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Table 9 — Offsets and step adjustments of UTC, until 1980 Dec. 31

Date (at 0h UTC)	Offsets	Steps
1961 Jan. 1	-150×10^{-10}	
Aug. 1	”	+ 0.050 s
1962 Jan. 1	-130×10^{-10}	
1963 Nov. 1	”	- 0.100 s
1964 Jan. 1	-150×10^{-10}	
April 1	”	- 0.100 s
Sept. 1	”	- 0.100 s
1965 Jan. 1	”	- 0.100 s
March 1	”	- 0.100 s
July 1	”	- 0.100 s
Sept. 1	”	- 0.100 s
1966 Jan. 1	-300×10^{-10}	
1968 Feb. 1	”	+ 0.100 s
1972 Jan. 1	0	- 0.107 7580 s
July 1	”	- 1 s
1973 Jan. 1	”	- 1 s
1974 Jan. 1	”	- 1 s
1975 Jan. 1	”	- 1 s
1976 Jan. 1	”	- 1 s
1977 Jan. 1	”	- 1 s
1978 Jan. 1	”	- 1 s
1979 Jan. 1	”	- 1 s
1980 Jan. 1	”	- 1 s

Table 10 — Relationship between TAI and UTC, until 1980 Dec. 31

Limits of validity (at 0h UTC)		TAI – UTC
1961 Jan. 1	- 1961 Aug. 1	1.422 818 0 s + (MJD - 37 300) x 0.001 296 s
Aug. 1	- 1962 Jan. 1	1.372 818 0 s + ” ”
1962 Jan. 1	- 1963 Nov. 1	1.845 858 0 s + (MJD - 37 665) x 0.001 123 2 s
1963 Nov. 1	- 1964 Jan. 1	1.945 858 0 s + ” ”
1964 Jan. 1	- April 1	3.240 130 0 s + (MJD - 38 761) x 0.001 296 s
April 1	- Sept. 1	3.340 130 0 s + ” ”
Sept. 1	- 1965 Jan. 1	3.440 130 0 s + ” ”
1965 Jan. 1	- March 1	3.540 130 0 s + ” ”
March 1	- July 1	3.640 130 0 s + ” ”
July 1	- Sept. 1	3.740 130 0 s + ” ”
Sept. 1	- 1966 Jan. 1	3.840 130 0 s + ” ”
1966 Jan. 1	- 1968 Feb. 1	4.313 170 0 s + (MJD - 39 126) x 0.002 592 s
1968 Feb. 1	- 1972 Jan. 1	4.213 170 0 s + ” ”
1972 Jan. 1	- July 1	10.000 000 0 s
July 1	- 1973 Jan. 1	11.000 000 0 s
1973 Jan. 1	- 1974 Jan. 1	12.000 000 0 s
1974 Jan. 1	- 1975 Jan. 1	13.000 000 0 s
1975 Jan. 1	- 1976 Jan. 1	14.000 000 0 s
1976 Jan. 1	- 1977 Jan. 1	15.000 000 0 s
1977 Jan. 1	- 1978 Jan. 1	16.000 000 0 s
1978 Jan. 1	- 1979 Jan. 1	17.000 000 0 s
1979 Jan. 1	- 1980 Jan. 1	18.000 000 0 s
1980 Jan. 1		19.000 000 0 s

