BIPM

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BUREAU INTERNATIONAL DES POIDS ET MESURES

Circular T 46 (1991 December 2)

1 - Coordinated Universal Time UTC. Computed values of UTC-UTC(k).

(Since 1991 January 1, 0hUTC, TAI-UTC=26s),

Date 1991 0hUTC		Sep 30	Oct 10	Oct 20	Oct 30
MJD		48529	48539	48549	48559
Laboratory k		UTC-UTC(k) (Unit = 1 microsecond)			
AOS (Borowiec)		-0.57	-0.39	-0.35	0.09
APL (Laurel)		-1.18	-1.23	-1.20	-1.20
AUS (Canberra)		0.13	0.12	0.14	0.12
BEV (Wien)		8.07	7.19	6.28	5.52
CAO (Cagliari)		-	-	-	-
CH (Bern)		1.58	1.54	1.53	1.48
CRL (Tokyo)		2.15	2.18	2.19	2.24
CSAO (Lintong)		-3.36	-3.11	-3.02	-2.98
DPT (Pretoria)		-24.61	-24.55	-24.53	-24.57
FTZ (Darmstadt)		22.43	22.58	22.77	22.90
IEN (Torino)		-1.03	-1.10	-1.15	-1.24
IFAG (Wettzell)		1.74	1.77	1.75	1.58
IGMA (Buenos Aires)		1.44	1.61	1.72	1.69
INPL (Jerusalem)		-0.65	-0.77	-0.88	-1.00
JATC (Lintong)		-26.92	-26.63	-26.58	-26.51
KRIS (Taejon)	(1)	0.62	0.55	0.55	0.61
LDS (Leeds)		-11.27	-12.05	-12.74	-13.53
NAOM (Mizusawa)		-9.43	-9.40	-9.19	-8.93
NIM (Beijing)		7.76	7.91	7.90	7.99
NIST (Boulder)		-1.07	-1.06	-1.04	-1.05
NPL (Teddington)		-0.41	-0.53	-0.52	-0.54
NPLI (New-Delhi)		-	-	4.90	6.07
NRC (Ottawa)		2.03	1.96	1.95	1.92
NRLM (Tsukuba)		-64.17	-67.73	-74.48	-80.97
OMH (Budapest)		2.83	3.02	3.09	3.05
ONRJ (Rio de Janeiro)		11.51	-	-	-
OP (Paris)		-0.77	-0.72	-0.66	-0.66
ORB (Bruxelles)		1.36	1.39	1.32	1.46
PEL (Lower Hutt)		-0.82	-0.99	-1.05	-1.12
PKNM (Warszawa)		-0.50	-0.30	-0.11	0.03
PTB (Braunschweig)		3.35	3.34	3.35	3.34
RC (Habana)		-3.08	-3.08	-2.86	-2.87
ROA (San Fernando)		5.86	5.82	5.53	5.38
SNT (Stockholm)		0.02	-0.01	0.01	0.03
SO (Shanghai)		2.31	2.38	2.39	2.36
SU (Moskva)	(2)	5.25	5.14	5.00	4.93
TAO (Tokyo)		1.19	1.20	1.19	1.23
TL (Chung-Li)		2.94	2.93	2.84	2.81
TP (Praha)		-0.44	-0.44	-0.45	-0.55
TUG (Graz)		-0.35	-0.03	0.31	0.60
USNO (Washington DC)	(USNO MC)	0.13	0.12	0.14	0.12
VSL (Delft)		1.94	1.93	1.94	1.98
YUZM (Beograd)		51.06	-	-	-
ZIPE (Potsdam)		-0.09	-0.10	-0.11	-0.20

PAVILLON DE BRETEUIL F - 92312 SÈVRES CEDEX

TÉL. (CENTRAL) : + 33 1 45 07 70 70 TELEX : BIPM 631351 F TÉLÉCOPIE : + 33 1 45 34 20 21

2 - International Atomic Time TAI and local atomic time scales TA(k).

The following table gives the computed values of TAI-TA(k).

Date 1991 0hUTC		Sep 30	Oct 10	Oct 20	Oct 30
MJD		48529	48539	48549	48559
Laboratory k		TAI-TA(k) (Unit = 1 microsecond)			
APL (Laurel)		-1.69	-1.73	-1.71	-1.71
AUS (Canberra)		-37.30	-37.45	-37.57	-37.73
CH (Bern)		-71.25	-71.34	-71.40	-71.49
CRL (Tokyo)		5.78	5.99	6.18	6.42
CSAO (Lintong)		24.08	24.12	24.00	23.84
F (Paris)		95.61	95.92	96.23	96.54
JATC (Lintong)		-1.37	-1.10	-0.91	-0.84
KRIS (Taejon)	(1)	-20.40	-21.01	-21.61	-22.15
NIM (Beijing)		-10.56	-10.40	-10.37	-10.27
NISA (Boulder)	(3)	-45078.19	-45078.53	-45078.86	-45079.22
NIST (Boulder)		-45174.46	-45175.14	-45175.79	-45176.48
NRC (Ottawa)		18.10	18.03	18.02	17.99
PTB (Braunschweig)		-360.05	-360.06	-360.05	-360.06
RC (Habana)	(4)	-294.95	-295.22	-295.40	-295.80
SO (Shanghai)		-45.08	-45.02	-45.01	-45.06
SU (Moskva)		2827255.25	2827255.14	2827255.00	2827254.93
USNO (Washington DC)	(5)	-34634.24	-34634.93	-34635.60	-34636.29

