BUREAU INTERNATIONAL DES POIDS ET MESURES

ISSN 1143-1393

Circular T 177 (2002 October 10)
Circulaire T 177

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

(From 1999 January 1, 0h UTC, TAI-UTC = 32 s)

Date 2002 0h UTC		Aug 28	Sep 2	Sep 7	Sep 12
MJD		52514	52519	52524	52529
Laboratory *k*			[*UTC-UTC*(*k*)]/ns		
AOS (Borowiec)		-52	-34	-16	7
AUS (Sydney)		-104	-101	-91	-83
BEV (Wien)		41	45	48	44
BIRM (Beijing)		539	555	575	589
CAO (Cagliari)		-	-	-	-3788
CH (Bern)		14	13	4	-1
CNM (Queretaro)		148	151	150	151
CRL (Tokyo)		-25	-26	-22	-19
CSIR (Pretoria)		-	-	-	-
DLR (Oberpfaffenhofen)		-	-	-	-
DTAG (Darmstadt)		12	32	3	-2
IEN (Torino)		61	81	86	88
IFAG (Wettzell)		-1528	-1531	-1521	-1493
IGMA (Buenos Aires)		-23	-21	-9	-14
INPL (Jerusalem)		-5204	-5253	-5308	-5364
IPQ (Monte de Caparica)		-	-	-	-
JATC (Lintong)		-10693	-10751	-10795	-10835
KRIS (Taejon)		-73	-65	-61	-
LDS (Leeds)		2106	2128	2154	2182
LT (Vilnius)		-260	-273	-278	-279
MSL (Lower Hutt)		501	493	482	453
NAO (Mizusawa)		71	72	66	62
NIM (Beijing)		-2626	-2620	-2616	-2615
NIMT (Bangkok)		-25	-31	-	124
NIST (Boulder)		-3	-1	0	0
NMC (Sofiya)		-2076	-2070	-2077	-2094
NMIJ (Tsukuba)	(1)	-391	-419	-157	260
NMLS (Shah Alam)		26	102	132	118
NPL (Teddington)		-2	-3	-5	-6
NPLI (New-Delhi)		1811	1852	1896	1942
NRC (Ottawa)		-19	-14	-7	-3
NTSC (Lintong)		21	-1	3	-2
OMH (Budapest)		7204	7237	7255	7292
ONBA (Buenos Aires)		-666	-670	-670	-649
ONRJ (Rio de Janeiro)		4875	4881	4900	4896
OP (Paris)		28	24	23	25
ORB (Bruxelles)		-99	-136	-73	18
PL (Warszawa)		-52	-47	-48	-46
PTB (Braunschweig)		6	8	4	-1
ROA (San Fernando)		18	26	27	19
SCL (Hong Kong)		-13	-19	-21	-28
SG (Singapore)		-25	-32	-37	-40
SMU (Bratislava)		-6705	-6742	-6776	-6808
SP (Boras)		308	287	262	241
SU (Moskva)		27	31	28	26
TL (Chung-Li)	(2)	-66	-58	-51	-47
TP (Praha)		35	19	15	14
UME (Gebze-Kocaeli)		-652	-652	-650	-655
USNO (Washington DC)(USNO MC)		-4	-4	-4	-4
VSL (Delft)		-21	-25	-29	-22

1 - Coordinated Universal Time UTC. (Cont.)

