CIRCULAR T 190 (revised version) ISSN 1143-1393
2003 NOVEMBER 18, 12h UTC

BUREAU INTERNATIONAL DES POIDS ET MESURES
ORGANISATION INTERGOUVERNEMENTALE DE LA CONVENTION DU METRE
PAVILLON DE BRETEUIL F-92312 SEVRES CEDEX TEL. +33 1 45 07 70 70 FAX. +33 1 45 34 20 21 tai@bipm.org

1 - Coordinated Universal Time UTC and its local realizations UTC(k). Computed values of [*UTC-UTC*(*k*)].
From 1999 January 1, 0h UTC, *TAI-UTC* = 32 s.

Date 2003 0h UTC	SEP 27	OCT 2	OCT 7	OCT 12	OCT 17	OCT 22	OCT 27	
MJD	52909	52914	52919	52924	52929	52934	52939	
Laboratory *k*				[*UTC-UTC*(*k*)]/ns				
AOS (Borowiec)	32.3	26.0	29.4	22.5	27.7	37.7	42.6	
AUS (Sydney)	-386.4	-382.7	-392.3	-397.4	-406.9	-406.8	-398.5	
BEV (Wien)	-15.0	-6.8	-2.3	-4.1	-3.3	-2.3	-0.9	
BIRM (Beijing)	1301.0	1327.2	1340.9	1351.7	1365.3	1385.3	1399.9	
CAO (Cagliari)	-4131.2	-4148.3	-4166.9	-4185.0	-4212.4	-4205.2	-4209.0	
CH (Bern)	-35.5	-27.7	-29.5	-26.5	-22.5	-11.9	4.2	
CNM (Queretaro)	17.4	12.1	5.0	-2.6	-8.0	1.3	-11.7	
CNMP (Panama)		-934.3	-980.7	-1024.9	-1080.8	-1141.8	-1186.6	(1)
CRL (Tokyo)	-11.6	-9.3	-6.9	-10.0	-7.1	-9.5	-13.4	
CSIR (Pretoria)	-2854.0	-2887.5	-2916.6	-1708.4	4547.7	4442.0	4369.8	(2)
DLR (Oberpfaffenhofen)	9.1	2.0	5.1	8.1	10.3	6.7	12.3	
DTAG (Darmstadt)	263.9	285.4	281.3	263.1	257.4	254.4	244.9	
IEN (Torino)	70.2	68.0	56.2	52.1	35.5	32.7	35.7	
IFAG (Wettzell)	-2315.9	-2337.1	-2342.0	-2351.1	-2370.4	-2382.1	-2396.0	
IGMA (Buenos Aires)	-91.3	-91.0	-86.8	-96.2	-94.4	-91.4	-94.3	
INPL (Jerusalem)	-8571.9	-8602.6	-8632.1	-8663.8	-8699.8	-8726.0	-8868.1	
IPQ (Monte de Caparica)	-	-	-	-	-	-	-	
JATC (Lintong)	-11275.3	-11257.6	-11252.3	-11235.2	-11222.5	-11212.2	-11210.0	
JV (Kjeller)	-10398.0	-10265.9	-10413.3	-	-10630.6	-10630.3	-10566.5	
KRIS (Daejon)	-219.7	-198.0	-173.4	-145.1	-121.2	-89.4	-68.6	(3)
LDS (Leeds)	4084.4	4104.0	4121.2	4155.3	4197.8	4213.8	4248.3	
LT (Vilnius)	-26.5	-9.9	3.8	15.6	24.6	52.5	59.9	
MSL (Lower Hutt)	25.0	11.4	18.8	-17.3	-27.9	-35.4	-46.5	
NAO (Mizusawa)	12.1	10.8	3.9	-0.3	12.3	11.6	-0.2	
NIM (Beijing)	-2635.3	-2631.3	-2628.0	-2640.0	-2639.7	-2649.3	-2657.9	
NIMB (Bucharest)	-169.9	-167.1	-180.2	-176.4	-181.4	-215.7	-221.7	
NIMT (Bangkok)	-273.0	-295.6	-315.0	-346.7	-384.1	-420.1	-455.1	
NIST (Boulder)	7.9	5.5	3.9	4.7	1.2	0.1	1.8	
NMC (Sofiya)	-3128.8	-3143.9	-3152.2	-3164.9	-3165.9	-3157.4	-3166.0	
NMIJ (Tsukuba)	37.5	42.0	41.8	41.1	43.1	43.7	44.7	

