

**Table 6. Measurements of the 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 (in practice the SI second on the geoid), i.e. the fractional frequency deviation of TAI with the opposite sign:  $d = -y_{\text{TAI}}$ .

In this table,  $d$  is obtained on the given periods of estimation by comparison of the TAI frequency with that of the individual primary frequency standards (PFS) CRL-O1, IEN-CSF1, NIST-F1, PTB-CS1, PTB-CS2, PTB-CSF1, SYRTE-FO2, SYRTE-FOM, and SYRTE-JPO for the year 2003.

Previous calibrations are available in the successive annual reports of the BIPM Time Section volumes 1 to 15.

Each comparison is provided with the following information:

$u_A$  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  $u_B$ ,

$u_{\text{link/lab}}$  is the uncertainty in the link between the PFS and the clock participating to TAI, including the uncertainty due to dead-time,

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

$u$  is the quadratic sum of all four uncertainty values.

In this table, a frequency over a time interval is defined as the ratio of the end-point phase difference to the duration of the interval.

The typical characteristics of the calibrations of the TAI frequency provided by the different primary standards over 2003 are indicated below.

Primary Standard	Type /selection	Typical type B std. uncertainty	Operation	Comparison with	Typical duration of comparison
CRL-O1	Beam /Opt.	$4 \times 10^{-15}$	Discontinuous	UTC(CRL)	15 d
IEN-CSF1	Fountain	$1.5 \times 10^{-15}$	Discontinuous	H maser	10 d
NIST-F1	Fountain	$0.6 \times 10^{-15}$	Discontinuous	H maser	30 d
PTB-CS1	Beam /Mag.	$8 \times 10^{-15}$	Continuous	TAI	30 d
PTB-CS2	Beam /Mag.	$12 \times 10^{-15}$	Continuous	TAI	30 d
PTB-CSF1	Fountain	$1 \times 10^{-15}$	Discontinuous	H maser	15 d
SYRTE-FO2	Fountain	$0.6 \times 10^{-15}$	Discontinuous	H maser	5 to 30 d
SYRTE-FOM	Fountain	$0.8 \times 10^{-15}$	Discontinuous	H maser	5 to 30 d
SYRTE-JPO	Beam /Opt.	$8 \times 10^{-15}$	Discontinuous	H maser	10-20 d

More detailed information on the characteristics and operation of individual PFS may be found in the annexes supplied by the individual laboratories.

**Table 6. (Cont.)**

Standard	Period of estimation	$d$ ( $10^{-15}$ )	$u_A$ ( $10^{-15}$ )	$u_B$ ( $10^{-15}$ )	Ref( $u_B$ )	$u_{\text{link/lab}}$ ( $10^{-15}$ )	$u_{\text{link/TAI}}$ ( $10^{-15}$ )	$u$ ( $10^{-15}$ )	Notes
CRL-01	52839 52854	1.8	5.2	4.3	[1]	0.8	2.0	7.1	
IEN-CSF1	52744 52754	22.4	1.3	2.0	[2]	0.4	3.0	3.9	(1)
IEN-CSF1	52934 52944	10.3	0.6	1.1		0.4	3.0	3.3	
NIST-F1	52679-52694	11.1	1.2	0.7	[3]	0.3	2.0	2.5	
NIST-F1	52694-52709	8.6	1.2	0.7		0.3	2.0	2.5	
NIST-F1	52869 52904	13.4	0.8	0.5		0.3	0.9	1.3	
NIST-F1	52969 52999	9.4	0.5	0.4		0.2	1.0	1.2	
PTB-CS1	52639-52669	-4.6	5.0	8.0	[4]	0.0	1.0	9.5	(2)
PTB-CS1	52669-52694	-1.2	5.0	8.0		0.0	1.2	9.5	
PTB-CS1	52694-52729	-2.6	5.0	8.0		0.0	0.9	9.5	
PTB-CS1	52729-52759	7.9	5.0	8.0		0.0	1.0	9.5	
PTB-CS1	52759-52789	11.3	5.0	8.0		0.0	1.0	9.5	
PTB-CS1	52789-52819	3.5	5.0	8.0		0.0	1.0	9.5	
PTB-CS1	52819 52849	7.6	5.0	8.0		0.0	1.0	9.5	
PTB-CS1	52849 52879	9.8	5.0	8.0		0.0	1.0	9.5	
PTB-CS1	52879 52909	-0.5	5.0	8.0		0.0	1.0	9.5	
PTB-CS1	52909 52939	-5.7	5.0	8.0		0.0	1.0	9.5	
PTB-CS1	52939 52969	6.4	5.0	8.0		0.0	1.0	9.5	
PTB-CS1	52969 53004	0.9	5.0	8.0		0.0	0.9	9.5	
PTB-CS2	52639-52669	5.1	3.0	12.0	[5]	0.0	1.0	12.4	(2)
PTB-CS2	52669-52694	0.6	3.0	12.0		0.0	1.2	12.4	
PTB-CS2	52694-52729	3.7	3.0	12.0		0.0	0.9	12.4	
PTB-CS2	52729-52759	2.3	3.0	12.0		0.0	1.0	12.4	
PTB-CS2	52759-52789	5.0	3.0	12.0		0.0	1.0	12.4	
PTB-CS2	52789-52819	10.9	3.0	12.0		0.0	1.0	12.4	
PTB-CS2	52819 52849	5.8	3.0	12.0		0.0	1.0	12.4	
PTB-CS2	52849 52879	5.4	3.0	12.0		0.0	1.0	12.4	
PTB-CS2	52879 52909	9.4	3.0	12.0		0.0	1.0	12.4	
PTB-CS2	52909 52939	0.3	3.0	12.0		0.0	1.0	12.4	
PTB-CS2	52939 52969	4.9	3.0	12.0		0.0	1.0	12.4	
PTB-CS2	52969 53004	6.2	3.0	12.0		0.0	0.9	12.4	
PTB-CSF1	52929 52944	11.5	1.1	0.9	[6]	0.1	2.0	2.5	
SYRTE-F02	52699-52734	8.5	0.2	0.5	[7]	0.7	0.9	1.3	
SYRTE-F02	52764 52789	3.7	0.2	0.6		1.3	1.2	1.9	
SYRTE-F02	52824 52829	7.3	0.6	0.5		0.1	6.0	6.1	
SYRTE-F02	52884 52909	7.9	0.1	0.6		0.3	1.2	1.4	
SYRTE-FOM	52704-52709	14.0	0.6	0.8	[7]	2.0	6.0	6.4	
SYRTE-FOM	52739-52744	21.6	0.8	0.8		2.4	6.0	6.6	
SYRTE-FOM	52794 52819	3.9	1.5	0.8		1.0	1.2	2.3	
SYRTE-FOM	52824 52829	4.8	0.3	0.8		0.1	6.0	6.1	