Date 2002 0h UTC		Sep 17	Sep 22	Sep 27
MJD		52534	52539	52544
Laboratory *k*			[*UTC*-*UTC*(*k*)]/ns	
AOS (Borowiec)		30	48	70
AUS (Sydney)		-83	-81	-81
BEV (Wien)		41	39	30
BIRM (Beijing)		603	618	627
CAO (Cagliari)		-3789	-3775	-3785
CH (Bern)		-9	-10	-14
CNM (Queretaro)		158	165	168
CRL (Tokyo)		-27	-22	-31
CSIR (Pretoria)		-	-	-
DLR (Oberpfaffenhofen)		-	-	-
DTAG (Darmstadt)	(3)	-	35	43
IEN (Torino)		84	70	67
IFAG (Wettzell)		-1472	-1466	-1449
IGMA (Buenos Aires)		-13	-21	-32
INPL (Jerusalem)		-5417	-5472	-5533
IPQ (Monte de Caparica)		-	-	-
JATC (Lintong)		-10893	-10921	-10967
KRIS (Taejon)		-	-	-68
LDS (Leeds)		2194	2218	2249
LT (Vilnius)		-269	-258	-288
MSL (Lower Hutt)		411	358	274
NAO (Mizusawa)		48	43	37
NIM (Beijing)		-2620	-2616	-2626
NIMT (Bangkok)		112	76	40
NIST (Boulder)		2	3	4
NMC (Sofiya)		-2136	-2153	-2183
NMIJ (Tsukuba)		254	266	266
NMLS (Shah Alam)		114	100	92
NPL (Teddington)		-6	-9	-9
NPLI (New-Delhi)		1989	2013	2069
NRC (Ottawa)		-1	-3	0
NTSC (Lintong)		-4	9	9
OMH (Budapest)		7296	7305	7311
ONBA (Buenos Aires)		-651	-649	-759
ONRJ (Rio de Janeiro)		4908	4915	4919
OP (Paris)		21	13	6
ORB (Bruxelles)		42	58	53
PL (Warszawa)		-52	-60	-66
PTB (Braunschweig)		-1	-3	-6
ROA (San Fernando)		18	17	21
SCL (Hong Kong)		-30	-23	-17
SG (Singapore)		-43	-42	-32
SMU (Bratislava)		-6827	-6873	-6917
SP (Boras)		226	210	195
SU (Moskva)		25	25	23
TL (Chung-Li)		-52	-46	-52
TP (Praha)		8	10	11
UME (Gebze-Kocaeli)		-668	-671	-681
USNO (Washington DC)(USNO MC)		-3	-4	-4
VSL (Delft)		-27	-30	-27

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

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

Date 2002 0h UTC		Aug 28	Sep 2	Sep 7	Sep 12
MJD		52514	52519	52524	52529
Laboratory *k*		[*TAI-TA*(*k*)]/ns			
AUS (Sydney)		-116762	-116846	-116919	-116996
CH (Bern)		23216	23398	23572	23750
CRL (Tokyo)		162290	162490	162689	162892
F (Paris)		168124	168148	168174	168200
IEN (Torino)		21063	21197	21317	21429
JATC (Lintong)		-24543	-24653	-24739	-24831
KRIS (Taejon)		6050	6057	6060	-
NIST (Boulder)		-45239113	-45239316	-45239519	-45239722
NRC (Ottawa)		28257	28266	28278	28286
NTSC (Lintong)		-127	-141	-124	-119
PL (Warszawa)		-853	-859	-864	-868
PTB (Braunschweig)		-359759	-359752	-359751	-359751
SU (Moskva)	(4)	27241027	27241031	27241028	27241026
USNO (Washington DC)		-34892886	-34893197	-34893507	-34893819

Date 2002 0h UTC		Sep 17	Sep 22	Sep 27
MJD		52534	52539	52544
Laboratory *k*		[*TAI-TA*(*k*)]/ns		
AUS (Sydney)		-117094	-117169	-117263
CH (Bern)		23925	24107	24286
CRL (Tokyo)		163085	163285	163484
F (Paris)		168222	168247	168269
IEN (Torino)		21547	21658	21773
JATC (Lintong)		-24941	-25032	-25131
KRIS (Taejon)		-	-	6069
NIST (Boulder)		-45239924	-45240127	-45240329
NRC (Ottawa)		28293	28294	28301
NTSC (Lintong)		-124	-115	-117
PL (Warszawa)		-873	-880	-888
PTB (Braunschweig)		-359746	-359743	-359741
SU (Moskva)	(4)	27241025	27241025	27241023
USNO (Washington DC)		-34894128	-34894441	-34894752

3 - Notes on sections 1 and 2.

