PRN14 NAV14 9h44m	PRN18 NAV18 11h52m
Dec 31	48256	124	-9	13	24	12	13
Jan 1	48257	129	-2	5	19	-15	-10
Jan 2	48258	140	9	18	14	9	-5
Jan 3	48259	154	-15	9	27	-9	3
Jan 4	48260	163	0	-1	35	-14	-11
Jan 5	48261	166	-20	11	19	-6	-15
Jan 6	48262	172	-13	16	15	-2	5
Jan 7	48263	178	-13	4	26	6	-13
Jan 8	48264	179	-15	11	29	-8	3
Jan 9	48265	179	4	21	25	8	9
Jan 10	48266	185	6	7	24	-2	6
Jan 11	48267	195	-27	5	9	-19	5
Jan 12	48268	203	-18	-3	19	-15	-12
Jan 13	48269	202	2	9	16	-12	-1
Jan 14	48270	190	-27	3	11	-6	-3
Jan 15	48271	179	-12	14	27	0	2
Jan 16	48272	162	3	35	24	11	10
Jan 17	48273	144	-18	4	29	-5	4
Jan 18	48274	132	-14	8	4	-11	-8
Jan 19	48275	114	-20	7	24	-1	6
Jan 20	48276	94	-14	-7	18	-20	-5
Jan 21	48277	77	-17	18	13	2	-4
Jan 22	48278	63	-24	9	19	-16	-3
Jan 23	48279	48	-9	-2	10	5	-16
Jan 24	48280	31	-5	4	7	-23	-11
Jan 25	48281	22	-1	-6	14	-10	-9
Jan 26	48282	17	-22	5	-3	1	10
Jan 27	48283	15	-13	7	14	-7	-21
Jan 28	48284	8	5	13	22	-1	9
Jan 29	48285	0	-12	10	-7	5	-1
Jan 30	48286	-2	-17	5	4	-16	-7
Jan 31	48287	-1	-17	10	13	-6	4
Feb 1	48288	6	-1	19	10	2	-5

TABLE 8C. (CONT.)

Date 1990/91 0hUTC	MJD	C0 (ns)	r(ns) PRN16 NAV16 15h36m	PRN 2 NAV13 18h48m	PRN20 NAV20 22h16m
Dec 31	48256	124	6	13	-1
Jan 1	48257	129	7	2	9
Jan 2	48258	140	6	7	5
Jan 3	48259	154	0	14	7
Jan 4	48260	163	1	0	3
Jan 5	48261	166	-7	8	6
Jan 6	48262	172	2	7	1
Jan 7	48263	178	-	18	3
Jan 8	48264	179	-	11	-9
Jan 9	48265	179	-10	5	-6
Jan 10	48266	185	-31	-3	3
Jan 11	48267	195	-18	-1	-1
Jan 12	48268	203	-23	1	-4
Jan 13	48269	202	2	12	-15
Jan 14	48270	190	-21	-9	-2
Jan 15	48271	179	3	18	12
Jan 16	48272	162	4	28	5
Jan 17	48273	144	-14	-9	3
Jan 18	48274	132	2	9	2
Jan 19	48275	114	-15	14	-7
Jan 20	48276	94	-15	12	0
Jan 21	48277	77	-9	-8	2
Jan 22	48278	63	-9	2	-11
Jan 23	48279	48	12	4	-11
Jan 24	48280	31	-14	3	-6
Jan 25	48281	22	-11	0	-2
Jan 26	48282	17	-3	12	6
Jan 27	48283	15	-10	7	6
Jan 28	48284	8	-11	12	-1
Jan 29	48285	0	-10	2	-7
Jan 30	48286	-2	-11	-10	-12
Jan 31	48287	-1	0	13	0
Feb 1	48288	6	6	-1	13

TABLE 8C. (CONT.)

Date 1991 0hUTC	MJD	C0 (ns)	r(ns) PRN17 NAV17 2h36m	PRN21 NAV21 3h 8m	PRN15 NAV15 5h16m	PRN14 NAV14 7h40m	PRN18 NAV18 9h48m
Jan 31	48287	-1	-17	9	12	-6	4
Feb 1	48288	5	-2	18	9	1	-6
Feb 2	48289	10	-4	11	14	-4	-3
Feb 3	48290	10	-2	6	37	4	-2
Feb 4	48291	7	-13	16	50	10	1
Feb 5	48292	6	-5	3	3	-13	-14
Feb 6	48293	9	-1	4	18	0	-17
Feb 7	48294	14	-3	6	4	-7	-14
Feb 8	48295	22	-	5	16	5	8
Feb 9	48296	35	2	12	16	5	-2
Feb 10	48297	51	-9	12	6	5	2
Feb 11	48298	64	5	16	16	-8	-3
Feb 12	48299	72	-14	7	12	15	17
Feb 13	48300	84	-	10	1	-3	-7
Feb 14	48301	96	3	1	18	5	-4
Feb 15	48302	110	-7	12	13	10	5
Feb 16	48303	123	0	6	16	-3	2
Feb 17	48304	129	10	5	31	10	2
Feb 18	48305	127	14	32	18	-4	-12
Feb 19	48306	129	-11	4	2	5	-3
Feb 20	48307	135	0	3	30	5	-4
Feb 21	48308	141	-7	7	38	-3	3
Feb 22	48309	146	12	6	10	9	-2
Feb 23	48310	149	2	5	10	4	8
Feb 24	48311	150	-10	12	23	1	-7
Feb 25	48312	150	-7	3	9	-6	4
Feb 26	48313	148	-5	14	8	-4	-4
Feb 27	48314	146	-11	23	15	18	11
Feb 28	48315	149	-6	-2	4	-1	-1
Mar 1	48316	158	-20	19	23	-8	-3

TABLE 8C. (CONT.)

Date 1991 0hUTC	MJD	C0 (ns)	r(ns) PRN16 NAV16 13h32m	PRN 2 NAV13 16h44m	PRN20 NAV20 20h12m
Jan 31	48287	-1	-1	12	-1
Feb 1	48288	5	5	-2	12
Feb 2	48289	10	0	23	-1
Feb 3	48290	10	13	3	2
Feb 4	48291	7	-17	10	-9
Feb 5	48292	6	-7	4	-4
Feb 6	48293	9	5	0	-1
Feb 7	48294	14	3	13	-1
Feb 8	48295	22	-15	6	7
Feb 9	48296	35	1	-6	0
Feb 10	48297	51	-9	4	-1
Feb 11	48298	64	-4	17	2
Feb 12	48299	72	-10	9	6
Feb 13	48300	84	7	-3	-6
Feb 14	48301	96	-17	13	6
Feb 15	48302	110	-9	-6	-12
Feb 16	48303	123	4	20	2
Feb 17	48304	129	5	16	13
Feb 18	48305	127	-9	15	-5
Feb 19	48306	129	-8	-4	6
Feb 20	48307	135	-1	10	19
Feb 21	48308	141	-5	-	-13
Feb 22	48309	146	-12	15	-5
Feb 23	48310	149	5	12	11
Feb 24	48311	150	11	10	-4
Feb 25	48312	150	-5	-15	-8
Feb 26	48313	148	-18	27	-
Feb 27	48314	146	-5	10	0
Feb 28	48315	149	6	19	5
Mar 1	48316	158	-19	1	-2

TABLE 8C. (CONT.)

Date 1991 0hUTC	MJD	C0 (ns)	r(ns) PRN17 NAV17 0h44m	PRN21 NAV21 1h16m	PRN15 NAV15 3h24m	PRN14 NAV14 5h48m	PRN18 NAV18 7h56m
Feb 28	48315	149	-6	-2	4	-1	-1
Mar 1	48316	158	-20	19	23	-8	-3
Mar 2	48317	166	-7	14	-10	-1	-3
Mar 3	48318	174	-21	16	24	12	2
Mar 4	48319	184	14	20	7	-6	7
Mar 5	48320	190	-5	3	12	13	-4
Mar 6	48321	187	-7	2	5	5	4
Mar 7	48322	184	4	2	6	-13	-5
Mar 8	48323	183	-12	4	-10	5	-13
Mar 9	48324	181	-11	23	3	-2	-6
Mar 10	48325	175	-	-12	11	23	4
Mar 11	48326	166	-3	16	-11	-1	6
Mar 12	48327	158	-22	2	12	0	2
Mar 13	48328	148	4	10	9	11	-8
Mar 14	48329	142	1	13	-1	-6	9
Mar 15	48330	139	5	11	11	14	-3
Mar 16	48331	134	1	4	9	-4	-1
Mar 17	48332	131	7	1	23	1	4
Mar 18	48333	130	-14	-	11	16	16
Mar 19	48334	125	-18	2	17	5	-12
Mar 20	48335	115	-14	8	3	-3	3
Mar 21	48336	107	-5	-12	5	-7	-14
Mar 22	48337	106	19	11	1	-9	-18
Mar 23	48338	111	8	18	-5	13	8
Mar 24	48339	116	4	0	8	6	16
Mar 25	48340	111	-3	-4	2	6	18
Mar 26	48341	102	-13	-4	20	6	-18
Mar 27	48342	96	-15	5	-14	-11	-7
Mar 28	48343	101	1	31	-7	-5	1
Mar 29	48344	112	-4	6	1	5	8
Mar 30	48345	120	-11	11	-11	1	-4
Mar 31	48346	121	14	9	2	13	-3
Apr 1	48347	122	-2	11	1	-1	6

TABLE 8C. (CONT.)

Date 1991 0hUTC	MJD	C0 (ns)	r(ns) PRN16 NAV16 11h40m	PRN 2 NAV13 14h52m	PRN20 NAV20 18h20m
Feb 28	48315	149	6	19	5
Mar 1	48316	158	-19	1	-2
Mar 2	48317	166	8	20	8
Mar 3	48318	174	-18	1	16
Mar 4	48319	184	-12	19	-4
Mar 5	48320	190	2	20	-3
Mar 6	48321	187	-8	23	1
Mar 7	48322	184	-19	3	-6
Mar 8	48323	183	3	22	-11
Mar 9	48324	181	-24	7	1
Mar 10	48325	175	12	18	-3
Mar 11	48326	166	-6	12	12
Mar 12	48327	158	-8	-3	-10
Mar 13	48328	148	-9	17	10
Mar 14	48329	142	11	-2	-8
Mar 15	48330	139	18	23	1
Mar 16	48331	134	9	19	0
Mar 17	48332	131	2	-7	2
Mar 18	48333	130	-6	33	10
Mar 19	48334	125	-11	5	-16
Mar 20	48335	115	-6	-7	2
Mar 21	48336	107	-3	9	-1
Mar 22	48337	106	-10	10	-6
Mar 23	48338	111	3	0	-7
Mar 24	48339	116	0	19	15
Mar 25	48340	111	0	12	-5
Mar 26	48341	102	-20	-24	3
Mar 27	48342	96	-17	24	-4
Mar 28	48343	101	-4	12	-2
Mar 29	48344	112	-10	-9	14
Mar 30	48345	120	-12	19	-6
Mar 31	48346	121	2	0	-11
Apr 1	48347	122	-17	21	-4

TABLE 8C. (CONT.)

Date 1991 0hUTC	MJD	C0 (ns)	r(ns) PRN17 NAV17 22h36m	PRN21 NAV21 23h 8m	PRN15 NAV15 1h20m	PRN14 NAV14 3h44m	PRN18 NAV18 5h52m
Mar 31	48346	121	14	9	2	13	-3
Apr 1	48347	120	-5	9	-1	-3	4
Apr 2	48348	128	8	15	-8	1	3
Apr 3	48349	139	4	11	10	9	9
Apr 4	48350	146	13	29	13	3	13
Apr 5	48351	148	14	30	12	20	3
Apr 6	48352	148	2	17	13	18	10
Apr 7	48353	145	0	18	10	4	6
Apr 8	48354	143	19	9	-25	12	-11
Apr 9	48355	144	4	10	-10	9	-11
Apr 10	48356	146	10	23	10	-8	12
Apr 11	48357	149	6	5	3	3	10
Apr 12	48358	152	23	17	2	-2	1
Apr 13	48359	158	6	-2	9	-	-1
Apr 14	48360	164	2	23	-4	8	9
Apr 15	48361	168	-1	6	20	-1	0
Apr 16	48362	170	13	8	-10	8	7
Apr 17	48363	176	7	7	0	9	-3
Apr 18	48364	183	5	6	13	0	2
Apr 19	48365	188	-2	11	-	7	15
Apr 20	48366	190	13	12	-	3	-12
Apr 21	48367	191	11	2	-1	0	4
Apr 22	48368	193	5	17	7	5	5
Apr 23	48369	193	-2	24	24	22	-2
Apr 24	48370	193	-8	6	4	9	4
Apr 25	48371	193	26	21	4	2	10
Apr 26	48372	194	-15	5	-	0	-5
Apr 27	48373	198	-	-	-	-	-
Apr 28	48374	202	-	-	-	-	-
Apr 29	48375	203	17	5	1	-	-
Apr 30	48376	205	7	18	6	4	14
May 1	48377	213	-1	19	-13	6	20

TABLE 8C. (CONT.)

Date 1991 0hUTC	MJD	C0 (ns)	r(ns) PRN16 NAV16 9h36m	PRN 2 NAV13 12h48m	PRN20 NAV20 16h16m
Mar 31	48346	121	2	0	-11
Apr 1	48347	120	-19	19	-6
Apr 2	48348	128	15	11	8
Apr 3	48349	139	-8	3	3
Apr 4	48350	146	-6	35	-10
Apr 5	48351	148	5	25	18
Apr 6	48352	148	3	8	3
Apr 7	48353	145	-12	14	4
Apr 8	48354	143	-10	9	-9
Apr 9	48355	144	9	8	9
Apr 10	48356	146	-	11	3
Apr 11	48357	149	-5	5	8
Apr 12	48358	152	18	22	4
Apr 13	48359	158	-11	0	-10
Apr 14	48360	164	-2	13	5
Apr 15	48361	168	-13	1	9
Apr 16	48362	170	15	15	15
Apr 17	48363	176	-2	11	-6
Apr 18	48364	183	-7	3	-3
Apr 19	48365	188	6	-8	-3
Apr 20	48366	190	-9	13	14
Apr 21	48367	191	-1	-6	-5
Apr 22	48368	193	10	0	7
Apr 23	48369	193	2	17	7
Apr 24	48370	193	-18	2	5
Apr 25	48371	193	8	25	9
Apr 26	48372	194	19	6	-7
Apr 27	48373	198	-	-	-
Apr 28	48374	202	-	-	-
Apr 29	48375	203	-9	9	7
Apr 30	48376	205	20	16	-4
May 1	48377	213	-25	5	21

TABLE 8C. (CONT.)