Table 11 - Atomic time, collaborating laboratories

APL	Applied Physics Laboratory, Laurel, U S A
ASMW	Amt für Standardisierung, Messwesen und Warenprüfung, Berlin, Deutsche Demokratische Republik
ATC	Australian Telecommunications Commission, Melbourne, Australia
BEV	Bundesamt für Eich - und Vermessungswesen, Wien, Österreich
DHI	Deutsches Hydrographisches Institut, Hamburg, Bundesrepublik Deutschland
DNM	Division of National Mapping, Canberra, Australia
F	Commission Nationale de l'Heure, Paris, France
IEN	Istituto Elettrotecnico Nazionale, Torino, Italia
IFAG	Institut für Angewandte Geodäsie, Frankfurt am Main, Bundesrepublik Deutschland
IGMA	Instituto Geographico Militar, Buenos-Aires, Argentina
ILOM	International Latitude Observatory, Mizusawa, Japan
NBS	National Bureau of Standards, Boulder, USA
NIS	National Institute for Standards, Cairo, Egypt, Arab Rep.
NPL	National Physical Laboratory, Teddington, U.K.
NPRL	National Physical Research Laboratory, Pretoria, South Africa
NRC	National Research Council of Canada, Ottawa, Canada
OAB	Observatoire Astronomique Bouzareah, Alger, République Algérienne
OMH	Országos Mérésügyi Hivatal, Budapest, Hungary
OMSF	Instituto y Observatorio de Marina, San Fernando, España
ON	Observatoire de Neuchâtel, Neuchâtel, Suisse
ONBA	Observatorio Naval, Buenos-Aires, Argentina
ONRJ	Observatorio National, Rio de Janeiro, Brazil
OP	Observatoire de Paris, Paris, France
ORB	Observatoire Royal de Belgique, Bruxelles, Belgique
PKNM	Polski Komitet Normalizacji i Miar, Warszawa, Polska
PTB	Physikalisch-Technische Bundesanstalt, Braunschweig, Bundesrepublik Deutschland
PTCH	Direction générale des PTT, Berne, Suisse
RGO	Royal Greenwich Observatory, Herstmonceux, U.K.
RRL	Radio Research Laboratories, Tokyo, Japan
STA	Swedish Telecommunications Administration, Stockholm, Sweden
SU	Laboratoire d'état de l'étalon de temps et de fréquences, URSS
TAO	Tokyo Astronomical Observatory, Tokyo, Japan
TL	Telecommunication Laboratories, Taiwan, China
TP (1)	Ústav Radiotechniky a Electroniky, Praha, Československo Astronomický Ústav, Praha, Československo
TUG	Technische Universität Graz, Österreich
USNO	U. S. Naval Observatory, Washington D. C., USA
VSL	Van Swinden Laboratorium, Den Haag, Nederland
ZIPE	Zentralinstitut Physik der Erde, Potsdam, Deutsche Demokratische Republik

(1) Both laboratories cooperate in the derivation of UTC(TP).

Table 12 - Laboratories keeping an independent local atomic time

Laboratory (i)	Equipment in atomic standards(1)	Information on TA(i) - UTC(i)	
		Interval of validity (in MJD at 0h UT)	TA(i) - UTC(i) in s
DDR(2)	3 Ind. Cs	year 1979	(3)
F(4)	15 Ind. Cs	year 1979	TA(F) - UTC(OP) is published in Bulletin H by OP
NBS	13 Ind. Cs 2 lab. Cs 2 H. Masers (5)	43874 - 44055 44055 - 44239	18.045 064 028 + (36.2×10^{-9}) (MJD - 43874) 18.045 070 580 + (3.1×10^{-9}) (MJD - 44055)
NRC	3 Ind. Cs 1 2.1 m lab. Cs 3 1.m lab. Cs (6)	year 1979	17.999 968 931
PTB	10 Ind. Cs 1 lab. Cs 1 H. Maser (7)	year 1979	published in PTB Time Service Bulletin
RGO	6 Ind. Cs	year 1979	17.999 926 09
RRL(8)	6 Ind. Cs 2 H. Masers	year 1979	published in RRL Standard Frequency and Time Service Bulletin
USNO	25 Ind. Cs 1 H. Maser	year 1979	A.1 (USNO, MEAN) - UTC(USNO, MC) : provisional values in USNO series 7 ; final values in USNO series 11. (9)

Table 12 (cont.)

(1) Ind. Cs designates an industry made Cs standard ; lab. Cs a laboratory Cs standard and H. Maser an Hydrogen Maser.

(2) The standards are located as follows :

ASMW : 2 Cs

ZIPE : 1 Cs

They are intercompared by TV Method.

(3) Given in ASMW Bulletin.

(4) The standards are located as follows (at the end of 1979).