3 - Notes on sections 1 and 2.

(1) KRIS. Korea Research Institute of Standards and Science.
Formerly KSRI.

(2) SU . Time transfer data obtained from GLONASS satellite trackings at the University of Leeds (U.K.) and SU. See Section 5.

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

(4) RC . Listed values are TAI-TA(RC) - 18 seconds.

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

4 - UTC - GPS time and TAI - GPS time.

UTC - GPS time = -7s + C0, TAI - GPS time = 19s + C0.

The GPS data are taken at the Paris Observatory, from Block I satellites, and are usually corrected for the measured ionospheric delays. They are smoothed to obtain daily values of UTC(OP) - GPS time at 0hUTC. UTC - GPS time is derived from them using linear interpolation of UTC - UTC(OP).

The r values are the residuals to the smoothed data for the middle of the 13-minute tracking period. The reference times are given for the first date of the table only. The r values are reported here only to 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 the access to UTC mainly depends upon local conditions of observation.

			r(ns) Block I				
Date 1991 0hUTC	MJD	C0 (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	171	-4	-2	4	10	-1
Oct 1	48530	171	0	5	2	-7	-6
Oct 2	48531	168	-6	-	3	-7	-2
Oct 3	48532	169	-3	3	2	4	-5
Oct 4	48533	170	-9	-	8	-4	-8
Oct 5	48534	167	3	-4	5	4	-5
Oct 6	48535	159	0	12	-2	6	-9
Oct 7	48536	152	-7	-16	-3	0	-11
Oct 8	48537	149	1	15	9	-3	-7
Oct 9	48538	144	7	-	5	11	-12
Oct 10	48539	138	2	-15	4	-1	-14
Oct 11	48540	135	-12	11	3	7	0
Oct 12	48541	133	-6	-13	8	7	-2
Oct 13	48542	129	5	-13	7	-8	-7
Oct 14	48543	129	-3	8	-1	-1	-1
Oct 15	48544	133	-4	-	-4	2	0
Oct 16	48545	135	-3	5	7	9	1
Oct 17	48546	135	-	-	-6	-10	13
Oct 18	48547	140	-	-	-	6	-
Oct 19	48548	154	-	-	-	-6	5
Oct 20	48549	172	-	-	-	-	-
Oct 21	48550	180	-	-	-	-	-
Oct 22	48551	183	-	-	-1	-	-
Oct 23	48552	184	-	-	4	9	-
Oct 24	48553	184	6	-	-5	-	6
Oct 25	48554	186	5	-	-10	13	-12
Oct 26	48555	188	-4	-3	14	5	-8
Oct 27	48556	188	-6	-	7	-13	10
Oct 28	48557	184	3	-	-5	-6	-2
Oct 29	48558	181	-12	-1	9	8	-9
Oct 30	48559	179	6	-9	3	-3	-3

Section 4 (Cont.)

For Block II satellites, the r values are computed with respect to C0 obtained from Block I only.

Date 1991 0hUTC	MJD	C0 (ns)	r(ns) Block II PRN20 NAV20 3h40m	PRN17 NAV17 10h 4m	PRN15 NAV15 12h28m	PRN21 NAV21 13h48m	PRN14 NAV14 15h24m
Sep 30	48529	171	20	1	8	20	6
Oct 1	48530	171	5	2	-6	17	-7
Oct 2	48531	168	7	2	8	8	-3
Oct 3	48532	169	0	1	8	16	-8
Oct 4	48533	170	11	15	1	8	7
Oct 5	48534	167	15	-7	10	5	5
Oct 6	48535	159	8	9	-19	9	-1
Oct 7	48536	152	16	11	9	19	3
Oct 8	48537	149	0	2	1	31	9
Oct 9	48538	144	19	4	9	-17	-8
Oct 10	48539	138	0	12	6	5	10
Oct 11	48540	135	13	-3	13	9	9
Oct 12	48541	133	18	1	6	3	-2
Oct 13	48542	129	-2	7	-9	15	6
Oct 14	48543	129	21	19	-8	11	-5
Oct 15	48544	133	11	-8	-6	14	-4
Oct 16	48545	135	13	10	-5	7	3
Oct 17	48546	135	-	1	-2	24	-
Oct 18	48547	140	-	30	-	-	-
Oct 19	48548	154	-	33	-	-	-
Oct 20	48549	172	-	41	-	-	-
Oct 21	48550	180	-	-	-	-	-
Oct 22	48551	183	-	29	-	-	-
Oct 23	48552	184	-	9	17	15	-
Oct 24	48553	184	-	1	-18	42	-2
Oct 25	48554	186	-4	2	-21	23	-17
Oct 26	48555	188	5	-12	-6	-4	-9
Oct 27	48556	188	10	-18	-31	15	-12
Oct 28	48557	184	13	5	13	9	6
Oct 29	48558	181	-12	-14	4	-17	-12
Oct 30	48559	179	2	-1	-6	26	5