(1) NMIJ. Change of master clock on MJD = 52527

(2) TL . Corrected values from *Circular T* 176

MJD	[*UTC-UTC*(*TL*)]/ns
52489	-57
52499	-65
52504	-63
52509	-60

(3) DTAG. Change of master clock on MJD = 52534

(4) SU . Listed values are *TAI-TA*(*SU*) - 2.80 seconds.

4 - Difference between the normalized frequencies of EAL and TAI.

Interval of validity		$f(EAL)-f(TAI)$
2002 July 29 - 2002 Sep. 27	52484-52544	7.010×10^{-13}
New steering correction for October and November 2002		
2002 Sep. 27 - 2002 Nov. 26	52544-52604	7.000×10^{-13}

5 - Duration of the TAI scale interval.

TAI is a realization of coordinate time TT. The following tables give the fractional deviation d of the scale interval of TAI from that of TT (the SI second on the geoid), i.e. the fractional frequency deviation of TAI with the opposite sign: $d = -y_{TAI}$.
In this section, a frequency over a time interval is defined as the ratio of the end-point phase difference to the duration of the interval. Whenever needed, the instability of EAL should be expressed as the quadratic sum of three components:

a white frequency noise $6.0 \times 10^{-15} / \sqrt{\tau}$,
a flicker frequency noise 0.6×10^{-15},
a random walk frequency noise $1.6 \times 10^{-16} \times \sqrt{\tau}$,

with τ in days. The relation between EAL and TAI is given in *Circular T* and the *Annual Report of the BIPM Time Section*.

In the first table, d is obtained, on the given periods of estimation by comparison of the TAI frequency with that of the given individual primary standards (PFS). In this table

u_B is the combined uncertainty from systematic effects,
Ref(u_B) is a reference giving information on the stated value of u_B or is the *Circular T* where this reference was first given,
u_A is the uncertainty originating in the instability of the PFS,
$u_{l/lab}$ is the uncertainty in the link between the PFS and the clock participating to TAI,
$u_{l/TAI}$ is the uncertainty in the link to TAI,
u is the quadratic sum of all four uncertainty values.

Standard	Period of estimation	$10^{15}d$	$10^{15}u_B$	Ref(u_B)	$10^{15}u_A$	$10^{15}u_{l/lab}$	$10^{15}u_{l/TAI}$	Notes	$10^{15}u$
PTB CS1	52514-52544	-1.6	8.	T148	5.	0.	1.	(1)	9.
PTB CS2	52514-52544	9.9	12.	T148	3.	0.	1.	(1)	12.
NIST-F1	52514-52544	8.4	0.9	[1]	1.1	0.5	1.0	(2)	1.8

[1] Jefferts S.R. et al., Metrologia, accepted.

Notes:

(1) Continuously operating as a clock participating to TAI.
(2) Report 27 September 2002 by NIST.

The second table gives the BIPM estimate of d, based on measurements of CRL-O1, LPTF-JPO, NIST-F1, PTB CS1, PTB CS2, PTBCSF1 over the period MJD 52154-52544, taking into account their individual uncertainties and characterizing the instability of EAL as noted above. u is the computed standard uncertainty of d.

Period of estimation	d	u
52514-52544	$+8.3 \times 10^{-15}$	1.5×10^{-15}

6 - [*UTC-GPS time*] and [*TAI-GPS time*].

[*UTC-GPS time*] = -13 s + C_0, [*TAI-GPS time*] = 19 s + C_0.