Centre National d'Études Spatiales	2 Cs
Centre National d'Études des Télécommunications	4 Cs
Centre d'Études et de Recherches Géodynamiques et Astronomiques	2 Cs
Hewlett - Packard (Orsay)	1 Cs
Observatoire de Paris : Laboratoire Primaire du Temps et des Fréquences (LPTF)	4 Cs
Observatoire de Besançon	1 Cs
Société Nationale Industrielle Aérospatiale (Toulouse)	1 Cs

They are intercompared by the TV method and linked to the foreign laboratories through OP (LPTF) (see Table 13).

(5) The laboratory primary standards control TA (NBS) via an accuracy algorithm. One of the two primary standards usually operates as a contributing member clock. Three of the commercial standards provide the reference for WWV and WWVB but do not contribute directly to TA(NBS) ; they are available for NBS time scales back-up and are compared to TA(NBS) towithin 0.1 μs.

(6) The 2.1 meter primary cesium clock, CsV, operated continuously during 1979, producing the scale of proper time PT(NRC CsV). The time scales UTC(NRC) and TA(NRC) were derived from PT(NRC CsV) according to the following expressions given in microseconds :

$$\mathrm{UTC(NRC)} = \mathrm{PT(NRC\ CsV)} - (\mathrm{MJD} - 43144) \times 0.000\,97 + 52.041$$

$$\mathrm{TA(NRC)} = \mathrm{PT(NRC\ CsV)} - (\mathrm{MJD} - 43144) \times 0.000\,97 + 20.972$$

with integral seconds disregarded.

Three 1 meter laboratory cesium clocks, CsVIA, -B, and -C, operated continuously as secondary standards during most of 1979. After evaluation of their systematic corrections they commenced operation as independent primary clocks at the beginning of December 1979.

(7) TA(PTB) results from the data of 8 Cs stds. Its frequency is adjusted to conform with the primary freq. std. CS 1 of PTB. UTC(PTB) + 1h = MEZ(D) is the legal time (in Central European Time) of the Federal Republic of Germany which is desseminated, e.g., by the LF transmitter DCF 77. Two Cs stds and one Rb std provide the reference for DCF 77.

CS 1 has been operating continuously since August 1978.

(8) The initial values of time and frequency of TA(RRL) are defined to be equal to UTC on referring to the values in Circular D of BIH, and time comparisons between the RRL and the USNO by portable clock. The origin of TA(RRL) is chosen at 0h UTC January 1, 1979 (see Standard Frequency and Time Signal Bulletin Annual Report for 1978 or 1979).

(9) TA(USNO) is designated by A.1 (USNO, MEAN).

Table 13 - Equipment and links of the collaborating laboratories

Laboratory (i)	Equipment (1)	Source of UTC(i)	LORAN-C receptions (2)	VLF and LF receptions (3)	Television link with
APL(4)	3 Ind. Cs	1 Cs + microstepper			USNO
ASMW	2 Ind. Cs	corrected mean of 2 Cs	7970-W	DCF 77, OMA	ZIPE, TP, PTB
BEV	1 Ind. Cs	1 Cs	7970-W 7990-M 7990-X 7990-Y (5)	GBR, OMA50, MSF60, HBG, DCF77	TUG
DHI	2 Ind. Cs	1 Cs	7970-W	DCF 77	PTB, TP, ZIPE
DNM(6)	4 Ind. Cs	all the Cs			other lab. in Australia
IEN	7 Ind. Cs	1 Cs + microstepper	7990-M 7990-Z	GBR	other lab. in Italy
IFAG	2 Ind. Cs	1 Cs	7970-W		
IGMA	2 Ind. Cs	Cs		GBR, OMEGA/ND, OMEGA/A	ONBA
ILOM	3 Ind. Cs	Cs	9970-M	OMEGA/H	RRL, TAO
NBS(7)	see Table 12	8 Cs 1 lab. Cs	9930-Z 9940-M 9960-Z	OMEGA/ND, OMEGA/H	NRC, USNO
NPL	5 Ind. Cs 1 lab. Cs	1 Cs	7970-W	GBR, MSF60	RGO, transmitting station at Rugby
NPRL	1 Ind. Cs	1 Cs		GBR, OMEGA/L	
NRC(7, 8)	see Table 12	Cs V	9930-Y 9960-X		NBS, USNO
OAB	2 Ind. Cs	1 Cs	7990-Z		
OMH	1 Ind. Cs	1 Cs			TP
OMSF	4 Ind. Cs	all the Cs	7990-Z	GBR	
ON	7 Ind. Cs 2 prototype Cs	all the Cs	7970-W 7990-Z		
ONBA	2 Ind. Cs	2 Cs		OMEGA/T	IGMA
ONRJ	2 Ind. Cs	all the Cs		GBR, OMEGA	other lab. in Brasil
OP(8)	4 Ind. Cs	1 Cs	7970-W 7990-Z		15 lab. in France, ORB, Hewlett-Packard (Switzerland), PTCH