Date 1991 0hUTC	MJD	C0 (ns)	r(ns) PRN17 NAV17 20h36m	PRN21 NAV21 21h 8m	PRN15 NAV15 23h16m	PRN14 NAV14 1h44m	PRN18 NAV18 3h52m
Apr 30	48376	205	7	18	6	4	14
May 1	48377	213	-1	19	-13	6	20
May 2	48378	218	7	-6	-4	-3	-4
May 3	48379	221	-11	7	-4	9	-7
May 4	48380	223	4	2	8	6	7
May 5	48381	230	-14	-6	4	-3	2
May 6	48382	240	18	20	-12	-3	7
May 7	48383	248	10	13	-1	-2	8
May 8	48384	255	9	11	12	6	18
May 9	48385	266	0	-1	9	13	11
May 10	48386	277	4	5	6	11	23
May 11	48387	282	5	5	3	-5	-2
May 12	48388	291	2	11	-3	-12	5
May 13	48389	300	-2	-4	-6	1	-1
May 14	48390	307	23	15	11	-5	8
May 15	48391	308	9	1	-2	-3	1
May 16	48392	304	10	-9	5	-1	5
May 17	48393	297	-8	2	-9	-1	-3
May 18	48394	297	2	8	8	4	-2
May 19	48395	302	1	3	-3	-6	3
May 20	48396	307	13	0	0	4	6
May 21	48397	306	5	-7	-9	3	8
May 22	48398	307	3	-8	6	-7	-7
May 23	48399	311	15	14	7	7	-2
May 24	48400	317	-	-	-	-11	-15
May 25	48401	320	-4	5	12	-	0
May 26	48402	332	4	-7	-3	3	0
May 27	48403	347	8	9	13	-2	22
May 28	48404	355	-9	1	-11	-16	2
May 29	48405	358	2	-9	-	-	-
May 30	48406	366	0	4	-6	-1	-
May 31	48407	373	-9	13	-10	5	-3
Jun 1	48408	377	15	13	8	7	10

TABLE 8C. (CONT.)

Date 1991 0hUTC	MJD	C0 (ns)	r(ns) PRN16 NAV16 7h36m	PRN 2 NAV13 10h48m	PRN20 NAV20 14h16m
Apr 30	48376	205	20	16	-4
May 1	48377	213	-25	5	21
May 2	48378	218	-17	12	2
May 3	48379	221	-15	1	-9
May 4	48380	223	-20	8	-12
May 5	48381	230	-8	10	12
May 6	48382	240	9	15	14
May 7	48383	248	16	7	-2
May 8	48384	255	-16	4	2
May 9	48385	266	19	7	22
May 10	48386	277	1	19	5
May 11	48387	282	-23	-13	-7
May 12	48388	291	-1	3	-4
May 13	48389	300	-4	12	8
May 14	48390	307	-10	11	10
May 15	48391	308	-9	16	-6
May 16	48392	304	-17	-9	-4
May 17	48393	297	9	4	9
May 18	48394	297	-10	-3	2
May 19	48395	302	-13	6	0
May 20	48396	307	-10	3	15
May 21	48397	306	0	23	-8
May 22	48398	307	-11	18	-2
May 23	48399	311	0	30	-3
May 24	48400	317	-12	7	1
May 25	48401	320	3	-8	-2
May 26	48402	332	8	13	3
May 27	48403	347	-2	3	8
May 28	48404	355	-2	-15	5
May 29	48405	358	-	-	-8
May 30	48406	366	-	-18	15
May 31	48407	373	8	5	9
Jun 1	48408	377	-6	5	-8

TABLE 8C. (CONT.)

Date 1991 0hUTC	MJD	C0 (ns)	r(ns) PRN17 NAV17 18h32m	PRN21 NAV21 19h 4m	PRN15 NAV15 21h12m	PRN14 NAV14 23h36m	PRN18 NAV18 1h48m
May 31	48407	371	-11	11	-12	3	-5
Jun 1	48408	375	15	13	8	7	9
Jun 2	48409	376	2	25	-8	-1	-5
Jun 3	48410	374	7	-7	-8	-19	-1
Jun 4	48411	370	-33	-3	-4	6	-3
Jun 5	48412	365	-9	-9	-14	7	-11
Jun 6	48413	362	6	6	12	-1	-5
Jun 7	48414	359	16	8	-5	-3	5
Jun 8	48415	355	11	0	-20	-6	7
Jun 9	48416	356	16	-13	3	-6	2
Jun 10	48417	360	8	3	-9	18	5
Jun 11	48418	365	12	10	-24	10	-7
Jun 12	48419	369	1	-2	9	5	3
Jun 13	48420	374	3	-11	3	-4	-12
Jun 14	48421	379	9	19	10	-15	-8
Jun 15	48422	383	16	-1	-11	-16	-1
Jun 16	48423	382	8	-2	-6	3	-3
Jun 17	48424	381	16	1	3	8	-11
Jun 18	48425	382	17	1	5	-2	-4
Jun 19	48426	380	21	-4	5	4	-3
Jun 20	48427	379	18	15	24	-4	2
Jun 21	48428	378	13	2	-7	2	-5
Jun 22	48429	376	12	4	3	-10	10
Jun 23	48430	375	20	15	9	10	0
Jun 24	48431	373	5	-6	17	6	-13
Jun 25	48432	370	16	4	-19	-16	-2
Jun 26	48433	369	-	11	-	-26	-

Date 1991 0hUTC	MJD	C0 (ns)	r(ns) PRN18 NAV18 0h24m	PRN16 NAV16 3h36m	PRN19 NAV19 4h 8m	PRN 2 NAV13 6h48m	PRN23 NAV23 7h20m
Jun 27	48434	380	6	-7	-17	9	2
Jun 28	48435	374	11	7	-32	-11	-11
Jun 29	48436	362	-11	-7	-44	-8	-12
Jun 30	48437	351	-13	-23	-42	-18	-3
Jul 1	48438	347	-11	-21	-38	-128	57

TABLE 8C. (CONT.)

Date 1991 0hUTC	MJD	C0 (ns)	r(ns) PRN16 NAV16 5h32m	PRN 2 NAV13 8h44m	PRN20 NAV20 12h12m
May 31	48407	371	6	3	7
Jun 1	48408	375	-7	4	-9
Jun 2	48409	376	0	3	-14
Jun 3	48410	374	14	-2	-2
Jun 4	48411	370	1	-9	-18
Jun 5	48412	365	-5	-9	-10
Jun 6	48413	362	-7	6	0
Jun 7	48414	359	-19	3	-4
Jun 8	48415	355	-1	-7	-8
Jun 9	48416	356	13	-9	-8
Jun 10	48417	360	-16	0	5
Jun 11	48418	365	6	-9	-10
Jun 12	48419	369	-2	1	3
Jun 13	48420	374	-9	-7	3
Jun 14	48421	379	-19	-19	-7
Jun 15	48422	383	-5	10	11
Jun 16	48423	382	-8	-10	-15
Jun 17	48424	381	-4	-4	-2
Jun 18	48425	382	-4	6	-5
Jun 19	48426	380	22	-13	0
Jun 20	48427	379	6	-1	1
Jun 21	48428	378	3	-7	1
Jun 22	48429	376	-3	4	-13
Jun 23	48430	375	-5	-6	0
Jun 24	48431	373	-4	-2	10
Jun 25	48432	370	-24	-13	4
Jun 26	48433	369	-8	-14	7

Date 1991 0hUTC	MJD	C0 (ns)	r(ns) PRN20 NAV20 10h 0m	PRN17 NAV17 16h24m	PRN15 NAV15 18h48m	PRN21 NAV21 20h 8m	PRN14 NAV14 21h44m
Jun 27	48434	380	1	6	2	-3	4
Jun 28	48435	374	3	9	-3	-16	2
Jun 29	48436	362	-14	-4	-9	-18	-19
Jun 30	48437	351	-21	4	-3	1	-8
Jul 1	48438	347	11	-12	-15	-26	33

TABLE 8C. (CONT.)

Date 1991 0hUTC	MJD	C0 (ns)	r(ns) PRN18 NAV18 0h12m	PRN16 NAV16 3h24m	PRN19 NAV19 3h56m	PRN 2 NAV13 6h36m	PRN23 NAV23 7h 8m
Jun 30	48437	353	-10	-20	-40	-16	-1
Jul 1	48438	347	-11	-21	-39	-129	56
Jul 2	48439	347	-	56	-33	83	-2
Jul 3	48440	349	-127	-11	17	-7	55
Jul 4	48441	352	7	-20	-5	-2	19
Jul 5	48442	353	1	28	-15	1	11
Jul 6	48443	354	5	-23	-25	5	5
Jul 7	48444	357	-	13	-32	-3	20
Jul 8	48445	360	-	42	-21	8	19
Jul 9	48446	358	-9	28	-8	-3	8
Jul 10	48447	351	-1	17	-20	6	14
Jul 11	48448	346	25	9	-7	22	9
Jul 12	48449	341	-11	26	-46	-6	2
Jul 13	48450	347	8	4	-42	-6	-2
Jul 14	48451	361	11	2	-34	5	22
Jul 15	48452	374	22	28	-5	15	15
Jul 16	48453	384	5	-2	-15	14	8
Jul 17	48454	385	4	8	-2	3	14
Jul 18	48455	383	-2	8	-23	6	4
Jul 19	48456	386	-2	-1	-29	-16	5
Jul 20	48457	390	4	9	-34	-9	-2
Jul 21	48458	395	22	3	-25	-5	10
Jul 22	48459	396	-7	24	-12	13	4
Jul 23	48460	390	-16	4	-20	-10	6
Jul 24	48461	377	-5	-12	-19	-3	-5
Jul 25	48462	365	2	15	-28	-8	0
Jul 26	48463	356	-2	0	-16	3	-2
Jul 27	48464	350	-10	5	4	-9	-6
Jul 28	48465	343	2	12	-32	-16	6
Jul 29	48466	334	8	-4	-29	-21	-4
Jul 30	48467	326	-1	9	-45	-7	-1
Jul 31	48468	317	6	4	-1	-21	-
Aug 1	48469	307	-2	2	0	7	3

TABLE 8C. (CONT.)

Date 1991 0hUTC	MJD	C0 (ns)	r(ns) PRN20 NAV20 9h48m	PRN17 NAV17 16h12m	PRN15 NAV15 18h36m	PRN21 NAV21 19h56m	PRN14 NAV14 21h32m
Jun 30	48437	353	-19	5	-2	1	-8
Jul 1	48438	347	10	-13	-16	-27	32
Jul 2	48439	347	-7	6	-29	-46	39
Jul 3	48440	349	6	-46	31	-131	27
Jul 4	48441	352	5	29	-7	-	-
Jul 5	48442	353	15	29	-25	-	-
Jul 6	48443	354	17	29	-7	-	-
Jul 7	48444	357	40	40	-8	-	-
Jul 8	48445	360	2	20	16	-	-
Jul 9	48446	358	-1	25	20	-	-
Jul 10	48447	351	10	2	26	30	0
Jul 11	48448	346	19	29	-14	7	10
Jul 12	48449	341	-2	30	19	19	4
Jul 13	48450	347	-2	6	6	15	8
Jul 14	48451	361	6	6	29	19	-
Jul 15	48452	374	-	19	-	-	-
Jul 16	48453	384	-	10	4	20	-
Jul 17	48454	385	-	27	11	-6	5
Jul 18	48455	383	-6	-2	6	5	7
Jul 19	48456	386	-18	16	-6	21	-13
Jul 20	48457	390	12	9	6	21	9
Jul 21	48458	395	8	20	-4	3	-7
Jul 22	48459	396	18	30	23	7	6
Jul 23	48460	390	-	21	-5	11	-3
Jul 24	48461	377	-2	14	18	19	1
Jul 25	48462	365	4	10	-2	-3	-3
Jul 26	48463	356	-230	12	16	26	9
Jul 27	48464	350	2	8	15	6	5
Jul 28	48465	343	12	1	5	22	-22
Jul 29	48466	334	-19	19	-1	14	-7
Jul 30	48467	326	-9	1	-28	19	21
Jul 31	48468	317	-	13	3	-12	-17
Aug 1	48469	307	13	5	16	34	16

TABLE 8C. (CONT.)

r(ns)

Date 1991 0hUTC	MJD	C0 (ns)	PRN18 NAV18 22h 4m	PRN16 NAV16 1h20m	PRN19 NAV19 1h52m	PRN 2 NAV13 4h32m	PRN23 NAV23 5h 4m
Jul 31	48468	317	6	4	-1	-21	-
Aug 1	48469	306	-3	1	-1	6	2
Aug 2	48470	298	-5	3	-29	-11	-5
Aug 3	48471	289	10	3	-14	-9	-6
Aug 4	48472	279	9	11	-21	-14	2
Aug 5	48473	269	6	15	-10	-4	5
Aug 6	48474	262	15	-8	-18	-6	5
Aug 7	48475	254	-11	4	-28	-18	3
Aug 8	48476	243	9	-19	-14	-1	5
Aug 9	48477	234	-4	12	-12	-14	2
Aug 10	48478	227	-7	3	-9	-9	-4
Aug 11	48479	223	-2	2	-20	1	-5
Aug 12	48480	227	13	8	-29	8	-3
Aug 13	48481	235	-2	5	-24	5	-5
Aug 14	48482	248	-3	14	-12	-13	4
Aug 15	48483	254	0	2	-36	2	-1
Aug 16	48484	257	9	-2	-27	-11	-4
Aug 17	48485	259	6	9	-25	-18	-7
Aug 18	48486	258	1	-12	-23	-5	5
Aug 19	48487	255	-2	-	-30	-16	-10
Aug 20	48488	250	2	-1	-4	-12	3
Aug 21	48489	245	8	18	-41	13	-
Aug 22	48490	240	18	1	-17	-7	2
Aug 23	48491	234	15	-5	-	-	-
Aug 24	48492	230	0	2	-31	-10	18
Aug 25	48493	223	12	0	-19	5	20
Aug 26	48494	212	6	4	-17	-15	17
Aug 27	48495	204	14	-8	-	-17	4
Aug 28	48496	205	17	4	-31	6	2
Aug 29	48497	211	4	18	-12	2	4
Aug 30	48498	212	-3	-10	-9	-8	3
Aug 31	48499	208	7	8	-42	-11	3
Sep 1	48500	207	6	-12	-3	-7	-7

TABLE 8C. (CONT.)

Date 1991 0hUTC	MJD	C0 (ns)	r(ns) PRN20 NAV20 7h44m	PRN17 NAV17 14h 8m	PRN15 NAV15 16h32m	PRN21 NAV21 17h52m	PRN14 NAV14 19h28m
Jul 31	48468	317	-	13	3	-12	-17
Aug 1	48469	306	12	4	15	33	15
Aug 2	48470	298	12	1	-3	15	-11
Aug 3	48471	289	2	5	20	4	5
Aug 4	48472	279	-10	2	-7	28	-13
Aug 5	48473	269	11	11	-9	24	8
Aug 6	48474	262	10	6	26	36	2
Aug 7	48475	254	0	8	-9	30	1
Aug 8	48476	243	7	9	4	27	3
Aug 9	48477	234	2	-5	-10	-16	8
Aug 10	48478	227	6	6	9	18	8
Aug 11	48479	223	-7	4	7	1	-9
Aug 12	48480	227	16	-5	-4	9	8
Aug 13	48481	235	7	17	-8	14	2
Aug 14	48482	248	10	26	-13	16	18
Aug 15	48483	254	-5	13	2	17	-8
Aug 16	48484	257	1	0	2	8	0
Aug 17	48485	259	5	18	-2	11	-3
Aug 18	48486	258	11	-9	-6	11	4
Aug 19	48487	255	8	31	-4	6	1
Aug 20	48488	250	-17	-4	19	18	17
Aug 21	48489	245	8	3	5	11	2
Aug 22	48490	240	14	22	16	16	11
Aug 23	48491	234	-	-10	4	11	9
Aug 24	48492	230	-13	4	-14	22	8
Aug 25	48493	223	5	15	-7	11	-9
Aug 26	48494	212	5	11	7	20	15
Aug 27	48495	204	5	4	-3	1	-10
Aug 28	48496	205	2	10	13	19	4
Aug 29	48497	211	17	5	15	9	14
Aug 30	48498	212	18	-1	11	15	2
Aug 31	48499	208	4	-13	-9	24	7
Sep 1	48500	207	8	17	-13	14	-13

TABLE 8C. (CONT.)