Date 2003 0h UTC	SEP 27	OCT 2	OCT 7	OCT 12	OCT 17	OCT 22	OCT 27
MJD	52909	52914	52919	52924	52929	52934	52939
Laboratory *k*				[*UTC-UTC*(*k*)]/ns			
NMLS (Shah Alam)	353.9	356.5	359.1	352.2	350.9	349.9	352.3
NPL (Teddington)	36.6	36.2	38.8	40.0	41.4	45.9	50.9
NPLI (New-Delhi)	5503.5	5549.9	-	-	-	-	-
NRC (Ottawa)	25.8	33.2	40.3	36.8	39.5	31.9	26.2
NTSC (Lintong)	-33.8	-34.4	-36.3	-27.8	-19.3	-20.9	-19.7
OMH (Budapest)	8532.8	8557.4	8569.0	8575.3	8585.4	8596.0	8597.8
ONBA (Buenos Aires)	-793.5	-984.0	-1042.2	-1109.4	-1134.5	-1213.4	-1326.1
ONRJ (Rio de Janeiro)	5748.1	5760.7	5762.2	5778.3	5782.5	5791.2	5798.4
OP (Paris)	29.4	23.3	23.2	31.6	39.0	35.3	54.0
ORB (Bruxelles)	-21.2	-24.1	-18.1	-16.2	-13.2	-10.9	-7.2
PL (Warszawa)	-200.8	-206.3	-203.2	-211.9	-222.3	-229.1	-238.8
PTB (Braunschweig)	-15.1	-11.3	-6.7	-5.4	-1.1	-2.2	-1.0
ROA (San Fernando)	72.3	81.4	80.5	80.0	76.0	73.9	78.0
SCL (Hong Kong)	-3.1	-8.7	-16.6	-18.4	-27.1	-31.3	-38.1
SG (Singapore)	19.6	13.0	10.3	8.3	11.4	27.0	15.1
SMU (Bratislava)	-8840.0	-8863.4	-8898.0	-8926.1	-8950.0	-8976.4	-8991.1
SP (Boras)	4.7	14.8	19.3	27.9	32.0	31.1	45.5
SU (Moskva)	13.2	12.6	8.9	3.9	3.1	-3.0	-0.7
TCC (Concepcion)	-4542.6	-4563.7	-4637.1	-4697.8	-4783.7	-4839.7	-4890.5
TL (Chung-Li)	-3.4	0.8	1.6	-8.2	-6.6	-7.3	-17.9
TP (Praha)	72.9	72.2	62.7	60.3	58.1	59.9	67.8
UME (Gebze-Kocaeli)	8.5	11.4	11.1	15.4	16.4	28.5	25.9
USNO (Washington DC)	0.4	1.1	1.2	1.3	1.3	1.4	3.9
VSL (Delft)	11.8	14.6	12.6	9.5	10.4	-0.4	5.3

- Notes on section 1:

(1) CNMP: Centro Nacional de Metrologia de Panama
(2) CSIR: Time step of UTC(CSIR) of about -1260 ns on MJD = 52922.62 and change of master clock on MJD = 52925.28
(3) KRIS: Change of master clock on MJD = 52912

2 - International Atomic Time TAI and Local atomic time scales TA(k). Computed values of [*TAI*-*TA*(*k*)].