Daily values of C_0 are given in the following table. They are obtained as follows: the GPS data taken at the Paris Observatory, for highest elevation, are first corrected for precise satellite ephemerides and for measured ionospheric delays, and then smoothed to obtain daily values of [*UTC*(*OP*)-*GPS time*] at 0h UTC; daily values of C_0 are derived from them using linear interpolation of [*UTC-UTC*(*OP*)]. The global uncertainty of daily C_0 values is of order 10 ns.

In the following table, the standard deviation σ characterizes the dispersion of individual measurements, and N is the number of measurements used on a given day for estimation of the corresponding daily C_0 value.

Date 2002 0h UTC	MJD	C_0/ns	σ/ns	$(\sigma/\sqrt{N})$/ns
Aug 28	52514	-8	3	1
Aug 29	52515	-6	3	1
Aug 30	52516	-11	2	1
Aug 31	52517	-11	3	0
Sep 1	52518	-11	3	0
Sep 2	52519	-15	3	1
Sep 3	52520	-14	4	1
Sep 4	52521	-16	3	1
Sep 5	52522	-15	3	1
Sep 6	52523	-14	4	1
Sep 7	52524	-14	3	0
Sep 8	52525	-11	2	0
Sep 9	52526	-12	3	0
Sep 10	52527	-11	3	0
Sep 11	52528	-8	4	1
Sep 12	52529	-6	3	0
Sep 13	52530	-5	2	0
Sep 14	52531	-3	5	1
Sep 15	52532	-1	6	1
Sep 16	52533	2	3	0
Sep 17	52534	1	4	1
Sep 18	52535	-1	3	1
Sep 19	52536	0	4	1
Sep 20	52537	-3	4	1
Sep 21	52538	-4	3	0
Sep 22	52539	-10	3	1
Sep 23	52540	-12	4	1
Sep 24	52541	-16	3	1
Sep 25	52542	-15	3	1
Sep 26	52543	-15	3	1
Sep 27	52544	-14	3	0

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

[*UTC-GLONASS time*] = 0 s + C_1, [*TAI-GLONASS time*] = +32 s + C_1.

Daily values of C_1 are given in the following table. They are obtained as follows: the GLONASS data taken at the NMi Van Swinden Laboratorium, Delft, The Netherlands, for highest elevation, are smoothed to obtain daily values of [*UTC(VSL)-GLONASS time*] at 0h UTC; daily values of C_1 are then derived from them using linear interpolation of [*UTC-UTC(VSL)*]. The global uncertainty of daily C_1 values is of order several hundreds of nanoseconds.

In the following table, the standard deviation σ characterizes the dispersion of individual measurements, and N is the number of measurements used on a given day for estimation of the corresponding daily C_1 value.

Date 2002 0h UTC	MJD	C_1/ns	σ/ns	$(\sigma/\sqrt{N})$/ns
Aug 28	52514	-418	32	16
Aug 29	52515	-400	-	-
Aug 30	52516	-384	10	5
Aug 31	52517	-412	18	4
Sep 1	52518	-406	30	6
Sep 2	52519	-374	53	12
Sep 3	52520	-353	36	9
Sep 4	52521	-415	28	20
Sep 5	52522	-405	23	6
Sep 6	52523	-350	70	49
Sep 7	52524	-330	48	34
Sep 8	52525	-326	-	-
Sep 9	52526	-357	-	-
Sep 10	52527	-382	-	-
Sep 11	52528	-386	-	-
Sep 12	52529	-379	-	-
Sep 13	52530	-357	-	-
Sep 14	52531	-328	-	-
Sep 15	52532	-299	-	-
Sep 16	52533	-275	-	-
Sep 17	52534	-258	30	17
Sep 18	52535	-276	-	-
Sep 19	52536	-287	-	-
Sep 20	52537	-271	-	-
Sep 21	52538	-231	37	17
Sep 22	52539	-248	-	-
Sep 23	52540	-291	-	-
Sep 24	52541	-286	8	5
Sep 25	52542	-209	-	-
Sep 26	52543	-187	47	21
Sep 27	52544	-236	-	-