Date 1991 0hUTC	MJD	C0 (ns)	r(ns) PRN18 NAV18 20h 0m	PRN16 NAV16 23h12m	PRN19 NAV19 23h44m	PRN 2 NAV13 2h28m	PRN23 NAV23 3h 0m
Aug 31	48499	208	8	8	-42	-11	3
Sep 1	48500	208	7	-11	-2	-6	-6
Sep 2	48501	215	20	2	-57	6	-2
Sep 3	48502	218	0	21	-18	-20	4
Sep 4	48503	219	9	5	-28	3	-2
Sep 5	48504	221	7	27	1	8	5
Sep 6	48505	227	2	25	-22	-	3
Sep 7	48506	231	21	-5	7	-1	2
Sep 8	48507	231	1	14	-30	2	-6
Sep 9	48508	229	11	28	-23	5	11
Sep 10	48509	224	12	1	-31	6	0
Sep 11	48510	219	24	3	-8	0	3
Sep 12	48511	214	11	7	-43	5	7
Sep 13	48512	209	-9	2	-23	-4	6
Sep 14	48513	205	10	1	-6	-2	-1
Sep 15	48514	203	0	17	-8	-3	3
Sep 16	48515	200	6	-10	-22	4	-3
Sep 17	48516	195	9	0	-4	-8	1
Sep 18	48517	185	16	15	-27	4	11
Sep 19	48518	177	20	26	-13	3	18
Sep 20	48519	171	8	18	-23	7	18
Sep 21	48520	164	8	14	-21	-20	21
Sep 22	48521	155	2	-14	-16	6	24
Sep 23	48522	150	8	20	-30	-8	9
Sep 24	48523	148	5	2	-12	-5	13
Sep 25	48524	150	20	22	-20	2	-3
Sep 26	48525	155	10	0	0	11	5
Sep 27	48526	164	8	26	-19	6	3
Sep 28	48527	172	16	13	-19	-6	13
Sep 29	48528	177	2	4	-11	9	9
Sep 30	48529	179	-1	16	-11	-8	11
Oct 1	48530	179	6	13	32	22	1

TABLE 8C. (CONT.)

Date 1991 0hUTC	MJD	C0 (ns)	PRN20 NAV20 5h40m	PRN17 NAV17 12h 4m	PRN15 NAV15 14h28m	PRN21 NAV21 15h48m	PRN14 NAV14 17h24m
			r(ns)				
Aug 31	48499	208	4	-13	-9	24	7
Sep 1	48500	208	9	18	-12	15	-12
Sep 2	48501	215	-3	6	-19	17	2
Sep 3	48502	218	19	14	4	27	2
Sep 4	48503	219	11	13	13	-11	1
Sep 5	48504	221	12	10	6	21	1
Sep 6	48505	227	21	6	-15	-6	0
Sep 7	48506	231	39	5	-1	35	-11
Sep 8	48507	231	5	3	0	-	-3
Sep 9	48508	229	5	10	17	14	9
Sep 10	48509	224	15	-5	9	7	-13
Sep 11	48510	219	18	13	8	8	-6
Sep 12	48511	214	8	13	-1	18	-1
Sep 13	48512	209	26	-8	-8	6	-2
Sep 14	48513	205	6	9	16	14	-10
Sep 15	48514	203	-	1	-19	15	9
Sep 16	48515	200	-	5	-17	10	-9
Sep 17	48516	195	-	8	12	-19	-9
Sep 18	48517	185	-	7	-16	14	-6
Sep 19	48518	177	-	12	11	40	-3
Sep 20	48519	171	-	8	3	10	-3
Sep 21	48520	164	-	10	-14	4	-4
Sep 22	48521	155	17	-4	-3	8	-2
Sep 23	48522	150	3	7	15	19	-21
Sep 24	48523	148	16	-1	-23	22	-6
Sep 25	48524	150	5	15	-8	-17	22
Sep 26	48525	155	13	-3	16	29	9
Sep 27	48526	164	21	12	0	0	-14
Sep 28	48527	172	27	4	10	13	8
Sep 29	48528	177	2	17	-13	32	-3
Sep 30	48529	179	20	1	8	20	6
Oct 1	48530	179	5	3	-5	17	-7

TABLE 8C. (CONT.)

Date 1991 0hUTC	MJD	C0 (ns)	r(ns) PRN18 NAV18 18h 0m	PRN16 NAV16 21h12m	PRN19 NAV19 21h44m	PRN 2 NAV13 0h28m	PRN23 NAV23 1h 0m
Sep 30	48529	179	-1	16	-11	-8	11
Oct 1	48530	179	5	12	32	22	1
Oct 2	48531	176	19	-5	-25	-9	8
Oct 3	48532	177	4	25	-21	-9	5
Oct 4	48533	178	3	7	-6	17	-7
Oct 5	48534	175	10	0	-12	-18	11
Oct 6	48535	167	6	22	-3	-	2
Oct 7	48536	159	0	7	-18	-6	2
Oct 8	48537	155	8	6	-28	-4	-9
Oct 9	48538	151	1	-7	-1	3	-9
Oct 10	48539	146	17	11	13	5	2
Oct 11	48540	143	0	-8	10	4	5
Oct 12	48541	141	9	-1	2	-5	4
Oct 13	48542	137	6	3	11	18	-3
Oct 14	48543	137	5	22	-12	-2	-
Oct 15	48544	141	15	29	-1	3	-9
Oct 16	48545	143	-5	-5	0	-	-
Oct 17	48546	143	-5	-1	-25	8	-13
Oct 18	48547	148	-	-	-	-	-
Oct 19	48548	162	12	27	20	-	-
Oct 20	48549	180	12	-3	-13	-	-
Oct 21	48550	187	-19	13	12	-	-
Oct 22	48551	189	-	-7	-24	-	-
Oct 23	48552	191	-15	-12	-20	-	-
Oct 24	48553	191	-20	-7	-38	-10	-7
Oct 25	48554	192	7	2	15	-2	-10
Oct 26	48555	194	1	1	-22	-7	9
Oct 27	48556	193	6	3	-22	-13	3
Oct 28	48557	190	6	9	5	8	2
Oct 29	48558	186	8	6	12	1	-2
Oct 30	48559	184	-5	6	-21	0	-1
Oct 31	48560	182	10	17	22	-1	-6
Nov 1	48561	179	6	0	8	-4	-4

TABLE 8C. (CONT.)

Date 1991 0hUTC	MJD	C0 (ns)	r(ns) PRN20 NAV20 3h40m	PRN17 NAV17 10h 4m	PRN15 NAV15 12h28m	PRN21 NAV21 13h48m	PRN14 NAV14 15h24m
Sep 30	48529	179	20	1	8	20	6
Oct 1	48530	179	5	2	-6	17	-7
Oct 2	48531	176	7	2	8	8	-3
Oct 3	48532	177	0	1	8	16	-8
Oct 4	48533	178	11	15	1	8	7
Oct 5	48534	175	15	-7	10	5	5
Oct 6	48535	167	8	9	-20	8	-1
Oct 7	48536	159	14	10	7	17	1
Oct 8	48537	155	-2	0	-1	29	7
Oct 9	48538	151	18	3	9	-17	-8
Oct 10	48539	146	0	12	6	5	10
Oct 11	48540	143	13	-3	13	9	9
Oct 12	48541	141	18	1	6	3	-2
Oct 13	48542	137	-2	7	-9	15	6
Oct 14	48543	137	21	19	-8	11	-5
Oct 15	48544	141	11	-8	-6	14	-4
Oct 16	48545	143	13	10	-5	7	3
Oct 17	48546	143	-	1	-2	24	-
Oct 18	48547	148	-	30	-	-	-
Oct 19	48548	162	-	33	-	-	-
Oct 20	48549	180	-	41	-	-	-
Oct 21	48550	187	-	-	-	-	-
Oct 22	48551	189	-	29	-	-	-
Oct 23	48552	191	-	9	17	15	-
Oct 24	48553	191	-	1	-18	42	-2
Oct 25	48554	192	-4	2	-21	23	-17
Oct 26	48555	194	5	-12	-6	-4	-9
Oct 27	48556	193	10	-18	-31	15	-12
Oct 28	48557	190	13	5	13	9	6
Oct 29	48558	186	-12	-14	4	-17	-12
Oct 30	48559	184	2	-1	-6	26	5
Oct 31	48560	182	-3	-1	-8	14	-7
Nov 1	48561	179	15	2	-4	20	-27

TABLE 8C. (CONT.)

Date 1991 0hUTC	MJD	C0 (ns)	PRN18 NAV18 15h56m	PRN16 NAV16 19h 8m	PRN19 NAV19 19h40m	PRN 2 NAV13 22h20m	PRN23 NAV23 22h52m
			r(ns)				
Oct 31	48560	182	10	17	22	-1	-6
Nov 1	48561	179	6	0	8	-4	-4
Nov 2	48562	175	4	7	-13	10	-2
Nov 3	48563	172	6	-21	0	7	0
Nov 4	48564	170	2	1	-10	5	-1
Nov 5	48565	165	2	30	9	9	-5
Nov 6	48566	162	5	17	-6	20	-6
Nov 7	48567	166	-4	24	-2	-5	-8
Nov 8	48568	171	-1	-4	1	-4	-1
Nov 9	48569	176	-8	-2	5	16	0
Nov 10	48570	189	7	-10	-17	-1	-8
Nov 11	48571	205	7	25	-9	3	9
Nov 12	48572	219	3	10	19	12	4
Nov 13	48573	225	7	2	-18	0	1
Nov 14	48574	226	11	8	-6	-1	4
Nov 15	48575	228	36	10	-27	-52	24
Nov 16	48576	231	-	3	-2	34	-4
Nov 17	48577	232	-26	-60	-12	-9	-30
Nov 18	48578	228	-16	72	-28	2	124
Nov 19	48579	224	13	55	-2	-54	9
Nov 20	48580	217	15	87	-8	-5	2
Nov 21	48581	215	-59	-6	-10	-2	0
Nov 22	48582	218	-1153	-1978	-5	2992	-
Nov 23	48583	217	597	-	-2	451	-712
Nov 24	48584	210	-408	11	-5	765	318
Nov 25	48585	199	14	-5	-2	72	11
Nov 26	48586	192	73	22	15	-18	-44
Nov 27	48587	191	-44	4	-1	47	47
Nov 28	48588	193	88	18	20	-9	-49
Nov 29	48589	195	7	-	-1	4	17
Nov 30	48590	195	0	-421	-6	93	60
Dec 1	48591	194	-	-58	-18	5	30

TABLE 8C. (CONT.)

Date 1991 0hUTC	MJD	C0 (ns)	r(ns) PRN20 NAV20 1h36m	PRN17 NAV17 8h 0m	PRN15 NAV15 10h24m	PRN21 NAV21 11h44m	PRN14 NAV14 13h20m
Oct 31	48560	182	-3	-1	-8	14	-7
Nov 1	48561	179	15	2	-4	20	-27
Nov 2	48562	175	4	-7	-5	-2	-6
Nov 3	48563	172	13	3	-4	6	-2
Nov 4	48564	170	18	-2	3	15	3
Nov 5	48565	165	2	5	0	-2	0
Nov 6	48566	162	8	4	9	-4	4
Nov 7	48567	166	9	-6	-4	11	-2
Nov 8	48568	171	39	-1	-20	0	-7
Nov 9	48569	176	7	-10	7	3	-10
Nov 10	48570	189	-11	5	-7	14	3
Nov 11	48571	205	4	-11	-1	4	-5
Nov 12	48572	219	2	-4	-30	-5	-8
Nov 13	48573	225	1	5	3	7	-6
Nov 14	48574	226	5	-8	-19	-10	-1
Nov 15	48575	228	-13	-11	3	2	-40
Nov 16	48576	231	-4	0	-51	25	11
Nov 17	48577	232	52	-	-37	-75	40
Nov 18	48578	228	-10	-34	86	112	49
Nov 19	48579	224	-18	-54	8	50	-15
Nov 20	48580	217	-28	37	23	-29	-
Nov 21	48581	215	54	66	61	33	-
Nov 22	48582	218	-	4	66	-30	-57
Nov 23	48583	217	-	5201	-1522	5198	-
Nov 24	48584	210	-38	274	-	-	-
Nov 25	48585	199	15	55	2	-15	-111
Nov 26	48586	192	30	6	4	44	-28
Nov 27	48587	191	-21	-79	54	-20	-54
Nov 28	48588	193	69	33	-41	114	-11
Nov 29	48589	195	32	-	-	5	12
Nov 30	48590	195	32	832	-	31	-2
Dec 1	48591	194	14	-88	25	90	-17

TABLE 8C. (CONT.)

Date 1991 0hUTC	MJD	C0 (ns)	r(ns) PRN18 NAV18 13h56m	PRN16 NAV16 17h 8m	PRN19 NAV19 17h40m	PRN 2 NAV13 20h20m	PRN23 NAV23 20h52m
Nov 30	48590	195	0	-421	-6	93	60
Dec 1	48591	194	-	-58	-18	5	30
Dec 2	48592	193	-35	-21	29	0	13
Dec 3	48593	197	62	-87	-9	-7	0
Dec 4	48594	207	70	-17	11	104	-31
Dec 5	48595	219	-19	9	-33	-1	41
Dec 6	48596	228	17	63	11	-54	-
Dec 7	48597	234	-21	2	9	-11	-13
Dec 8	48598	239	-22	-	7	0	-60
Dec 9	48599	244	76	87	-35	-1	59
Dec 10	48600	251	-20	65	-9	-14	-
Dec 11	48601	253	-15	-4	0	32	48
Dec 12	48602	252	21	-	-	-	-

Date 1991 0hUTC	MJD	C0 (ns)	r(ns) PRN23 NAV23 4h 8m	PRN17 NAV17 4h56m	PRN15 NAV15 7h 4m	PRN14 NAV14 10h 0m	PRN18 NAV18 11h 4m
Dec 13	48603	247	1	60	-	8	17
Dec 14	48604	248	-17	-44	13	59	55
Dec 15	48605	246	19	-23	-2	42	-26
Dec 16	48606	243	22	-43	-11	18	-1
Dec 17	48607	240	78	-8	-12	-40	-49
Dec 18	48608	242	-26	-23	15	43	0
Dec 19	48609	242	-	11	-34	39	7
Dec 20	48610	241	27	-68	11	44	46
Dec 21	48611	236	67	2	64	-45	-53
Dec 22	48612	233	37	-46	-8	-77	31
Dec 23	48613	231	-66	-	-11	30	65
Dec 24	48614	229	51	-12	74	44	-56
Dec 25	48615	228	70	-23	-44	53	-19
Dec 26	48616	232	-34	26	-33	18	42
Dec 27	48617	237	38	58	29	53	-28
Dec 28	48618	241	-12	24	21	-	-
Dec 29	48619	240	-2	-79	16	10	-
Dec 30	48620	236	13	61	-28	-83	-34
Dec 31	48621	235	-12	36	-33	56	-3
Jan 1	48622	234	0	-63	-29	66	-

TABLE 8C. (CONT.)