Table 13 - (cont.)

Laboratory (i)	Equipment (1)	Source of UTC(i)	LORAN–C receptions (2)	VLF and LF receptions (3)	Television link with
ORB	2 Ind. Cs	1 Cs	7970-W		OP
PKNM	4 Ind. Cs	corrected mean of 4 Cs	7970-W (5)	DCF77, OMA 50, RBU66	ASMW, ZIPE
PTB	see Table 12	2 Cs	7970-W	GBR, DCF77	ASMW, DHI, TP and other lab.
PTCH	2 Ind. Cs	2 Cs	7970-W	DCF77, HBG	OP and other lab. in Switzerland
RGO	see Table 12	selection of the Cs	7930-X 7970-M 7970-W 7990-Z	GBR, MSF60	NPL
RRL	see Table 12	1 Cs	9970-M	OMEGA/H, OMEGA/J	ILOM, TAO
STA	3 Ind. Cs	1 Cs	7970-W		other lab. in Sweden
SU	6 Ind. Cs 3 H Masers 1 lab. Cs	4 Cs 3 H Masers 1 lab. Cs	7990-X 7990-Y 9970-M	GBR, OMA50, RBU, OMEGA/J	other lab. in USSR, TP, ASMW
TAO	5 Ind. Cs	1 Cs	9970-M	NWC	ILOM, RRL
TL	3 Ind. Cs	all the Cs	9970-M	NDT, NWC	
TP	1 Ind. Cs	1 Cs + micro stepper		DCF77	DHI, PTB, SU, ZIPE, ASMW, OMH
TUG	1 Ind. Cs	1 Cs	7970-W 7990-M	OMEGA, GBR	BEV
USNO (7, 9)	see Table 12	Cs	(10)	(10)	APL, NBS, NRC
VSL	4 Ind. Cs	Cs	7970-M 7970-W 7930-X	DCF77	other lab. in Holland
ZIPE	1 Ind. Cs	1 Cs	7970-W	DCF77, GBR, OMA50, HBG, OMEGA/N	ASMW, DHI, PKNM, PTB TP, Borowiec (Poland)

Table 13 - (cont.)

Notes

(1) Ind. Cs designates an industry made Cs standard ; lab. Cs a laboratory Cs standard and H. Maser an Hydrogen Maser.

(2) LORAN-C stations :

9930*-Y	East Coast chain, Nantucket	7970-M	Norwegian Sea chain, Ejde
9930*-Z	" " Dana	7970-W	" " Sylt
7930-M	North Atlantic chain, Angissog	9970-M	Northwest Pacific chain, Iwo Jima
7930-X	" " Ejde		
		5970-M	Southeast Asia
7990-M	Mediterranean chain, Simeri Crichi	9940-M	West Coast chain, Fallon
7990-X	" " Lampedusa		
7990-Y	" " Kargabarun	9960-X	Northeast Coast chain, Nantucket
7990-Z	" " Estartit	9960-Z	" " Dana

* The LORAN-C chain 9930 was stopped on the 30th of September 1979.