Date 2003 0h UTC	SEP 27	OCT 2	OCT 7	OCT 12	OCT 17	OCT 22	OCT 27	
MJD	52909	52914	52919	52924	52929	52934	52939	
Laboratory *k*				[*TAI*-*TA*(*k*)]/ns				
CH (Bern)	36692.9	36858.0	37013.4	37173.7	37331.7	37491.6	37656.9	
CRL (Tokyo)	178205.9	178407.5	178610.8	178816.3	179018.4	179219.6	179416.3	
F (Paris)	169285.8	169296.2	169300.0	169305.2	169311.7	169316.3	169327.3	
IEN (Torino)	30400.6	30519.0	30635.4	30751.8	30863.2	30982.2	31105.5	
JATC (Lintong)	-32614.3	-32715.6	-32805.3	-32892.2	-32980.5	-33076.2	-33170.0	
KRIS (Taejon)	6109.3	6118.8	6140.0	6165.1	6185.7	6213.9	6231.3	
NIST (Boulder)	-45254946.5	-45255146.4	-45255345.5	-45255542.2	-45255743.2	-45255941.2	-45256136.3	
NRC (Ottawa)	28643.2	28655.1	28666.5	28667.3	28674.7	28671.4	28670.1	
NTSC (Lintong)	218.0	224.8	235.0	249.6	259.6	263.2	267.5	
PL (Warszawa)	-1726.8	-1740.3	-1749.2	-1761.9	-1773.3	-1785.1	-1798.8	
PTB (Braunschweig)	-359385.1	-359376.5	-359366.6	-359360.6	-359351.4	-359347.5	-359341.5	
SU (Moskva)	27241013.2	27241012.6	27241008.9	27241003.9	27241003.1	27240997.0	27240999.3	(1)
USNO (Washington DC)	-34917393.9	-34917701.9	-34918011.0	-34918320.4	-34918629.1	-34918938.2	-34919245.2	

- Note on section 2:

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

3 - Difference between the normalized frequencies of EAL (free atomic time scale) and TAI.

	Interval of validity	*f*(*EAL*)-*f*(*TAI*)	
Steering correction	52909 - 52969	6.950×10^{-13}	(2003 Sep 27 - 2003 Nov 26)
New correction foreseen	52969 - 53004	6.940×10^{-13}	(2003 Nov 26 - 2003 Dec 31)

4 - 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 with τ in days: (1) a white frequency noise of $6.0\times10^{-15} / \sqrt{\tau}$, (2) a flicker frequency noise of 0.6×10^{-15} and (3) a random walk frequency noise of $1.6\times10^{-16} \times \sqrt{\tau}$. 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 Frequency Standards (PFS). In this table: u_A is the uncertainty originating in the instability of the PFS, 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, $u_{l/lab}$ is the uncertainty in the link between the PFS and the clock participating to TAI, including the uncertainty due to the dead-time, $u_{l/TAI}$ is the uncertainty in the link to TAI, u is the quadratic sum of all four uncertainty values. All values are expressed in 10^{-15}.

Standard	Period of Estimation	d	u_A	u_B	Ref(u_B)	$u_{l/Lab}$	$u_{l/Tai}$	u	Note
SYRTE-JPO	52889 52909	18.1	1.0	6.5	T160	0.3	1.5	6.8	(1)
SYRTE-JPO	52909 52919	16.8	1.0	6.5	T160	0.3	3.0	7.2	(2)
PTB-CS1	52909 52939	-5.7	5.0	8.0	T148	0.0	1.0	9.5	(3)
PTB-CS2	52909 52939	0.3	3.0	12.0	T148	0.0	1.0	12.4	(3)

Notes:
(1) Report 7 October by BNM-SYRTE.
(2) Report 6 November by BNM-SYRTE.
(3) Continuously operating as a clock participating to TAI.

The second table gives the BIPM estimate of d, based on all available PFS measurements over the period MJD 52549-52939, 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	
52909-52939	9.8×10^{-15}	2.2×10^{-15}	(2003 Sep 27 - 2003 Oct 27)

5 - Relations of UTC and TAI with GPS time and GLONASS time.

[*UTC-GPS time*] = -13 s + C_0, [*TAI-GPS time*] = 19 s + C_0, global uncertainty is of order 10 ns.
[*UTC-GLONASS time*] = 0 s + C_1, [*TAI-GLONASS time*] = 32 s + C_1, global uncertainty is of order hundreds ns.