Date 1991 0hUTC	MJD	C0 (ns)	r(ns) PRN20 NAV20 23h32m	PRN17 NAV17 6h 0m	PRN15 NAV15 8h24m	PRN21 NAV21 9h44m	PRN14 NAV14 11h20m
Nov 30	48590	195	32	832	-	31	-2
Dec 1	48591	194	14	-88	25	90	-17
Dec 2	48592	193	37	6	65	86	-6
Dec 3	48593	197	73	3	-85	28	26
Dec 4	48594	207	24	-71	-8	76	10
Dec 5	48595	219	-83	11	45	-22	-51
Dec 6	48596	228	2	-32	-45	-2	59
Dec 7	48597	234	34	-13	15	73	56
Dec 8	48598	239	37	7	36	-43	-37
Dec 9	48599	244	-25	30	55	63	-25
Dec 10	48600	251	13	-109	33	-33	-7
Dec 11	48601	253	50	-43	13	-46	-5
Dec 12	48602	252	-	109	29	-30	29

Date 1991/92 0hUTC	MJD	C0 (ns)	r(ns) PRN24 NAV24 13h28m	PRN19 NAV19 13h44m	PRN16 NAV16 15h52m	PRN 2 NAV13 19h20m	PRN20 NAV20 22h32m
Dec 13	48603	247	47	-36	7	22	26
Dec 14	48604	248	30	-10	46	38	5
Dec 15	48605	246	-16	-10	-63	32	-81
Dec 16	48606	243	-	-23	24	65	4
Dec 17	48607	240	-40	-16	-43	-9	50
Dec 18	48608	242	7	-52	-30	-28	56
Dec 19	48609	242	-78	-44	-44	19	-12
Dec 20	48610	241	75	0	-28	-15	-48
Dec 21	48611	236	2	-40	-44	31	78
Dec 22	48612	233	48	-11	-3	-	8
Dec 23	48613	231	-49	17	-44	48	36
Dec 24	48614	229	1	-22	0	-36	-48
Dec 25	48615	228	23	-10	-22	93	39
Dec 26	48616	232	-22	18	-49	1	-4
Dec 27	48617	237	7	-31	-35	62	-43
Dec 28	48618	241	-	-	-	-	-
Dec 29	48619	240	48	6	-1	-79	27
Dec 30	48620	236	-43	-9	-29	94	-26
Dec 31	48621	235	-48	-29	51	35	9
Jan 1	48622	234	4	-17	-66	-56	-39

TABLE 8D. UTC - GLONASS TIME

The GLONASS satellites disseminate a common time scale designated as 'GLONASS time' related to UTC with :

UTC - GLONASS time = C1 (modulo 1s).

From his current observation of both the GPS and GLONASS satellite systems Prof. P. Daly, University of Leeds, establishes and reports GPS time - GLONASS time at ten-day intervals, together with the standard deviation SD of his daily GLONASS data. C1 is then derived using UTC - GPS time of Table 8B.

Date 1991 0hUTC	MJD	C1 (μs)	SD (μs)
Jan 3	48259	2.19	0.06
Jan 13	48269	1.83	0.06
Jan 23	48279	1.42	0.06
Feb 2	48289	0.98	0.06
Feb 12	48299	0.59	0.06
Feb 22	48309	0.17	0.06
Mar 4	48319	-0.27	0.06
Mar 14	48329	-0.70	0.06
Mar 24	48339	-1.11	0.06
Apr 3	48349	-1.54	0.06
Apr 13	48359	-1.86	0.06
Apr 23	48369	-2.19	0.07
May 3	48379	-2.51	0.06
May 13	48389	-2.81	0.06
May 23	48399	-3.10	0.05
Jun 2	48409	-3.40	0.06
Jun 12	48419	-3.68	0.06
Jun 22	48429	-3.95	0.05
Jul 2	48439	-4.19	0.06
Jul 12	48449	-4.48	0.06
Jul 22	48459	-4.73	0.06
Aug 1	48469	-4.98	0.05
Aug 11	48479	-5.28	0.06
Aug 21	48489	-5.59	0.06
Aug 31	48499	-5.89	0.07
Sep 10	48509	-6.16	0.05
Sep 20	48519	-6.43	0.05
Sep 30	48529	-6.64	0.06
Oct 10	48539	-6.90	0.05
Oct 20	48549	-7.12	0.06
Oct 30	48559	-7.38	0.06
Nov 9	48569	-7.58	0.05
Nov 19	48579	-7.75	0.05
Nov 29	48589	-7.93	0.05
Dec 9	48599	-8.08	0.05
Dec 19	48609	-8.21	0.05
Dec 29	48619	-8.32	0.06

TABLE 9. COMPARISON BETWEEN ABSOLUTE TIME COMPARISONS AND THE BIPM RESULTS

The following tables give the differences between absolute time comparison values of Table 5 and the BIPM data deduced from Table 8A (before rounding-off).

9A. CLOCK TRANSPORTATION

Date 1991	MJD	Time Comparison	Difference Clock Tr. - BIPM (1 microsecond)
Feb 12	48299.07	UTC(CRL) - UTC(TAO)	-0.056
Apr 11	48357.05	UTC(CRL) - UTC(TAO)	-0.065
May 5	48381.05	UTC(SU) - UTC(RC)	-0.228
Jul 2	48439.04	UTC(CRL) - UTC(TAO)	-0.061
Sep 24	48523.15	UTC(SU) - UTC(RC)	-0.078
Oct 30	48559.05	UTC(CRL) - UTC(TAO)	-0.064

9B. GPS TIME RECEIVER TRANSPORTATION

Date 1991	MJD	Time Comparison	Difference GPS Comp. - BIPM (1 microsecond)
Apr 23	48369.00	UTC(OP) - UTC(TUG)	-0.016

TABLE 10A. RATES RELATIVE TO TAI OF CONTRIBUTING CLOCKS IN 1991

Mean clock rates relative to TAI are computed for two-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 10A gives homogeneous rates for the whole year 1991. For studies including the clock rates of previous years, corrections must be brought to the data published in the Annual Reports for 1988, 1989 and 1990 and in the BIH Annual Reports for the previous years. These corrections are given in Table 10B.

Unit in ns/day, *** denotes that the clock was not used.

LAB.	CLOCK		48309	48369	48429	48499	48559	48619
AOS	19	7	***	-29.40	-32.40	***	4.10	-45.16
APL	14	793	1.69	-1.47	-0.82	5.33	-2.41	-2.18
APL	31	571	-14.84	1.13	-2.66	-12.20	-6.28	-9.75
APL	40	3101	-13.77	-14.08	-13.37	-11.26	-0.56	2.86
APL	40	3102	-6.24	-7.09	-6.40	-4.52	-0.45	2.79
APL	40	3103	-2.67	-3.29	-2.28	***	***	***
APL	40	3106	-2.81	-3.12	-2.38	-0.42	-0.91	2.75
AUS	12	590	278.67	***	***	***	***	***
AUS	12	1823	***	***	***	***	***	79.15
AUS	14	870	10.61	6.89	-0.59	-9.35	-13.97	1.03
AUS	14	902	-162.77	***	***	59.90	67.64	79.11
AUS	14	1270	18.00	19.49	34.47	34.87	17.77	23.06
AUS	14	1307	28.50	29.37	41.82	42.85	46.25	52.57
AUS	14	1694	-1.70	-2.21	-2.10	-6.26	-7.13	-3.46
AUS	14	1777	-139.72	-139.15	-142.87	***	***	***
AUS	14	1844	93.23	95.18	88.71	73.73	***	***
AUS	14	2019	-111.43	-109.52	-114.17	-121.18	-114.36	-113.68
AUS	14	2020	***	-96.79	-73.77	-65.35	-31.55	-29.29
AUS	40	5401	***	16.10	18.27	16.25	17.53	20.36
AUS	44	2	47.46	48.34	50.51	47.72	49.86	51.24
BEV	16	71	-71.63	***	-80.73	-81.98	-86.38	-68.67
CAO	16	183	***	***	***	***	***	-64.59
CAO	30	384	***	-48.13	-35.50	***	***	***
CH	12	285	64.12	47.00	46.53	43.62	49.18	47.12
CH	12	863	-14.24	-22.39	-13.72	-43.06	-33.78	-18.73
CH	16	64	22.88	15.14	20.80	***	***	***
CH	16	69	-113.33	-100.03	-104.23	-117.98	-127.31	-131.54
CH	16	77	0.40	5.47	***	***	***	***
CH	16	140	41.59	20.74	13.80	-6.41	9.97	40.21
CH	17	206	-58.00	-61.75	-53.28	-51.90	***	***
CH	21	179	***	1.00	3.38	3.07	2.91	6.54
CH	21	194	97.27	104.06	106.25	108.90	108.92	108.14
CH	21	217	23.62	45.17	33.21	30.91	33.12	36.19
CH	21	243	29.15	37.61	38.78	-3.77	18.00	19.48
CH	21	265	-30.03	-36.35	12.73	-0.60	-3.32	-18.36

TABLE 10A. (CONT.)

LAB.	CLOCK		48309	48369	48429	48499	48559	48619
CH	31	403	-8.35	-12.50	-10.66	-14.45	-7.44	-19.87
CRL	14	764	-5.88	-5.23	-2.92	-1.61	-0.70	-5.54
CRL	14	865	-71.49	-71.10	-67.50	-65.06	-63.29	-62.77
CRL	14	932	-293.50	-293.90	-293.95	-294.62	-292.50	-290.30
CRL	14	1729	-40.25	-39.63	-37.52	-43.15	-42.28	-15.17
CRL	14	2456	1.43	2.30	2.94	2.98	5.96	11.02
CRL	31	305	212.90	***	***	***	***	***
CSAO	12	1646	-86.35	-63.24	-62.82	-66.86	-69.86	-88.39
CSAO	12	1648	67.13	73.68	77.95	78.38	74.89	63.35
CSAO	12	2068	146.31	109.92	135.02	138.63	148.79	144.49
CSAO	30	151	357.53	315.47	170.82	130.28	111.49	203.61
CSAO	40	4902	***	***	-130.84	-115.23	-153.70	-100.46
F	12	206	-286.99	-279.37	-278.70	-261.15	-263.49	-281.77
F	12	439	-214.19	***	***	-193.82	-194.21	-205.45
F	12	2405	29.46	43.27	32.59	5.76	18.89	14.34
F	14	134	-23.71	-21.67	-13.61	-8.70	***	***
F	14	158	71.09	66.71	67.40	69.02	67.58	67.86
F	14	195	-127.03	-123.27	-126.67	-126.50	-124.26	-128.55
F	14	347	-82.52	-79.00	-82.54	-97.93	-99.18	-84.64
F	14	405	0.26	-7.32	-36.95	-41.29	-43.84	-41.64
F	14	500	-5.68	-6.46	-6.56	***	***	-9.69
F	14	560	-94.51	-94.12	-94.88	-96.41	-89.05	-87.05
F	14	594	-73.94	-75.51	-77.42	-82.86	-82.20	-69.72
F	14	753	-32.73	-35.84	-33.53	-34.05	-39.66	-36.22
F	14	1120	-62.35	-60.18	-59.64	-58.74	-58.84	-62.15
F	14	1407	-59.62	-57.56	-56.67	-61.33	-56.60	-61.38
F	14	1645	-1.77	***	19.49	23.94	21.64	25.66
F	14	1712	-107.37	-105.04	-101.54	-84.93	-87.89	-94.40
F	14	1842	***	-7.20	-10.83	-5.00	-3.57	-4.51
F	16	106	-9.60	-10.22	-12.35	***	***	-24.59
F	16	178	12.41	12.29	11.15	29.83	41.92	53.70
F	16	187	-17.78	-19.41	***	-27.14	-21.09	-30.59
F	17	489	-0.31	0.85	-4.26	-10.73	-4.01	***
FTZ	14	312	-9.92	***	***	***	***	***
FTZ	14	1217	18.33	11.13	13.12	15.04	15.73	6.06
FTZ	14	1482	23.92	19.55	27.68	41.46	33.77	38.20
FTZ	14	1656	27.19	11.64	9.49	5.26	***	***
FTZ	14	1674	21.41	16.93	19.04	19.65	20.55	13.60
FTZ	16	130	***	***	***	37.84	14.59	13.32
IEN	12	303	***	***	***	***	***	-295.42
IEN	14	469	-216.92	-220.31	-223.07	-228.06	-234.17	-235.90
IEN	14	893	-54.15	-55.71	***	***	0.44	1.20
IEN	14	1230	-87.60	-92.46	***	***	***	***
IEN	31	659	-58.61	-57.75	-54.12	-46.00	***	***
IFAG	14	1105	-128.84	-133.25	-132.16	-105.41	***	***

TABLE 10A. (CONT.)