(3) OMEGA stations :

/A	Argentina
/H	Hawaii
/J	Japan
/L	Liberia
/N	Aldra, Norway
/ND	Lamoure, North Dakota, USA
/T	Trinidad, West Indies

(4) Weekly Cesium transfers are carried out between APL and USNO

(5) Reception of the Soviet Union LORAN chain 8000

(6) Satellite link via Timation with RGO and combination of Timation and Television links with USNO. Microwave link with Orroral facility of NASA (National Aeronautics and Space Administration)

(7) Satellite link via Hermes between NBS, NRC and USNO

(8) Satellite link via Symphonie between NRC and OP

(9) USNO Time Service Publication, Series 16, entitled Precise Time Transfer Report, lists UTC(USNO MC) - UTC (Reference Clock). Difference from Satellite Communication terminals as well as many international timing centers are reported. USNO Time Service Publication, Series 17, entitled Transit Satellite Reports, lists UTC(USNO MC) - UTC (Satellite Clock) and also the frequency offset of each satellite.

(10) The daily phase values Series 4 of the USNO give the values of UTC(USNO MC) – transmitting station for :

the LORAN – C chains
the OMEGA stations A, H, L, ND, T
the VLF station GBR
the US TV Networks

TABLE 14 - TIME COMPARISONS BETWEEN LABORATORIES BY CLOCK TRANSPORTATION IN 1979

UNLESS OTHERWISE STATED, THE TRANSPORTATION WAS CARRIED OUT BY THE FIRST MENTIONED LABORATORY

DATE		MJD	TIME COMPARISONS		UNCERT.	SOURCE	
1979			(UNIT : 1 MICROSECOND)				
FEB	1	43906.0	UTC(USNO) - UTC(NBS) =	-1.3	0.2	USNO DPV 627	(1)
FEB	27	43931.3	UTC(USNO) - UTC(NPL) =	1.4	0.2	USNO DPV 634	
FEB	28	43932.3	UTC(USNO) - UTC(OP) =	1.4	0.2	USNO DPV 634	
MAR	1	43934.0	UTC(USNO) - UTC(ONRJ) =	-304.4	0.1	USNO DPV 634	(2)
MAR	8	43940.7	UTC(USNO) - UTC(IEN) =	-9.4	0.2	USNO DPV 634	
MAR	15	43947.5	UTC(USNO) - UTC(OMSF) =	-0.8	0.2	USNO DPV 634	
APR	5	43968.3	UTC(ILOM) - UTC(RRL) =	-29.3	0.2	ILOM LETTER	
MAY	25	44018.0	UTC(TAO) - UTC(RRL) =	-19.61	0.02	TAO LETTER	
MAY	25	44018.1	UTC(TAO) - UTC(NRLM) =	-62.99	0.02	TAO LETTER	(3)
MAY	30	44023.5	UTC(OP) - UTC(OAB) =	0.75	0.15	OP LETTER	
JUN	8	44032.0	UTC(TAO) - UTC(ILOM) =	-13.10	0.02	TAO LETTER	
JUN	18	44042.3	UTC(USNO) - UTC(VSL) =	2.3	0.2	USNO DPV 647	
JUN	19	44043.2	UTC(USNO) - UTC(ORB) =	9.0	0.2	USNO DPV 647	
JUN	19	44043.6	UTC(ORB) - UTC(OP) =	-6.73		OP LETTER	(4)
JUN	20	44044.2	UTC(USNO) - UTC(OP) =	2.3	0.2	USNO DPV 647	
JUN	21	44045.6	UTC(USNO) - UTC(RGO) =	-0.4	0.2	USNO DPV 647	
JUN	22	44046.3	UTC(USNO) - UTC(NPL) =	5.7	0.2	USNO DPV 647	
AUG	7	44092.7	UTC(OP) - UTC(NRC) =	-9.11	0.05	OP LETTER	
AUG	8	44093.4	UTC(ASMW) - UTC(ZIPE) =	-0.40	0.05	ASMW LETTER	
AUG	16	44101.6	UTC(USNO) - UTC(NBS) =	2.3	0.2	USNO DPV 656	
SEP	18	44134.6	UTC(USNO) - UTC(PTB) =	3.2	0.2	USNO DPV 662	
SEP	19	44135.3	UTC(USNO) - UTC(DHI) =	3.4	0.2	USNO DPV 662	
SEP	21	44137	UTC(NBS) - UTC(USNO) =	-1.8	0.3	NBS BULL 263	(5)
SEP	25	44141.3	UTC(USNO) - UTC(TUG) =	3.1	0.2	USNO DPV 662	
SEP	25	44141.6	UTC(USNO) - UTC(BEV) =	6.2	0.2	USNO DPV 662	
SEP	28	44144.3	UTC(USNO) - UTC(ON) =	17.1	0.2	USNO DPV 662	
OCT	3	44149.3	UTC(USNO) - UTC(NPL) =	7.6	0.2	USNO DPV 662	
OCT	24	44170.8	UTC(OP) - UTC(TP) =	-1.02	0.05	OP LETTER	
OCT	24	44170.8	UTC(ASMW) - UTC(OP) =	-0.56	0.15	OP LETTER	
OCT	31	44177.1	UTC(TAO) - UTC(ILOM) =	-18.63	0.05	TAO LETTER	
NOV	8	44185.2	UTC(USNO) - UTC(RRL) =	-20.5	0.2	USNO DPV 668	
NOV	13	44190.2	UTC(USNO) - UTC(TAO) =	-3.8	0.2	USNO DPV 668	
NOV	20	44197	UTC(PKNM) - UTC(SU) =	12.70	0.05	PKNM LETTER	
NOV	20	44197.0	UTC(TAO) - UTC(RRL) =	-16.61	0.02	TAO LETTER	
NOV	20	44197.1	UTC(TAO) - UTC(NRLM) =	-77.64	0.02	TAO LETTER	
NOV	20	44197.6	UTC(IGMA) - UTC(ONBA) =	57.28		IGMA LETTER	
NOV	24	44201.6	UTC(USNO) - UTC(ONBA) =	48.62		IGMA LETTER	
DEC	1	44208	UTC(NBS) - UTC(USNO) =	-2.2	0.3	NBS BULL 265	(5)
DEC	1	44208	UTC(NBS) - UTC(USNO) =	-2.1	0.3	NBS BULL 265	
DEC	6	44213.0	UTC(USNO) - UTC(DNM) =	-35.8	0.2	USNO DPV 674	
DEC	7	44214.2	UTC(USNO) - UTC(ATC) =	-26.1	0.2	USNO DPV 674	
DEC	11	44218.1	UTC(OP) - UTC(NRC) =	-11.47	0.15	OP LETTER	