**Table 6. (Cont.)**

Standard	Period of estimation	$d$ ( $10^{-15}$ )	$u_A$ ( $10^{-15}$ )	$u_B$ ( $10^{-15}$ )	Ref( $u_B$ )	$u_{1\text{ink}/1\text{ab}}$ ( $10^{-15}$ )	$u_{1\text{ink}/\text{TAI}}$ ( $10^{-15}$ )	$u$ ( $10^{-15}$ )	Notes
SYRTE-JPO	52639-52659	13.1	2.0	8.0	[8]	0.3	1.5	8.4	
SYRTE-JPO	52664-52694	5.8	1.7	8.0		0.3	1.0	8.2	
SYRTE-JPO	52719-52729	13.2	1.1	8.0		0.3	3.0	8.6	
SYRTE-JPO	52729-52744	7.8	1.0	8.0		0.3	2.0	8.3	
SYRTE-JPO	52749-52764	11.1	0.6	8.0		0.3	2.0	8.3	
SYRTE-JPO	52824-52834	11.4	1.0	6.5		0.3	3.0	7.2	
SYRTE-JPO	52839-52849	16.6	1.0	6.5		0.3	3.0	7.2	
SYRTE-JPO	52889-52909	18.1	1.0	6.5		0.3	1.5	6.8	
SYRTE-JPO	52909-52919	16.8	1.0	6.5		0.3	3.0	7.2	
SYRTE-JPO	52959-52969	20.8	1.0	6.5		0.3	3.0	7.2	
SYRTE-JPO	52974-52984	22.0	0.7	6.5		0.3	3.0	7.2	
SYRTE-JPO	52989-53004	19.2	0.5	6.5		0.3	2.0	6.8	

**Notes:**

- (1) IEN atomic caesium fountain.  
(2) Continuously operating as a clock participating to TAI.

**References:**

- [1] The evaluation procedure the type B uncertainty of CRL-O1 is based on that of NIST-7: Lee W.D. et al., *IEEE Trans. IM-44*, 120, 1995. See also Hasegawa A. et al., *Metrologia*, submitted.  
[2] Levi F. et al., *IEEE trans. IM 52 2*, 267, 2003.  
[3] Jefferts S.R. et al., *Metrologia* 39, 321, 2002.  
[4] Bauch A. et al., *Metrologia* 35, 829, 1998.  
[5] Bauch A. et al., *IEEE Trans. IM-36*, 613, 1987.  
[6] Weyers S. et al., *Metrologia* 38-4, 343, 2001.  
[7] Marion H. et al. *Phys. Rev. Lett.*, 90, 150801, 2003.  
[8] Makdissi A. and de Clercq E., *Metrologia* 38-5, 409 2001.