LAB.	CLOCK		48309	48369	48429	48499	48559	48619
IFAG	16	131	-29.49	-29.14	-26.30	-29.54	-28.74	-7.52
IFAG	16	138	89.67	77.09	71.48	23.30	70.80	110.85
IFAG	16	274	212.52	204.08	215.53	218.32	214.73	205.50
IGMA	14	2407	-98.88	-98.27	-106.33	-111.17	-114.01	-113.57
IGMA	16	112	9.97	12.69	6.16	-2.61	-5.80	-5.52
IGMA	17	127	-31.54	-47.13	-39.86	44.50	60.00	65.86
INPL	14	2308	***	-11.96	-15.19	-18.89	-17.62	-22.39
INPL	14	2426	***	-230.52	-237.16	-253.30	-269.48	-284.65
INPL	31	145	***	-137.31	-140.67	-121.08	-125.18	-135.70
INPL	31	619	***	-110.34	-106.06	-105.51	-106.91	-113.29
KRIS	12	1902	156.68	189.38	185.94	177.63	179.21	208.26
KRIS	12	1903	-185.22	-162.23	-153.42	-151.84	-160.90	***
KRIS	14	1516	-91.86	-77.30	-70.49	-65.00	-61.47	-38.10
LDS	14	868	-151.98	***	-80.34	-70.83	-78.49	***
NAOM	14	614	248.14	198.90	212.30	201.47	251.50	304.84
NAOM	14	885	***	-41.43	-37.90	-36.52	-33.02	-34.34
NAOM	14	1315	***	***	-57.82	-57.25	-52.75	-53.69
NAOM	14	2146	-104.41	-102.40	-102.25	-103.53	-107.41	***
NIM	12	1615	-488.98	-487.94	-483.53	-482.96	-479.83	-481.54
NIM	12	1633	12.88	10.27	11.81	10.09	12.42	10.55
NIM	12	1640	2.67	0.05	1.18	-1.06	0.73	0.86
NIST	11	167	8.26	14.66	17.55	18.93	31.36	30.65
NIST	13	61	-104.85	-103.70	-105.22	-103.07	-96.66	-89.26
NIST	14	323	-84.37	-89.45	-93.74	-90.26	-91.67	-92.40
NIST	14	324	-39.30	-38.97	-40.96	-45.71	-49.77	-52.53
NIST	14	601	-19.51	***	11.34	6.48	1.74	1.19
NIST	14	1316	-83.50	-83.65	-84.82	***	***	-48.95
NIST	14	2165	-223.61	***	***	-44.74	-64.09	-71.13
NIST	16	217	17.64	22.55	20.97	23.32	17.46	20.63
NIST	18	113	-267.09	-288.65	-300.20	-306.06	-308.48	-319.43
NIST	31	569	-106.27	-107.84	-108.72	-107.85	-109.30	-110.37
NMC	30	2740	***	***	***	***	***	49.06
NPL	12	316	-92.34	-106.00	-101.23	-107.28	-108.46	-98.66
NPL	12	832	-303.08	-299.26	-306.08	-306.14	***	***
NPL	14	418	***	***	-13.82	-7.36	-9.44	-7.15
NPL	14	1334	-132.61	-134.71	-134.16	-137.79	-139.78	-140.41
NPL	14	1813	-27.63	-21.46	-11.27	-6.84	-7.11	-15.61
NPL	14	2064	-24.47	-24.94	-25.37	-20.90	-22.38	-26.39
NPL	31	328	-40.30	-36.55	-34.43	-20.62	-34.67	-45.85
NPL	40	1701	***	***	***	***	-10.96	-12.89
NRC	14	267	-85.87	-92.29	-71.56	-181.15	-281.31	-303.57
NRC	90	5	4.87	8.26	5.91	1.02	-3.94	-10.10
NRC	90	61	-12.87	16.39	20.83	9.55	5.48	9.86
NRC	90	63	-11.05	-15.66	-5.36	-2.80	-5.19	-0.44
NRLM	12	363	-83.49	-126.19	-140.41	-190.51	-388.86	-640.85

TABLE 10A. (CONT.)

LAB.	CLOCK		48309	48369	48429	48499	48559	48619
NRLM	14	906	40.60	-56.23	-96.62	-164.85	***	***
NRLM	31	310	-1.02	-1.13	-8.22	-7.53	-22.09	-32.70
NRLM	31	312	264.40	307.80	***	***	***	***
OMH	12	1067	-1.12	32.20	-12.69	0.08	-4.83	***
ORB	12	205	-11.24	-19.05	-20.38	-20.89	-22.01	-13.97
ORB	12	804	1.63	-7.71	-8.72	11.49	19.93	21.60
ORB	21	312	35.75	32.28	34.73	24.46	48.38	76.29
PEL	12	933	***	***	***	***	***	-5.01
PKNM	14	1144	-73.51	-103.01	-87.70	***	***	***
PKNM	16	124	35.67	***	***	***	***	***
PKNM	30	652	-62.51	-93.23	-83.49	-85.69	-69.24	-87.26
PKNM	30	664	-168.80	-178.80	-167.34	-150.04	-165.75	-176.48
PTB	12	320	***	***	***	***	-6.54	***
PTB	14	394	-31.80	-29.60	-29.42	-21.91	-24.55	-31.10
PTB	14	867	-177.52	-171.23	-168.49	-160.73	-164.01	***
PTB	14	1103	-67.92	-64.87	-64.22	-57.91	-60.18	-64.92
PTB	14	2379	***	***	***	***	-45.06	-52.82
PTB	16	76	150.21	149.55	141.13	114.86	127.91	164.28
PTB	21	178	14.50	0.65	-1.73	-23.01	-1.52	20.35
PTB	40	502	***	-2.26	-0.62	-0.58	0.80	3.13
PTB	40	505	***	-2.23	-0.65	-0.82	0.70	3.47
PTB	92	1	-1.76	-1.91	-0.69	-0.07	-0.61	-0.22
PTB	92	2	-3.35	-4.56	-1.47	-2.35	-3.09	-1.45
RC	40	6477	***	***	***	***	***	-72.15
RC	40	6482	***	8.06	32.13	-9.14	-19.21	***
RC	40	6483	***	-4.08	-19.37	-52.89	-86.36	-4.60
RC	40	6487	***	***	***	-69.85	-80.58	-88.72
ROA	14	896	11.82	11.67	11.68	14.92	-4.56	-20.69
ROA	14	1569	3.56	7.74	15.99	33.69	***	33.22
ROA	16	113	10.20	-2.78	-2.10	7.68	-0.32	17.09
ROA	16	121	69.54	57.12	54.54	66.80	64.90	103.08
ROA	16	177	-10.95	-9.05	-11.54	-21.13	-14.35	-22.00
SNT	14	900	-37.22	-35.95	-26.27	-41.34	-35.85	-31.15
SNT	14	1376	-115.04	-110.99	-121.13	-122.62	-119.98	-118.56
SNT	16	137	-5.40	-6.42	-27.43	-42.70	-40.70	-36.68
SO	12	2067	***	***	***	-69.79	-72.04	-66.56
SO	14	574	1.92	18.51	4.02	1.77	13.71	***
SO	16	180	69.46	71.96	67.78	62.95	70.53	72.58
SU	40	3803	12.82	4.90	2.88	0.78	1.33	2.54
SU	40	3804	-22.45	-20.25	-22.91	-23.38	-20.00	-18.71
SU	40	3805	***	***	-28.01	-30.68	***	-27.76
SU	40	3806	***	***	***	***	***	0.10
TAO	14	1075	-31.68	-32.59	-32.37	***	***	***
TAO	14	1498	-135.97	-136.59	-137.07	-138.70	-137.88	-136.59
TAO	31	283	-80.34	-84.30	-87.11	-92.43	-97.05	-96.52

TABLE 10A. (CONT.)

LAB.	CLOCK		48309	48369	48429	48499	48559	48619
TAO	31	284	-165.22	-164.60	-166.92	-165.94	-166.59	-167.92
TAO	31	285	-33.24	-22.81	-5.82	8.86	13.35	35.65
TAO	31	286	-146.10	-143.17	-140.51	-165.64	-174.31	-183.64
TL	12	477	-137.64	-151.06	-136.15	-123.32	-103.46	-99.79
TL	12	1145	148.28	163.75	159.19	139.02	145.44	143.34
TL	12	2276	-58.52	-56.93	-61.72	-62.83	-60.89	-59.06
TL	16	283	-157.63	-143.95	-173.02	-166.05	-160.79	-82.76
TL	31	317	-50.64	-35.98	-31.39	-27.51	-18.36	-29.39
TP	12	335	***	-77.56	-77.80	-81.42	-80.61	-95.31
TP	17	101	-23.43	6.73	7.78	-102.61	-103.34	18.17
TUG	12	524	55.08	65.68	70.41	96.88	***	***
TUG	14	1654	***	29.69	31.96	32.85	32.28	31.50
TUG	18	108	683.54	708.78	723.80	743.34	757.45	783.45
USNO	14	333	***	-70.44	-48.81	***	-37.14	***
USNO	14	444	***	129.88	137.32	97.50	80.71	61.36
USNO	14	527	-177.21	-171.31	-165.71	-173.93	-170.40	-166.09
USNO	14	532	***	***	***	***	-166.23	-178.74
USNO	14	582	-213.36	-232.20	***	***	***	***
USNO	14	583	-7.57	-38.60	-28.19	12.97	29.98	-17.57
USNO	14	651	-114.56	-124.65	-117.86	-114.12	***	***
USNO	14	653	-58.84	-68.21	-72.41	-69.77	-63.95	***
USNO	14	654	-108.95	-106.55	-105.53	-105.12	-105.15	-109.11
USNO	14	656	68.13	67.53	64.76	***	***	71.06
USNO	14	660	***	***	***	***	64.32	71.11
USNO	14	752	32.15	34.27	35.79	38.72	43.27	69.11
USNO	14	761	***	***	-65.62	***	***	***
USNO	14	787	-3.48	5.50	***	***	575.31	586.10
USNO	14	862	-14.12	7.82	-0.99	-5.01	6.54	***
USNO	14	1028	***	***	-89.28	-124.80	-148.40	***
USNO	14	1035	***	***	-62.23	***	-64.92	-73.14
USNO	14	1094	-123.25	-123.72	-122.02	-118.74	-118.89	-118.58
USNO	14	1100	***	***	***	***	-121.75	-111.64
USNO	14	1255	-57.47	-55.12	-56.18	-56.34	-55.48	-55.10
USNO	14	1264	17.85	28.95	23.68	39.02	44.32	50.88
USNO	14	1300	***	***	-187.62	***	-187.38	-187.52
USNO	14	1301	-100.44	-115.43	-117.06	-120.19	-110.52	***
USNO	14	1305	-66.65	-64.15	-61.79	***	***	***
USNO	14	1423	***	***	***	***	***	-247.31
USNO	14	1586	-78.47	-90.54	***	***	***	***
USNO	14	1605	41.37	42.30	45.03	44.70	41.37	57.60
USNO	14	1710	-36.93	-38.60	-28.96	***	-29.26	-28.28
USNO	14	1809	-80.51	-78.79	-82.78	***	***	-77.35
USNO	14	1846	-56.93	-53.96	-54.31	-56.27	-53.39	-51.67
USNO	14	1946	***	113.35	124.71	***	***	***
USNO	14	2098	-48.57	-47.10	-48.77	-45.39	-41.44	-32.85

TABLE 10A. (CONT.)

LAB.	CLOCK	48309	48369	48429	48499	48559	48619
USNO	14 2313	-78.09	-80.72	-73.84	-74.84	-52.69	***
USNO	14 2315	923.02	922.34	***	***	***	***
USNO	14 2481	***	80.79	76.62	17.55	15.80	15.45
USNO	14 2482	***	-342.05	-319.74	***	***	***
USNO	14 2483	-31.61	-29.73	-30.11	-32.54	-37.20	***
USNO	14 2484	***	***	***	-30.26	-32.53	-29.71
USNO	14 2485	-81.58	-81.41	-81.73	-81.29	***	***
USNO	14 2486	-54.57	-35.72	-44.99	***	-63.00	-61.47
USNO	14 2488	-107.19	-93.89	-98.41	***	-95.94	-94.35
USNO	31 116	***	***	-51.49	-42.15	-45.00	-48.10
USNO	31 218	-117.33	-117.72	-113.24	***	***	***
USNO	31 313	-83.87	-119.81	-120.24	***	***	***
USNO	31 333	***	***	***	***	***	-44.15
USNO	31 334	29.64	25.03	20.90	16.38	48.16	***
USNO	31 335	***	***	-247.58	-262.30	-259.11	-235.25
USNO	31 336	-158.79	-178.83	-175.29	-183.45	-195.75	-194.38
USNO	31 340	-6.81	-4.33	9.00	20.40	10.48	-3.09
USNO	31 390	***	-371.14	***	***	***	***
USNO	31 395	***	39.44	***	***	***	***
USNO	31 426	0.77	-6.68	-4.13	***	***	***
USNO	40 22	-131.21	-146.41	-163.14	-178.14	***	***
USNO	40 23	-7.72	-17.67	-20.73	***	***	***
USNO	40 703	99.37	98.83	96.96	94.47	95.91	96.39
USNO	40 704	***	***	-52.00	***	***	-53.48
USNO	40 705	-25.03	-25.23	-26.91	-29.20	***	***
USNO	40 723	***	***	***	***	***	-40.15
USNO	40 724	-719.19	-727.37	-734.85	-742.72	***	***
USNO	40 725	-119.90	-110.61	54.79	38.99	28.48	22.60
USNO	40 6201	19.35	18.60	16.43	***	11.66	12.29
USNO	40 6208	13.16	15.76	***	***	***	***
VSL	12 349	20.50	19.57	37.66	34.21	31.57	***
VSL	12 1489	39.39	42.67	49.86	53.55	47.84	48.52
VSL	14 1034	-68.99	-65.56	-63.11	-60.54	-68.28	-62.71
VSL	31 288	***	***	-37.79	-40.33	-40.22	-37.55
YUZM	12 1189	7.28	116.33	-52.29	274.62	***	***
ZIPE	12 979	***	***	94.09	77.30	70.49	***

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

11 HEWLETT-PACKARD 5060A
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
19 RHODE AND SCHWARZ XSC
21 OSCILLOQUARTZ 3210
30 HEWLETT-PACKARD 5061B
31 HEWLETT-PACKARD 5061B OPT. 4
4x HYDROGEN MASERS
9x PRIMARY CLOCKS AND PROTOTYPES

TABLE 10B. 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.

	1991	1990		1989		1988	
	clock n°	clock n°	corr. (ns/d)	clock n°	corr. (ns/d)	clock n°	corr. (ns/d)
AUS	14 1694	14 1694		14 1694	-43.20		
APL	40 3101	40 3101	-11.00	40 3101	-11.00		
	40 3102	40 3102	-4.00				
CRL	14 764	14 764	+40.02	14 764	+40.02		
	14 1729	14 1729	+51.40	14 1729	+51.40	14 1729(1)	+51.40
CSAO	12 1646	12 1646		12 1646		12 1646(2)	
	12 1648	12 1648		12 1648		12 1648(3)	
	30 151	30 151	+104.96	30 151	+104.96		
F	17 489	17 489	-8.64				
NIST	14 323	14 323	-29.20				
	14 324	14 324	+17.07				
	14 601	14 601	+12.96	14 601	+12.96	14 601	+31.71
	14 1316	14 1316	+10.70	14 1316	+27.63	14 1316(4)	+27.63
	14 2165	14 2165(5)	+70.51				
	16 217	16 217	+58.63	16 217	+52.50	16 217	+52.50
ROA	14 1569	14 1569		14 1569		14 1569(6)	
	16 177	16 177		16 177		16 177(7)	
VSL	12 1489	12 1489	+181.00				

(1) A correction of +51.40 ns/d has to be applied for the last two-month interval of 1987.

(2) A correction of +41.60 ns/d has to be applied in 1987 and for the last three two-month intervals of 1986.

(3) A correction of +98.60 ns/d has to be applied in 1987, 1986 and 1985.

(4) A correction of +27.63 ns/d has to be applied in 1987, 1986, 1985 and for the last three two-month intervals of 1984.

(5) A correction of +70.51 ns/d has to be applied for the last four two-month intervals of 1990.

(6) A correction of -13.00 ns/d has to be applied in 1987 and 1986.

(7) A correction of +46.00 ns/d has to be applied in 1987, 1986, 1985 and for the last two-month interval of 1984.

TABLE 11A. WEIGHTS OF CONTRIBUTING CLOCKS IN 1991

Clock weights are computed for two-month intervals ending at the dates given in the table.

Since 1988 January 1st, the absolute weight of a given clock cannot exceed the value 100. For the year 1991, it corresponds to a maximum relative weight of about 1.6%.