COMPLEMENTARY RESULTS FOR THE PREVIOUS YEAR

1978						
FEB	16	43555.7	UTC(IGMA) - UTC(OP) =	1.19		IGMA LETTER
FEB	17	43556.7	UTC(IGMA) - UTC(RGO) =	0.55		IGMA LETTER
FEB	23	43562.7	UTC(IGMA) - UTC(USNO) =	1.37		IGMA LETTER
JUL	13	43702.3	UTC(ILOM) - UTC(RRL) =	13.7	0.2	ILOM LETTER
OCT	6	43787.3	UTC(ILOM) - UTC(RRL) =	18.8	0.2	ILOM LETTER

(1) UTC(USNO) IS WRITTEN INSTEAD OF UTC(USNO MC)
DPV: DAILY PHASE VALUES, SERIES 4, PUBLISHED BY USNO
(2) MEASUREMENT MADE BY NASA
(3) NRLM : NATIONAL RESEARCH LABORATORY OF METROLOGY, MINISTRY OF INTERNATIONAL TRADE AND INDUSTRY, JAPAN
(4) MEASUREMENT MADE BY USNO
(5) MEASUREMENT MADE BY HUGHES AIRCRAFT

TABLE 15 - INDEPENDENT ATOMIC TIMES

TA(I) DENOTES THE ATOMIC TIME OF THE LABORATORY I

UNIT IS ONE MICROSECOND

DATE 1979	MJD	TAI - TA(I) DDR	F	NBS	NRC
JAN 6	43879	10.72	-84.31	-45067.73	24.53
JAN 16	43889	11.08	-84.05	-45068.00	24.50
JAN 26	43899	11.52	-83.88	-45068.09	24.39
FEB 5	43909	11.77	-83.60	-45068.43	24.32
FEB 15	43919	12.21	-83.45	-45068.67	24.18
FEB 25	43929	12.50	-83.16	-45068.52	24.11
MAR 7	43939	12.75	-82.98	-45068.41	24.04
MAR 17	43949	13.22	-82.71	-45068.66	23.98
MAR 27	43959	13.53	-82.52	-45068.64	23.89
APR 6	43969	13.80	-82.27	-45068.75	23.85
APR 16	43979	14.39	-82.03	-45068.76	23.81
APR 26	43989	14.77	-81.80	-45068.77	23.78
MAY 6	43999	15.37	-81.60	-45068.87	23.69
MAY 16	44009	15.81	-81.36	-45068.87	23.66
MAY 26	44019	16.43	-81.08	-45069.17	23.52
JUN 5	44029	17.04	-80.71	-45069.43	23.43
JUN 15	44039	17.61	-80.43	-45069.59	23.27
JUN 25	44049	18.15	-80.08	-45069.62	23.18
JUL 5	44059	18.68	-79.69	-45069.57	23.08
JUL 15	44069	19.24	-79.27	-45069.73	22.96
JUL 25	44079	19.81	-78.84	-45069.82	22.88
AUG 4	44089	20.25	-78.50	-45069.84	22.77
AUG 14	44099	20.79	-78.12	-45070.06	22.65
AUG 24	44109	21.21	-77.75	-45070.04	22.56
SEP 3	44119	21.91	-77.38	-45070.13	22.51
SEP 13	44129	22.54	-77.00	-45070.14	22.47
SEP 23	44139	23.05	-76.64	-45070.26	22.40