Section 4 (Cont.)

Date 1991 0hUTC	MJD	C0 (ns)	r(ns) Block II PRN18 NAV18 18h 0m	PRN16 NAV16 21h12m	PRN19 NAV19 21h44m	PRN 2 NAV13 0h28m	PRN23 NAV23 1h 0m
Sep 30	48529	171	-1	16	-11	-8	11
Oct 1	48530	171	5	12	32	22	1
Oct 2	48531	168	19	-5	-25	-9	8
Oct 3	48532	169	4	25	-21	-9	5
Oct 4	48533	170	3	7	-6	17	-7
Oct 5	48534	167	10	0	-12	-18	11
Oct 6	48535	159	7	23	-2	-	2
Oct 7	48536	152	2	9	-16	-4	3
Oct 8	48537	149	10	7	-27	-3	-7
Oct 9	48538	144	1	-7	-1	3	-8
Oct 10	48539	138	17	11	13	5	2
Oct 11	48540	135	0	-8	10	4	5
Oct 12	48541	133	9	-1	2	-5	4
Oct 13	48542	129	6	3	11	18	-3
Oct 14	48543	129	5	22	-12	-2	-
Oct 15	48544	133	15	29	-1	3	-9
Oct 16	48545	135	-5	-5	0	-	-
Oct 17	48546	135	-5	-1	-25	8	-13
Oct 18	48547	140	-	-	-	-	-
Oct 19	48548	154	12	27	20	-	-
Oct 20	48549	172	12	-3	-13	-	-
Oct 21	48550	180	-19	13	13	-	-
Oct 22	48551	183	-	-7	-24	-	-
Oct 23	48552	184	-15	-12	-20	-	-
Oct 24	48553	184	-20	-7	-38	-10	-7
Oct 25	48554	186	7	2	15	-2	-10
Oct 26	48555	188	1	1	-22	-7	9
Oct 27	48556	188	6	3	-22	-13	3
Oct 28	48557	184	6	9	5	8	2
Oct 29	48558	181	8	6	12	1	-2
Oct 30	48559	179	-5	6	-21	0	-1

5 - UTC - GLONASS time.

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

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 at ten-day intervals, together with the standard deviation SD of his daily GLONASS data. C1 is then derived using UTC - GPS time of section 4.

Date 1991 0hUTC	MJD	C1 (μs)	SD (μs)
Sep 30	48529	-6.65	0.06
Oct 10	48539	-6.91	0.05
Oct 20	48549	-7.13	0.06
Oct 30	48559	-7.39	0.06

6 - Measurement of UTC(j)-UTC(k).

Date 1991	MJD	Time comparisons (Unit = 1 microsecond)	uncert.	source	meth.
Apr 23	48369.00	UTC(OP)-UTC(TUG) = 2.790	0.001	BIPM report	(1)
Oct 30	48559.05	UTC(CRL)-UTC(TAO) = -1.077	0.005	CRL report	(2)

(1) GPS receiver transportation.
(2) Clock transportation.

7 - Duration of the TAI scale interval.

The following table gives the departure D of the duration of the TAI scale interval from the SI second on the rotating geoid as realized by a given primary frequency standard occasionally evaluated or continuously operating as a clock. In the later case the chosen two-month period of observation is also indicated. The last communicated estimate of the inaccuracy of the standard provides the uncertainty s of the D value.

D and s are expressed in units of 10^{-14} second.

Standard	Obs. period	D	s
NRC-CsV	48499-48559	+3.5	10.0
PTB-CS1	48499-48559	+0.7	3.0
PTB-CS2	48499-48559	+3.6	1.5

The estimate of the duration of the TAI scale interval, computed by the BIPM, from all the available measurements of the TAI frequency, obtained by comparison with primary frequency standards continuously observed or occasionally evaluated (CRL, NIST, NRC, PTB, SU), is:

$$1 + 3\times10^{-14} \pm 2\times10^{-14}$$

in SI second on the rotating geoid, for the two-month interval 48499-48559 .