*** denotes that the clock was not used.

LAB.	CLOCK		48309	48369	48429	48499	48559	48619
AOS	19	7	***	0	0	***	0	0
APL	14	793	0	0	100	73	76	89
APL	31	571	3	6	5	16	17	28
APL	40	3101	15	100	100	100	0	21
APL	40	3102	76	100	100	100	100	89
APL	40	3103	0	100	100	***	***	***
APL	40	3106	20	100	100	100	100	100
AUS	12	590	0	***	***	***	***	***
AUS	12	1823	***	***	***	***	***	0
AUS	14	870	6	9	16	15	10	10
AUS	14	902	0	***	***	0	0	6
AUS	14	1270	0	0	0	9	11	16
AUS	14	1307	0	0	0	13	14	13
AUS	14	1694	32	28	39	86	99	100
AUS	14	1777	33	43	45	***	***	***
AUS	14	1844	23	31	31	0	***	***
AUS	14	2019	33	46	65	0	51	53
AUS	14	2020	***	0	0	2	1	1
AUS	40	5401	***	0	0	100	100	100
AUS	44	2	100	100	100	100	100	100
BEV	16	71	0	***	0	0	49	13
CAO	16	183	***	***	***	***	***	0
CAO	30	384	***	0	0	***	***	***
CH	12	285	0	10	10	12	14	16
CH	12	863	3	2	2	4	7	7
CH	16	64	5	4	5	***	***	***
CH	16	69	28	0	15	15	10	6
CH	16	77	100	100	***	***	***	***
CH	16	140	0	1	2	2	4	3
CH	17	206	100	100	95	59	***	***
CH	21	179	***	0	0	100	100	100
CH	21	194	100	100	85	48	43	69
CH	21	217	0	2	4	6	9	21
CH	21	243	5	3	3	0	4	4
CH	21	265	22	23	0	2	2	3

TABLE 11A. (CONT.)

LAB.	CLOCK		48309	48369	48429	48499	48559	48619
CH	31	403	31	47	70	95	100	0
CRL	14	764	100	100	100	100	100	100
CRL	14	865	92	100	100	100	100	100
CRL	14	932	100	100	100	100	100	100
CRL	14	1729	30	68	100	100	100	0
CRL	14	2456	0	100	100	100	100	100
CRL	31	305	3	***	***	***	***	***
CSAO	12	1646	0	2	2	2	11	7
CSAO	12	1648	6	9	11	20	29	26
CSAO	12	2068	7	4	6	6	5	5
CSAO	30	151	0	3	0	0	0	0
CSAO	40	4902	***	***	0	0	1	1
F	12	206	5	4	4	7	11	10
F	12	439	20	***	***	0	0	0
F	12	2405	15	6	6	5	6	5
F	14	134	33	36	43	31	***	***
F	14	158	100	100	100	100	100	100
F	14	195	73	72	66	63	100	100
F	14	347	36	50	52	19	12	12
F	14	405	4	6	5	4	3	2
F	14	500	25	27	36	***	***	0
F	14	560	100	100	100	100	100	96
F	14	594	0	27	30	32	52	38
F	14	753	49	100	100	100	71	100
F	14	1120	100	100	100	100	100	100
F	14	1407	73	64	71	73	92	100
F	14	1645	0	***	0	0	99	100
F	14	1712	0	100	100	0	12	13
F	14	1842	***	0	0	55	73	100
F	16	106	29	49	38	***	***	0
F	16	178	35	32	65	0	0	3
F	16	187	19	19	***	0	0	20
F	17	489	70	100	100	0	41	***
FTZ	14	312	3	***	***	***	***	***
FTZ	14	1217	15	18	24	68	86	0
FTZ	14	1482	100	100	100	0	17	16
FTZ	14	1656	3	3	4	5	***	***
FTZ	14	1674	0	36	61	97	100	89
FTZ	16	130	***	***	***	0	0	2
IEN	12	303	***	***	***	***	***	0
IEN	14	469	77	48	27	21	16	14
IEN	14	893	42	56	***	***	0	0
IEN	14	1230	1	1	***	***	***	***
IEN	31	659	0	0	100	0	***	***
IFAG	14	1105	15	12	10	0	***	***

TABLE 11A. (CONT.)

LAB.	CLOCK		48309	48369	48429	48499	48559	48619
IFAG	16	131	100	100	98	100	100	0
IFAG	16	138	2	2	2	2	2	1
IFAG	16	274	23	47	31	20	21	30
IGMA	14	2407	100	100	76	31	18	16
IGMA	16	112	18	26	35	21	12	13
IGMA	17	127	0	1	1	1	0	0
INPL	14	2308	***	0	0	35	57	42
INPL	14	2426	***	0	0	3	2	2
INPL	31	145	***	0	0	0	8	12
INPL	31	619	***	0	0	97	100	67
KRIS	12	1902	0	0	1	3	7	4
KRIS	12	1903	4	5	6	6	7	***
KRIS	14	1516	59	34	17	9	7	3
LDS	14	868	15	***	0	0	19	***
NAOM	14	614	0	0	1	1	1	1
NAOM	14	885	***	0	0	100	72	100
NAOM	14	1315	***	***	0	0	78	100
NAOM	14	2146	15	13	21	67	74	***
NIM	12	1615	0	0	0	11	9	100
NIM	12	1633	5	5	10	19	19	100
NIM	12	1640	3	7	10	11	16	100
NIST	11	167	12	13	11	10	6	14
NIST	13	61	100	88	100	100	100	0
NIST	14	323	0	21	16	25	32	64
NIST	14	324	92	100	100	58	36	24
NIST	14	601	82	***	0	0	20	26
NIST	14	1316	100	100	100	***	***	0
NIST	14	2165	30	***	***	0	0	3
NIST	16	217	100	100	100	100	100	100
NIST	18	113	1	1	1	2	3	3
NIST	31	569	100	100	100	100	100	100
NMC	30	2740	***	***	***	***	***	0
NPL	12	316	0	40	40	31	24	23
NPL	12	832	21	21	24	92	***	***
NPL	14	418	***	***	0	0	47	79
NPL	14	1334	13	13	12	14	27	65
NPL	14	1813	8	7	7	13	17	17
NPL	14	2064	67	70	74	100	100	100
NPL	31	328	5	5	5	9	23	14
NPL	40	1701	***	***	***	***	0	0
NRC	14	267	4	3	3	0	0	0
NRC	90	5	14	13	26	25	41	17
NRC	90	61	0	11	7	7	8	8
NRC	90	63	1	1	30	43	51	40
NRLM	12	363	0	0	0	0	0	0

TABLE 11A. (CONT.)

LAB.	CLOCK		48309	48369	48429	48499	48559	48619
NRLM	14	906	0	0	0	0	***	***
NRLM	31	310	0	0	0	0	0	0
NRLM	31	312	0	0	***	***	***	***
OMH	12	1067	0	0	1	2	3	***
ORB	12	205	8	8	36	29	45	46
ORB	12	804	40	32	30	17	9	6
ORB	21	312	28	41	51	44	17	0
PEL	12	933	***	***	***	***	***	0
PKNM	14	1144	29	0	9	***	***	***
PKNM	16	124	4	***	***	***	***	***
PKNM	30	652	0	1	1	2	3	7
PKNM	30	664	0	3	6	6	9	10
PTB	12	320	***	***	***	***	0	***
PTB	14	394	49	47	71	56	60	70
PTB	14	867	57	100	88	35	30	***
PTB	14	1103	45	44	47	77	93	90
PTB	14	2379	***	***	***	***	0	0
PTB	16	76	4	3	3	4	5	3
PTB	21	178	0	7	11	4	6	4
PTB	40	502	***	0	0	100	100	100
PTB	40	505	***	0	0	100	100	100
PTB	92	1	100	100	100	100	100	100
PTB	92	2	100	100	100	100	100	100
RC	40	6477	***	***	***	***	***	0
RC	40	6482	***	0	0	1	1	***
RC	40	6483	***	0	0	1	0	1
RC	40	6487	***	***	***	0	0	5
ROA	14	896	100	100	100	100	0	0
ROA	14	1569	37	62	60	0	***	0
ROA	16	113	15	21	31	28	31	16
ROA	16	121	17	18	29	25	28	0
ROA	16	177	0	0	100	0	32	27
SNT	14	900	72	86	0	34	41	40
SNT	14	1376	0	3	5	9	13	43
SNT	16	137	1	1	1	1	3	3
SO	12	2067	***	***	***	0	0	79
SO	14	574	5	5	5	11	10	***
SO	16	180	17	18	18	23	24	81
SU	40	3803	0	0	14	19	27	38
SU	40	3804	0	0	100	100	100	100
SU	40	3805	***	***	0	0	***	0
SU	40	3806	***	***	***	***	***	0
TAO	14	1075	100	100	100	***	***	***
TAO	14	1498	100	100	100	75	81	100
TAO	31	283	5	5	8	14	14	18

TABLE 11A. (CONT.)

LAB.	CLOCK		48309	48369	48429	48499	48559	48619
TAO	31	284	33	35	58	100	100	100
TAO	31	285	17	9	4	2	2	2
TAO	31	286	100	100	94	0	5	3
TL	12	477	0	1	22	9	3	3
TL	12	1145	20	12	12	8	9	10
TL	12	2276	100	100	60	61	100	100
TL	16	283	1	5	5	5	7	0
TL	31	317	15	13	11	9	6	10
TP	12	335	***	0	0	87	100	0
TP	17	101	2	1	1	1	0	0
TUG	12	524	63	30	17	0	***	***
TUG	14	1654	***	0	0	100	100	100
TUG	18	108	1	1	1	1	1	1
USNO	14	333	***	0	0	***	0	***
USNO	14	444	***	0	0	0	1	1
USNO	14	527	3	6	10	13	40	66
USNO	14	532	***	***	***	***	0	0
USNO	14	582	0	0	***	***	***	***
USNO	14	583	0	0	1	1	1	2
USNO	14	651	0	0	29	43	***	***
USNO	14	653	3	3	3	3	7	***
USNO	14	654	100	100	100	100	100	100
USNO	14	656	38	33	28	***	***	0
USNO	14	660	***	***	***	***	0	0
USNO	14	752	100	100	100	100	86	0
USNO	14	761	***	***	0	***	***	***
USNO	14	787	77	52	***	***	0	0
USNO	14	862	0	0	4	8	11	***
USNO	14	1028	***	***	0	0	1	***
USNO	14	1035	***	***	0	***	0	0
USNO	14	1094	100	81	98	100	100	100
USNO	14	1100	***	***	***	***	0	0
USNO	14	1255	100	100	100	100	100	100
USNO	14	1264	0	18	19	17	12	7
USNO	14	1300	***	***	0	***	0	0
USNO	14	1301	0	14	17	19	19	***
USNO	14	1305	0	9	10	***	***	***
USNO	14	1423	***	***	***	***	***	0
USNO	14	1586	100	0	***	***	***	***
USNO	14	1605	34	34	100	100	100	0
USNO	14	1710	7	8	9	***	0	0
USNO	14	1809	43	35	30	***	***	0
USNO	14	1846	100	100	100	100	100	100
USNO	14	1946	***	0	0	***	***	***
USNO	14	2098	100	100	100	100	100	0

TABLE 11A. (CONT.)

LAB.	CLOCK	48309	48369	48429	48499	48559	48619
USNO	14 2313	2	3	5	7	0	***
USNO	14 2315	100	100	***	***	***	***
USNO	14 2481	***	0	0	0	1	1
USNO	14 2482	***	0	0	***	***	***
USNO	14 2483	100	100	100	100	94	***
USNO	14 2484	***	***	***	0	0	100
USNO	14 2485	100	100	100	100	***	***
USNO	14 2486	19	13	15	***	0	0
USNO	14 2488	100	0	22	***	0	0
USNO	31 116	***	***	0	0	22	40
USNO	31 218	0	0	100	***	***	***
USNO	31 313	0	0	1	***	***	***
USNO	31 333	***	***	***	***	***	0
USNO	31 334	0	0	20	17	0	***
USNO	31 335	***	***	0	0	8	5
USNO	31 336	26	0	4	4	3	5
USNO	31 340	22	38	25	0	10	9
USNO	31 390	***	0	***	***	***	***
USNO	31 395	***	0	***	***	***	***
USNO	31 426	0	0	28	***	***	***
USNO	40 22	0	0	0	1	***	***
USNO	40 23	0	0	0	***	***	***
USNO	40 703	0	0	0	84	100	100
USNO	40 704	***	***	0	***	***	0
USNO	40 705	0	0	0	46	***	***
USNO	40 723	***	***	***	***	***	0
USNO	40 724	0	0	0	3	***	***
USNO	40 725	0	0	0	0	0	0
USNO	40 6201	0	0	0	***	0	0
USNO	40 6208	0	0	***	***	***	***
VSL	12 349	22	18	6	6	10	***
VSL	12 1489	11	18	14	17	34	48
VSL	14 1034	52	85	88	87	84	100
VSL	31 288	***	***	0	0	100	100
YUZM	12 1189	1	0	0	0	***	***
ZIPE	12 979	***	***	0	0	3	***

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

11 HEWLETT-PACKARD 5060A
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
19 RHODE AND SCHWARZ XSC
21 OSCILLOQUARTZ 3210
30 HEWLETT-PACKARD 5061B
31 HEWLETT-PACKARD 5061B OPT. 4
4x HYDROGEN MASERS
9x PRIMARY CLOCKS AND PROTOTYPES

TABLE 11B. STATISTICAL DATA ON WEIGHTS FOR 1991

Interval 1991	Total number of clocks	Number of clocks in a given class of weight							
		weight 0*	weight 0**	weight 1-19	weight 20-39	weight 40-59	weight 60-79	weight 80-99	weight 100
Jan-Feb	194	38	19	54	28	9	9	3	34
Mar-Apr	207	48	13	63	20	13	5	4	41
May-Jun	212	46	10	66	25	7	11	7	40
Jul-Aug	192	21	24	67	17	9	8	8	38
Sep-Oct	191	24	13	71	16	12	7	9	39
Nov-Dec	190	32	21	62	12	8	8	6	41

* A priori null weight (test interval of new clocks).
** Null weight resulting from the statistics.
Clocks with missing data during a two-month interval of computation are excluded.

TABLE 12. MEASUREMENTS OF THE EAL AND TAI FREQUENCIES

The following table gives the differences of frequencies, measured in 1986-1991, between EAL, and TAI, and the laboratory cesium standards: CRL Cs1, NIST 6, NRC CsV, NRC CsVI A, B, C, PTB CS1, PTB CS2, SU MCsR 101, SU MCsR 102. The frequencies are expressed on the rotating geoid (gravitational corrections applied).

The standard CRL Cs1 (previously RRL Cs1) performs discontinuous calibrations of UTC(CRL) which are transferred to EAL by linear adjustment of EAL-UTC(CRL) over 60 days.

The standard NIST 6 (previously NBS 6) is operated in discontinuous mode. The calibration data, referred to UTC(NIST), are transferred to EAL and TAI by a linear adjustment of EAL-UTC(NIST) over 80 days.

The standard NRC CsV has been continuously operating as a clock since May 1975. The EAL and TAI calibrations result from a linear adjustment of EAL-standard over 60-day intervals.
The standards NRC Cs VI A and C have been used as clocks since the end of 1979 and the calibrations data are transferred to EAL as for NRC CsV. The standard NRC Cs VI B was used as clock from the end of 1979 until the beginning of 1988.

The standard PTB CS1 was used as a frequency reference operating discontinuously until July 1978. Since then, it has been running as a clock, and the calibrations are obtained as for NRC CsV.
The standard PTB CS2 runs as a clock. The data, starting from August 1986, have been used in the same way as those of PTB CS1.