OCT 3	44149	23.51	-76.26	-45070.39	22.30
OCT 13	44159	24.12	-75.85	-45070.29	22.13
OCT 23	44169	24.68	-75.54	-45070.38	21.98
NOV 2	44179	25.48	-75.26	-45070.27	21.87
NOV 12	44189	26.13	-74.90	-45070.16	21.81
NOV 22	44199	26.81	-74.57	-45070.02	21.72
DEC 2	44209	27.31	-74.25	-45069.84	21.59
DEC 12	44219	28.01	-73.82	-45069.86	21.55
DEC 22	44229	28.57	-73.56	-45069.77	21.50

TABLE 15 - (CONT.)

UNIT IS ONE MICROSECOND

DATE 1979	MJD	TAI - TA(I) PTB	RGO	RRL	USNO
JAN 6	43879	-361.44	70.90	0.8	-34419.53
JAN 16	43889	-361.47	70.95	0.7	-34419.99
JAN 26	43899	-361.44	71.04	0.5	-34420.46
FEB 5	43909	-361.46	71.11	0.3	-34420.84
FEB 15	43919	-361.50	71.16	0.2	-34421.18
FEB 25	43929	-361.53	71.24	-0.3	-34421.82
MAR 7	43939	-361.56	71.26	-0.6	-34422.23
MAR 17	43949	-361.54	71.20	-1.1	-34422.75
MAR 27	43959	-361.66	71.00	-1.0	-34423.16
APR 6	43969	-361.68	70.88	-1.1	-34423.63
APR 16	43979	-361.69	70.79	-1.2	-34423.98
APR 26	43989	-361.68	70.85	-1.3	-34424.33
MAY 6	43999	-361.70	70.91	-1.4	-34424.79
MAY 16	44009	-361.73	70.99	-1.7	-34425.18
MAY 26	44019	-361.71	70.98	-1.9	-34425.68
JUN 5	44029	-361.72	71.09	-1.8	-34426.15
JUN 15	44039	-361.69	71.12	-1.8	-34426.58
JUN 25	44049	-361.68	71.17	-1.5	-34426.95
JUL 5	44059	-361.74	71.12	-1.3	-34427.36
JUL 15	44069	-361.85	71.21	-1.7	-34427.76
JUL 25	44079	-361.95	71.34	-1.9	-34428.15
AUG 4	44089	-362.15	71.44	-1.8	-34428.47
AUG 14	44099	-362.17	71.56	-2.0	-34428.85
AUG 24	44109	-362.27	71.54	-2.2	-34429.20
SEP 3	44119	-362.37	71.64	-2.4	-34429.52
SEP 13	44129	-362.50	71.78	-2.3	-34429.86
SEP 23	44139	-362.73	71.91	-1.9	-34430.18
OCT 3	44149	-362.78	72.02	-1.8	-34430.49
OCT 13	44159	-362.89	72.07	-1.5	-34430.90
OCT 23	44169	-363.02	72.08	-1.4	-34431.16
NOV 2	44179	-363.20	72.02	-1.3	-34431.41
NOV 12	44189	-363.13	71.91	-1.0	-34431.64
NOV 22	44199	-363.11	71.78	-0.8	-34432.04
DEC 2	44209	-363.22	71.71	-0.5	-34432.33
DEC 12	44219	-363.26	71.64	-0.4	-34432.71
DEC 22	44229	-363.43	71.48	-0.1	-34432.95