The C_0 values are obtained using the values [*UTC-UTC*(*OP*)] and the GPS data taken at the Paris Observatory, corrected for IGS precise orbits and ionosphere maps. The C_1 values are obtained using the values [*UTC-UTC*(*VSL*)] and the GLONASS data taken at the NMi Van Swinden Laboratorium (VSL). The standard deviations σ_0 and σ_1 characterize the dispersion of individual measurements. N_0 and N_1 are the numbers of measurements.
For this circular, σ_0 = 2.6 ns, σ_1 = 26.8 ns

Date 2003 0h UTC	MJD	C_0/ns	N_0	C_1/ns	N_1
SEP 27	52909	-11.1	37	130.1	76
SEP 28	52910	-11.9	39	128.0	68
SEP 29	52911	-11.2	38	133.3	52
SEP 30	52912	-9.0	45	133.2	55
OCT 1	52913	-7.1	43	116.3	25
OCT 2	52914	-7.2	45	118.4	0
OCT 3	52915	-4.1	45	129.4	2
OCT 4	52916	-0.2	45	129.5	0
OCT 5	52917	-0.4	45	114.9	0
OCT 6	52918	-3.0	46	92.8	0
OCT 7	52919	-2.4	45	72.3	0
OCT 8	52920	-4.3	44	59.9	0
OCT 9	52921	-6.2	44	55.5	7
OCT 10	52922	-10.1	44	49.5	59
OCT 11	52923	-13.0	47	56.4	75
OCT 12	52924	-12.4	43	45.8	70
OCT 13	52925	-12.4	44	28.5	72
OCT 14	52926	-14.9	43	12.5	60
OCT 15	52927	-14.7	46	7.8	49
OCT 16	52928	-12.1	44	10.8	61
OCT 17	52929	-10.3	44	10.7	63
OCT 18	52930	-11.7	45	-2.7	50
OCT 19	52931	-8.3	45	-7.8	57
OCT 20	52932	-8.1	46	0.5	60
OCT 21	52933	-7.9	41	-11.5	68
OCT 22	52934	-5.4	44	18.5	68
OCT 23	52935	-5.3	45	66.6	42
OCT 24	52936	-8.9	44	57.2	55
OCT 25	52937	-9.2	45	49.7	60
OCT 26	52938	-9.9	42	53.5	69
OCT 27	52939	-9.4	44	56.4	63

6 - Time links used for the computation of TAI.

The time links used in the elaboration of this *Circular T* are listed in this section. The type of link is indicated as follows: GPS SC for GPS common-view single-channel C/A data; GPS MC for GPS common-view multi-channel C/A data; GPS P3 for GPS common-view multi-channel dual-frequency P code data; GPS GT for 'GPS time' observations; INT LK for internal cable link and TWSTFT for two-way satellite time and frequency transfer data.

Link	Type
AOS /NPL	GPS MC
AUS /CRL	GPS MC
BEV /NPL	GPS MC
BIRM/CRL	GPS MC
CAO /PTB	GPS SC
CH /PTB	GPS SC
CNM /NIST	GPS SC
CNMP/USNO	GPS MC
CRL /PTB	GPS SC
CSIR/NPL	GPS MC
DLR /PTB	GPS P3
DTAG/PTB	GPS SC
IEN /PTB	TWSTFT
IFAG/PTB	GPS P3
IGMA/NIST	GPS GT
INPL/PTB	GPS SC
IPQ /PTB	-
JATC/NTSC	INT LK
JV /PTB	GPS GT
KRIS/CRL	GPS MC
LDS /PTB	GPS SC
LT /NPL	GPS MC
MSL /CRL	GPS MC
NAO /CRL	GPS SC
NIM /CRL	GPS SC
NIMB/PTB	GPS SC
NIMT/CRL	GPS MC
NIST/PTB	GPS MC
NMC /PTB	GPS GT
NMIJ/CRL	TWSTFT
NMLS/CRL	GPS MC
NPL /PTB	GPS MC
NPLI/PTB	GPS SC
NRC /USNO	GPS SC
NTSC/CRL	TWSTFT
OMH /PTB	GPS SC
ONBA/USNO	GPS MC
ONRJ/NIST	GPS SC
OP /PTB	GPS SC
ORB /PTB	GPS P3
ROA /PTB	TWSTFT
PL /NPL	GPS MC
SCL /CRL	GPS SC
SG /CRL	GPS MC
SMU /PTB	GPS SC
SP /PTB	GPS SC
SU /PTB	GPS SC
TCC /NIST	GPS SC
TL /CRL	TWSTFT
TP /PTB	GPS SC
UME /PTB	GPS SC
USNO/PTB	TWSTFT
VSL /PTB	TWSTFT