The standards SU MCsR 101 and 102 provide the frequency of TA(SU) and UTC(SU). The transfer to EAL is made by averaging the frequency difference of TA(SU) and EAL over several months.

Table 12. (Cont.)

Interval MJD	Central date	f(EAL) - f(Standard) in 10^{-13} NRC CsV	NRC CsVIA	NRC CsVIB	NRC CsVIC	PTB CS1	PTB CS2
46429-46489	1986 Jan 29	8.70	8.93	9.69	8.21	8.58	
46489-46549	1986 Mar 30	8.62	8.68	9.62	8.16	8.36	
46549-46609	1986 May 29	8.81	8.39	8.78	8.63	8.05	
46609-46669	1986 Jul 28	8.11	9.25	9.02	8.80	7.85	
46669-46729	1986 Sep 26	8.05	9.77	9.35	9.17	8.02	7.61
46729-46789	1986 Nov 25	8.56	8.53	8.99	8.79	8.06	7.85
46789-46849	1987 Jan 24	7.99	8.01	9.18	8.90	8.18	7.98
46849-46909	1987 Mar 25	8.33	8.13	8.41	8.65	8.36	7.91
46909-46969	1987 May 24	7.03	7.46	8.70	8.26	7.99	7.69
46969-47029	1987 Jul 23	6.40	7.01	8.38	7.00	8.20	7.64
47029-47099	1987 Sep 26	6.50	7.79	7.55	6.43	7.82	7.68
47099-47159	1987 Nov 30	7.11	8.78	10.48	6.87	8.04	7.79
47159-47219	1988 Jan 29	9.71	10.70	-	8.18	7.97	7.85
47219-47279	1988 Mar 29	8.56	7.78	-	7.48	8.16	7.79
47279-47339	1988 May 28	8.16	7.16	-	7.59	8.11	7.76
47339-47399	1988 Jul 27	9.14	5.98	-	7.39	7.80	7.64
47399-47459	1988 Sep 25	4.47	4.91	-	7.22	7.82	7.62
47459-47519	1988 Nov 24	4.79	4.13	-	4.77	7.87	7.76
47519-47579	1989 Jan 23	6.77	5.17	-	5.93	8.21	7.87
47579-47639	1989 Mar 24	7.64	5.71	-	9.12	8.14	7.72
47639-47699	1989 May 23	6.93	5.48	-	6.24	7.80	7.59
47699-47769	1989 Jul 27	4.18	4.73	-	6.62	7.66	7.42
47769-47829	1989 Sep 30	4.78	4.46	-	5.68	7.64	7.54
47829-47889	1989 Nov 29	4.52	5.66	-	6.99	7.85	7.61
47889-47949	1990 Jan 28	5.06	6.89	-	8.06	7.82	7.55
47949-48009	1990 Mar 29	8.44	7.40	-	8.22	7.77	7.49
48009-48069	1990 May 28	9.62	7.95	-	-2.09	7.82	7.53
48069-48129	1990 Jul 27	7.95	7.50	-	5.74	7.83	7.62
48129-48189	1990 Sep 25	6.66	7.70	-	7.38	7.69	7.21
48189-48249	1990 Nov 24	7.65	8.49	-	7.09	7.51	7.60
48249-48309	1991 Jan 23	8.37	6.32	-	6.53	7.50	7.31
48309-48369	1991 Mar 24	8.69	9.63	-	5.92	7.40	7.10
48369-48429	1991 May 23	8.34	10.07	-	7.04	7.47	7.38
48429-48499	1991 Jul 27	7.78	8.77	-	7.34	7.54	7.28
48499-48559	1991 Sep 30	7.15	8.24	-	7.01	7.43	7.14
48559-48619	1991 Nov 29	6.39	8.70	-	7.51	7.42	7.28

TABLE 12. (CONT.)

Interval MJD	Central date	f(EAL) - f(Standard) in 10^{-13} CRL Cs1	NIST NBS6	SU MCsR 101	SU MCsR 102
46502-46516	1986 Mar 20				5.87
46509-46569	1986 Apr 19	7.22			
46521-46543	1986 Apr 12				5.61
46563-46580	1986 May 22				5.76
46585-46600	1986 Jun 11				5.28
46684-46732	1986 Oct 5			5.99	
46737-46762	1986 Nov 16			5.58	
46773-46794	1986 Dec 19				5.35
46801-46816	1987 Jan 14				5.06
46859-46919	1987 Apr 5	8.73			
46886-46914	1987 Apr 14			5.37	
46919-46941	1987 May 15			5.67	
46947-46976	1987 Jun 15			6.11	
46959-47019	1987 Jul 13		9.65		
46977-46998	1987 Jul 11			6.09	
47061-47063	1987 Sep 24			5.59	
47083-47097	1987 Oct 21				5.76
47098-47124	1987 Nov 13				5.76
47130-47150	1987 Dec 11				5.36
47164-47173	1988 Jan 9				5.37
47215-47222	1988 Feb 28			5.45	
47256-47278	1988 Apr 16				5.87
47286-47288	1988 May 6				5.67
47354-47361	1988 Jul 16				5.77
47416-47433	1988 Sep 20				5.57
47437-47439	1988 Oct 4				5.64
47949-48009	1990 Apr 5	8.04			
48499-48559	1991 Sep 27	7.37			

TABLE 12. (CONT.)

f(TAI) - f(Standard) in 10^{-13}

Interval MJD	Central date	NRC CsV	NRC CsVIA	NRC CsVIB	NRC CsVIC	PTB CS1	PTB CS2
46429-46489	1986 Jan 29	0.70	0.93	1.69	0.21	0.58	
46489-46549	1986 Mar 30	0.62	0.68	1.62	0.16	0.36	
46549-46609	1986 May 29	0.81	0.39	0.78	0.63	0.05	
46609-46669	1986 Jul 28	0.11	1.25	1.02	0.80	-0.15	
46669-46729	1986 Sep 26	0.05	1.77	1.35	1.17	0.02	-0.39
46729-46789	1986 Nov 25	0.56	0.53	0.99	0.79	0.06	-0.15
46789-46849	1987 Jan 24	-0.02	0.00	1.17	0.89	0.17	-0.04
46849-46909	1987 Mar 25	0.32	0.12	0.40	0.64	0.35	-0.10
46909-46969	1987 May 24	-0.99	-0.55	0.69	0.25	-0.03	-0.32
46969-47029	1987 Jul 23	-1.61	-1.01	0.37	-1.01	0.19	-0.37
47029-47099	1987 Sep 26	-1.51	-0.22	-0.46	-1.58	-0.19	-0.34
47099-47159	1987 Nov 30	-0.91	0.77	2.46	-1.14	0.02	-0.23
47159-47219	1988 Jan 29	1.71	2.70	-	0.18	-0.03	-0.15
47219-47279	1988 Mar 29	0.56	-0.22	-	-0.52	0.16	-0.21
47279-47339	1988 May 28	0.16	-0.84	-	-0.41	0.11	-0.24
47339-47399	1988 Jul 27	1.14	-2.02	-	-0.61	-0.20	-0.36
47399-47459	1988 Sep 25	-3.53	-3.09	-	-0.78	-0.18	-0.38
47459-47519	1988 Nov 24	-3.21	-3.87	-	-3.23	-0.13	-0.24
47519-47579	1989 Jan 23	-1.23	-2.83	-	-2.07	0.21	-0.13
47579-47639	1989 Mar 24	-0.36	-2.29	-	1.12	0.14	-0.28
47639-47699	1989 May 23	-1.07	-2.52	-	-1.76	-0.20	-0.41
47699-47769	1989 Jul 27	-3.77	-3.22	-	-1.33	-0.29	-0.53
47769-47829	1989 Sep 30	-3.17	-3.49	-	-2.27	-0.31	-0.41
47829-47889	1989 Nov 29	-3.43	-2.29	-	-0.96	-0.10	-0.34
47889-47949	1990 Jan 28	-2.84	-1.01	-	0.16	-0.08	-0.35
47949-48009	1990 Mar 29	0.59	-0.45	-	0.37	-0.08	-0.36
48009-48069	1990 May 28	1.82	0.15	-	-9.89	0.02	-0.27
48069-48129	1990 Jul 27	0.20	-0.25	-	-2.01	0.08	-0.13
48129-48189	1990 Sep 25	-1.04	0.00	-	-0.32	-0.01	-0.49
48189-48249	1990 Nov 24	-0.05	0.79	-	-0.61	-0.19	-0.10
48249-48309	1991 Jan 23	0.67	-1.38	-	-1.17	-0.20	-0.39
48309-48369	1991 Mar 24	1.07	2.01	-	-1.70	-0.22	-0.53
48369-48429	1991 May 23	0.79	2.52	-	-0.51	-0.08	-0.17
48429-48499	1991 Jul 27	0.23	1.22	-	-0.21	-0.01	-0.27
48499-48559	1991 Sep 30	-0.35	0.74	-	-0.49	-0.07	-0.36
48559-48619	1991 Nov 29	-1.06	1.25	-	0.06	-0.03	-0.17

TABLE 12. (CONT.)

Interval MJD	Central date	CRL Cs1	NIST NBS6	SU MCsR 101	SU MCsR 102
		f(TAI) - f(Standard) in 10^{-13}			
46502-46516	1986 Mar 20				-2.13
46509-46569	1986 Apr 19	-0.78			
46521-46543	1986 Apr 12				-2.39
46563-46580	1986 May 22				-2.24
46585-46600	1986 Jun 11				-2.72
46684-46732	1986 Oct 5			-2.01	
46737-46762	1986 Nov 16			-2.42	
46773-46794	1986 Dec 19				-2.65
46801-46816	1987 Jan 14				-2.94
46859-46919	1987 Apr 5	0.73			
46886-46914	1987 Apr 14			-2.64	
46919-46941	1987 May 15			-2.34	
46947-46976	1987 Jun 15			-1.09	
46959-47019	1987 Jul 13		1.64		
46977-46998	1987 Jul 11			-1.92	
47061-47063	1987 Sep 24			-2.42	
47083-47097	1987 Oct 21				-2.26
47098-47124	1987 Nov 13				-2.26
47130-47150	1987 Dec 11				-2.66
47164-47173	1988 Jan 9				-2.63
47215-47222	1988 Feb 28			-2.55	
47256-47278	1988 Apr 16				-2.13
47286-47288	1988 May 6				-2.33
47354-47361	1988 Jul 16				-2.23
47416-47433	1988 Sep 20				-2.43
47437-47439	1988 Oct 4				-2.36
47949-48009	1990 Apr 5	0.19			
48499-48559	1991 Sep 27	-0.13			

TABLE 13. MEAN DURATION OF THE TAI SCALE INTERVAL IN SI SECOND ON THE ROTATING GEOID

The estimate of the mean duration of the TAI scale interval in SI second on the rotating geoid, is computed by the BIPM according to the method described in 'Azoubib J., Granveaud M., Guinot B., Metrologia 13, 1977, pp. 87-93' and is based on the calibrations of Table 12.

In the BIH Annual Reports from 1984 to 1987, the uncertainty was conservatively estimated to 5 10^{-14} since 1979. In the above table, the uncertainty is strictly the output of the computation and is based on the uncertainties reported by the laboratories.

For the months	Mean duration	Uncertainty
1985 Jan - Feb	1 + 0.9 10^{-14}	2.1 10^{-14}
1985 Mar - Apr	+ 1.8	2.0
1985 May - Jun	+ 1.3	2.0
1985 Jul - Aug	+ 1.3	2.0
1985 Sep - Oct	+ 0.8	2.0
1985 Nov - Dec	- 1.6	2.0
1986 Jan - Feb	1 - 2.9 10^{-14}	2.0 10^{-14}
1986 Mar - Apr	- 2.2	2.0
1986 May - Jun	- 0.9	1.9
1986 Jul - Aug	+ 0.4	1.9
1986 Sep - Oct	+ 2.1	1.3
1986 Nov - Dec	+ 0.6	1.3
1987 Jan - Feb	1 - 0.4 10^{-14}	1.3 10^{-14}
1987 Mar - Apr	- 0.1	1.3
1987 May - Jun	+ 2.1	1.3
1987 Jul - Aug	+ 2.6	1.3
1987 Sep - Oct	+ 2.7	1.3
1987 Nov - Dec	+ 1.5	1.3
1988 Jan - Feb	1 + 0.9 10^{-14}	1.3 10^{-14}
1988 Mar - Apr	+ 1.0	1.3
1988 May - Jun	+ 1.5	1.3
1988 Jul - Aug	+ 2.6	1.3
1988 Sep - Oct	+ 3.0	1.3
1988 Nov - Dec	+ 2.7	1.3
1989 Jan - Feb	1 + 0.8 10^{-14}	1.3 10^{-14}
1989 Mar - Apr	+ 1.9	1.3
1989 May - Jun	+ 3.5	1.3
1989 Jul - Aug	+ 4.5	1.3
1989 Sep - Oct	+ 3.8	1.3
1989 Nov - Dec	+ 3.0	1.3
1990 Jan - Feb	1 + 2.9 10^{-14}	1.3 10^{-14}
1990 Mar - Apr	+ 2.8	1.3
1990 May - Jun	+ 2.0	1.3
1990 Jul - Aug	+ 1.1	1.3
1990 Sep - Oct	+ 3.3	1.3
1990 Nov - Dec	+ 1.2	1.3
1991 Jan - Feb	1 + 3.2 10^{-14}	1.3 10^{-14}
1991 Mar - Apr	+ 4.0	1.3
1991 May - Jun	+ 1.5	1.3
1991 Jul - Aug	+ 2.1	1.3
1991 Sep - Oct	+ 2.8	1.3
1991 Nov - Dec	+ 0.8	1.3

PART C

TIME SIGNALS

PARTIE C

SIGNAUX HORAIRES

The time signal emissions reported here follow the UTC system, in accordance with the Recommendation 460-4 of the International Radio Consultative Committee (CCIR), 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 1992.

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	Telecommunication Laboratories Directorate General of Telecommunications Ministry of Transportation and Communications P.O. Box 71 - Chung-Li 320 Taiwan, R.O.C.
CHU	National Research Council Institute for National Measurement Standards - Time Standards Attn : Dr. R.J. Douglas Ottawa, Ontario, Canada K1A OR6
DCF77	Physikalisch-Technische Bundesanstalt, Lab. Zeiteinheit Bundesallee 100 W - 3300 Braunschweig Germany
EBC	Real Instituto y Observatorio de la Armada - San Fernando Cadiz, Spain
HBG	Service horaire HBG Observatoire Cantonal CH - 2000 Neuchâtel, Suisse
HLA	Time and Frequency Laboratory Korea Research Institute of Standards and Science P. O. Box 3, Taedok Science Town Taejon 305-606, Republic of Korea

Signal	Authority
IAM	Istituto Superiore delle Poste e delle Telecomunicazioni Ufficio 8°, Rep.2° - Viale Europa 190 00144 - Roma, Italy
JG2AS, JJY	Standards and Measurements Division Communications Research Laboratory 2-1, Nukui-kitamachi 4-chome Koganei-shi, Tokyo 184 Japan
LOL	Director Observatorio Naval Av. Espana 2099 1107 - Buenos-Aires, Republica Argentina
MSF	National Physical Laboratory Division of Electrical Science Teddington, Middlesex TW11 OLW United Kingdom
OMA	Standard time and frequency information Ustav radiotechniky a elektroniky CSAV Chaberská 57 182 51 Praha 8 - Czechoslovakia in cooperation with Astronomický ústav. ČSAV Budečská 6 120 23 Praha 2 - Czechoslovakia
PPE, PPR	Departamento Serviço da hora Observatorio Nacional (CNPq) Rua General Bruce, 586 20921 Rio de Janeiro - RJ, Brasil
RBU, RCH, RID, RTA, RTZ, RWM, UNW3, UPD8, UQC3, USB2,UTR3	VNIIFTRI Mendeleevo Moscow Region 141570 Russia

Signal	Authority
TDF	Centre National d'Etudes des Télécommunications - PAB - STC Etalons de fréquence et de temps 196 avenue Henri Ravera 92220 - Bagneux, France
VNG	Orroral Geodetic Observatory Australian Surveying and Land Information Group PO Box 2 Belconnen ACT 2616 Australia
WWV,WWVH **WWVB**	Time and Frequency Division, 847.00 National Institute of Standards and Technology - 325 Broadway Boulder, Colorado 80303, U.S.A.
YVTO	Direccion de Hidrografia y Navegacion Observatorio Cagigal Apartado Postal No 6745 Caracas, Venezuela

Note

The emission of time signals by IBF, Torino, Italy, ceased on 1991, November 1.

The emission of time signals by DGI, Oranienburg, Germany, will cease in early 1992.
As requested by the authority responsible for its emission, no information about DGI is given in this volume. Last available information about DGI can be found in the Annual Report of the BIPM Time Section for 1990 - Volume 3.

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	5 000 10 000 15 000	12 h 30 m to 3 h 30 m continuous 3 h 30 m to 12 h 30 m	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 of 1 kHz modulation. Minute pulses of 300 ms of 1 kHz modulation. From minutes 0 to 10, 15 to 25, 30 to 40, 45 to 55. UT1 time signals are emitted from minutes 25 to 29, 55 to 59.
BSF	Chung-Li Taiwan ROC 24° 57'N 121° 9'E	5 000 15 000	continuous except interruption between minutes 35 and 40	(a) From min. 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. (b) From min. 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. (c) Minute pulses are extended to 300 ms. (d) DUT1: CCIR code by 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 time code after 10 cycles of 1 kHz on the 31st to 39th seconds. Broadcast is single sideband; upper sideband with carrier reinsert. DUT1 : CCIR code by split pulses.
DCF77	Mainflingen Germany, F.R. 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 FRG and second markers 17 and 18 indicate if the transmitted time refers to UTC(PTB) + 2 h (summer time) or UTC(PTB) + 1 h. Second marker No 15 is prolonged to 0.2 s, if the reserve antenna is in use. 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.

TIME SIGNALS EMITTED IN THE UTC SYSTEM

Station	Location Latitude Longitude	Frequency (kHz)	Schedule (UTC)	Form of the signal
EBC	San Fernando Spain 36° 28'N 6° 12'W	12 008 6 840	10 h 00 m to 10 h 25 m 10 h 30 m to 10 h 55 m	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: CCIR code by double pulse.
HBG	Prangins Switzerland 46° 24'N 6° 15'E	75	continuous	Interruption of the carrier at the beginning of each second, during 100 ms. The minutes are identified by a double pulse, the hours by a triple pulse. No transmission of DUT1. Time code and other coded information.
HLA	Taedok Science Town Republic of Korea 36° 23'N 127° 22'E	5 000	Continuous	Pulses of 9 cycles of 1800 Hz modulation. 29th and 59th second pulses omitted. Hour identified by 0.8 second long 1500 Hz tone. Beginning of each minute identified by 0.8 second long 1800 Hz tone. Voice announcement of hours and minutes each minute following 52nd second pulse. BCD time code given on 100 Hz subcarrier. DUT1 : CCIR code by double pulse.
IAM	Rome Italy 41° 47'N 12° 27'E	5 000	7 h 30 m to 8 h 30 m 10 h 30 m to 11 h 30 m except sunday and national holidays. Advance by 1 hour in summer.	Second pulses of 5 cycles of 1 kHz modulation. Minute pulses of 20 cycles. Voice announcements every 15 m beginning at 0 h 0 m. Time announcement by Morse code beginning at 0 h 5 m. DUT1 : CCIR code by double pulse.
JG2AS	Sanwa Ibaraki Japan 36° 11'N 139° 51'E	40	continuous, except interruptions during communications.	During experimental coded transmission of the total day, hour, minute and DUT1, second pulses are 0.2 s, 0.5 s and 0.8 s duration. In case of no coded transmission, A1A type second pulses of 0.5 s duration.
JJY	Sanwa Ibaraki Japan 36° 11'N 139° 51'E	2 500 5 000 8 000 10 000 15 000	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 : CCIR code by lengthening.
LOL1	Buenos-Aires Argentina 34° 37'S 58° 21'W	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 1 000 Hz modulation. Second 59 is omitted. Announcement of hours and minutes every 5 minutes, followed by 3 m of 1 000 Hz or 440 Hz modulation. DUT1 : CCIR code by lengthening.

TIME SIGNALS EMITTED IN THE UTC SYSTEM

Station	Location Latitude Longitude	Frequency (kHz)	Schedule (UTC)	Form of the signal
LOL2 LOL3	Buenos-Aires Argentina 34° 37'S 58° 21'W	4 856 8 030 17 180	1 h, 13 h, 21 h	A1 second pulses during the 5 minutes preceding the indicated times. Second 29 is omitted. Minute pulses are prolonged. DUT1 : CCIR code by double pulse.
MSF	Rugby United Kingdom 52° 22'N 1° 11'W	60	continuous except for an interruption for maintenance from 10 h 0 m to 14 h 0 m on the first Tuesday in each month.	Interruptions of the carrier of 100 ms for the second pulses, of 500 ms for the minute pulses. The signal is given by the beginning of the interruption. BCD NRZ code, 100 bits/s (month, day of month, hour, minute), during minute interruption. BCD PWM code, 1 bit/s (year, month, day of month, day of week, hour, minute) from seconds 17 to 59 in each minute. DUT1 : CCIR code by double pulse.
OMA (1)	Liblice Czechoslovakia 50° 4'N 14° 53'E	50	continuous (from 6 h to 12 h on the first Wednesday in each month, emitted from Podebrady with reduced power)	Interruption of the carrier of 100 ms at the beginning of every second, of 500 ms at the beginning of every minute. The precise time is given by the beginning of the interruption. Phase coded announcement of date, UT and local civil time, leap second and civil time change, and identification of the transmitter in operation. No DUT1 code.
PPE	Rio-de-Janeiro Brasil 22° 54'S 43° 13'W	8 721	0 h 30 m, 11 h 30 m, 13 h 30 m, 19 h 30 m, 20 h 30 m, 23 h 30 m	Second ticks, of A1 type, during the five minutes preceding the indicated times. The minute ticks are longer. DUT1 : CCIR code by double pulse.
PPR	Rio-de-Janeiro Brasil 22° 59'S 43° 11'W	435 4 244 8 634 13 105 17 194.4 22 603	1 h 30 m, 14 h 30 m, 21 h 30 m	Second ticks, of A1 type, during the five minutes preceding the indicated times. The minute ticks are longer.
RBU (2)	Moscow Russia 55° 48'N 38° 18'E	66	continuous	DXXXW type signals. The time of day in hours, minutes and seconds is transmitted in BCD code. From 9 h to 11 h, 19 h to 23 h, NON type signals.
RCH (2)	Tashkent Uzbekistan 41° 19'N 69° 15'E	 2 500 5 000 10 000	between minutes 0 and 10, 30 and 40 0 h to 4 h 40 m 6 h to 23 h 40 m 0 h to 4 h 40 m 15 h to 23 h 40 m 6 h to 14 h 10 m	A1X type second pulses. The pulses at the beginning of the minute are prolonged to 0.5 s.

Notes : see p. C-14

TIME SIGNALS EMITTED IN THE UTC SYSTEM

Station	Location Latitude Longitude	Frequency (kHz)	Schedule (UTC)	Form of the signal
RID (2)	Irkutsk Russia 52° 26'N 104° 2'E	5 004 10 004 15 004	The station simultaneously operates on three frequencies between minutes 20 and 30, 50 and 60	A1X type second pulses. The pulses at the beginning of the minute are prolonged to 0.5 s.
RTA (2)	Novosibirsk Russia 55° 4'N 82° 58'E	 10 000 15 000	between minutes 0 and 10, 30 and 40 0 h to 6 h 10 m 15 h to 23 h 40 m 7 h 30 m to 14 h 10 m	A1X type second pulses. The pulses at the beginning of the minute are prolonged to 0.5 s.
RTZ (2)	Irkutsk Russia 52° 26'N 104° 2'E	50	between minutes 0 and 5 0 h to 21 h 05 m 23 h to 23 h 05 m	A1X type second pulses. The pulses at the beginning of the minute are prolonged to 0.5 s.
RWM (2)	Moscow Russia 55° 48'N 38° 18'E	4 996 9 996 14 996	The station simultaneously operates on three frequencies between minutes 10 and 20, 40 and 50	A1X type second pulses. The pulses at the beginning of the minute are prolonged to 0.5 s.
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 + and - 1 radian in 0.1 s every second except the 59th second of each minute. This modulation is doubled to indicate binary 1. The numbers of the minute, hour, day of the month, day of the week, month and year are transmitted each minute from the 21st to the 58th second, in accordance with the French legal time scale. In addition a binary 1 at the 17th second indicates that the local time is 2 hours ahead of UTC(summer time); a binary 1 at the 18th second indicates that the local time is one hour ahead of UTC(winter time); a binary 1 at the 14th second indicates that the current day is a public holiday (Christmas, 14 July, etc...); a binary 1 at the 13th second indicates that the current day is a day before a public holiday.
UNW3	Molodechno Belarus 54° 26'N 26° 48'E	25	Winter schedule : 8 h 13 m to 8 h 22 m 14 h 13 m to 14 h 22 m Summer schedule : 7 h 13 m to 7 h 22 m 13 h 13 m to 13 h 22 m	A1N type 0.1 second pulses of 0.025 s duration. Second pulses are prolonged to 0.1 s. 10 second pulses are prolonged to 1 s and minute pulses are prolonged to 10 s. No transmission of DUT1 code.
UPD8	Arkhangelsk Russia 64° 24'N 41° 32'E	25	Winter schedule : 12 h 13 m to 12 h 22 m 22 h 13 m to 22 h 22 m Summer schedule : 3 h 13 m to 3 h 22 m 9 h 13 m to 9 h 22 m	A1N type 0.1 second pulses of 0.025 s duration. Second pulses are prolonged to 0.1 s. 10 second pulses are prolonged to 1 s and minute pulses are prolonged to 10 s. No transmission of DUT1 code.

Notes : see p. C-14

TIME SIGNALS EMITTED IN THE UTC SYSTEM

Station	Location Latitude Longitude	Frequency (kHz)	Schedule (UTC)	Form of the signal
UQC3	Chabarovsk Russia 48 30'N 134 51'E	25	Winter schedule : 3 h 13 m to 3 h 22 m 9 h 13 m to 9 h 22 m 15 h 13 m to 15 h 22 m Summer schedule : 2 h 13 m to 2 h 22 m 8 h 13 m to 8 h 22 m 14 h 13 m to 14 h 22 m	A1N type 0.1 second pulses of 0.025 s duration. Second pulses are prolonged to 0.1 s. 10 second pulses are prolonged to 1 s and minute pulses are prolonged to 10 s. No transmission of DUT1 code.
USB2	Bishkek Kirgiztan 43 04'N 73 39'E	25	Winter schedule : 5 h 13 m to 5 h 22 m 11 h 13 m to 11 h 22 m 17 h 13 m to 17 h 22 m Summer schedule : 4 h 13 m to 4 h 22 m 10 h 13 m to 10 h 22 m 20 h 13 m to 20 h 22 m	A1N type 0.1 second pulses of 0.025 s duration. Second pulses are prolonged to 0.1 s. 10 second pulses are prolonged to 1 s and minute pulses are prolonged to 10 s. No transmission of DUT1 code.
UTR3	Nizhni Novgorod Russia 56 11'N 43 58'E	25	Winter schedule : 6 h 13 m to 6 h 22 m 20 h 13 m to 20 h 22 m Summer schedule : 5 h 13 m to 5 h 22 m 19 h 13 m to 19 h 22 m	A1N type 0.1 second pulses of 0.025 s duration. Second pulses are prolonged to 0.1 s. 10 second pulses are prolonged to 1 s and minute pulses are prolonged to 10 s. No transmission of DUT1 code.
VNG	Llandilo New South Wales Australia 33 43'S 150 48'E	5 000 8 638 12 984 16 000	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. Second pulse 59 omitted. Minute pulses of 0.5 seconds of 1 kHz modulation. During minutes 5, 10, 15,... second pulses 50 to 58 are 5 ms of 1 kHz. BCD time code giving day of year, hour and minute at the next minute is given between seconds 20 and 46. Voice announcement on 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 : CCIR code by double pulse, 50 ms of 900 Hz.
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 : CCIR 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 savings time in effect, leap year and leap second.

TIME SIGNALS EMITTED IN THE UTC SYSTEM

Station	Location Latitude Longitude	Frequency (kHz)	Schedule (UTC)	Form of the signal
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 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 : CCIR code by double pulse. BCD time code given on 100 Hz subcarrier, includes DUT1 correction.
YVTO	Caracas Venezuela 10 30'N 66 55'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.

NOTES ON THE CHARACTERISTICS OF THE SIGNALS

(1) OMA, 50 kHz
The main transmitter in Liblice radiates approximately 7 kW and the stand-by transmitter in Podebrady (50 9'N, 15 9'E) approximately 50 W. The details of the time code were published in ' Nomenclature des stations de radiorepérage et des stations effectuant des services spéciaux'. Liste VI, Volume I, édition 7 de U.I.T. in Geneva in July 1980.

(2) CIS radiostation emitting DUT1 information in accordance with the CCIR 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 21th and 24th second so that dUT1 = +p.0,02 s. Negative values of dUT1 are transmitted by the marking of q second markers within the range between the 31th and the 34th second, so that dUT1 = -q.0,02 s.

ACCURACY OF THE CARRIER FREQUENCY

Station	Relative uncertainty of the carrier frequency in 10^{-10}
ATA	0.1
BPM	0.1
BSF	0.1
CHU	0.05
DCF77	0.005 (10d-mean)
EBC	0.1
HBG	0.005
HLA	0.1
IAM	0.5
JG2AS, JJY	0.1
LOL	0.1
MSF	0.02
OMA	0.5
RBU, RTZ	0.05
RCH, RID, RTA, RWM	0.5
TDF	0.02
UNW3, UPD8, UQC3,	0.05
USB2, UTR3	0.05
WWV	0.1
WWVB	0.1
WWVH	0.1

Erratum

Annual Report for 1990

TABLE 6, page B-25:

Add 1000 microseconds to the published values of TAI - TA(RC).

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