NOTE - The uncertainties of the computed values of TAI-TA(i) are of a few 0.1 μs. However, in order to avoid rounding errors, the results are given to ± 0.01 μs.

TABLE 16 - PRIMARY STANDARDS USED AS CLOCKS

UNIT IS ONE MICROSECOND

DATE 1979	MJD	TAI-LAB.STD. PTB CS1	NRC CSV
JAN 6	43879	-359.61	44.79
JAN 16	43889	-359.67	44.76
JAN 26	43899	-359.58	44.63
FEB 5	43909	-359.56	44.55
FEB 15	43919	-359.60	44.40
FEB 25	43929	-359.61	44.32
MAR 7	43939	-359.62	44.24
MAR 17	43949	-359.62	44.17
MAR 27	43959	-359.76	44.07
APR 6	43969	-359.73	44.03
APR 16	43979	-359.72	43.97
APR 26	43989	-359.74	43.93
MAY 6	43999	-359.75	43.83
MAY 16	44009	-359.76	43.79
MAY 26	44019	-359.77	43.64
JUN 5	44029	-359.86	43.54
JUN 15	44039	-359.95	43.37
JUN 25	44049	-360.10	43.27
JUL 5	44059	-360.19	43.16
JUL 15	44069	-360.27	43.04
JUL 25	44079	-360.26	42.95
AUG 4	44089	-360.38	42.83
AUG 14	44099	-360.39	42.70
AUG 24	44109	-360.51	42.60
SEP 3	44119	-360.67	42.54
SEP 13	44129	-360.76	42.49
SEP 23	44139	-360.91	42.41
OCT 3	44149	-360.91	42.29
OCT 13	44159	-360.99	42.12
OCT 23	44169	-361.07	41.96
NOV 2	44179	-361.12	41.84
NOV 12	44189	-361.13	41.77
NOV 22	44199	-361.19	41.67
DEC 2	44209	-361.29	41.53
DEC 12	44219	-361.29	41.48
DEC 22	44229	-361.40	41.42

NOTES

(1) The primary frequency standard CS1 of PTB, operating continuously as a clock during 1979, produces a scale of proper time. The time scale under the headline PTB CS1 is a coordinate time scale at sea level derived from this scale of proper time applying a gravitational frequency correction of -0.00066 µs/d.

(2) The time scale under the headline NRC CsV is the scale of proper time PT(NRC CsV) produced directly by the primary frequency standard CsV of NRC used as a clock. The gravitational frequency correction to PT(NRC CsV), to obtain a coordinate time at sea level is -0.00097 µs/d. The primary frequency standards Cs VI A, B and C operated as independent clocks since December 1979. Their associated time scales will be published in the next Annual Report.

(3) The NBS-4 primary frequency standard operated as a clock during the first half of 1979. However the uses of NBS-4 as a clock and as a standard are distinct from each other.

TABLE 17 - COORDINATED UNIVERSAL TIME

UTC(I) DENOTES THE APPROXIMATION TO UTC KEPT BY THE LABORATORY I

UNIT IS ONE MICROSECOND

DATE 1979	MJD	UTC - UTC(I)* APL (1)	ASMW	AUS (2)	BEV (3)	DHI	IEN	IFAG
JAN 6	43879	-15.28	2.96	-7.1	5.99	-0.33	-11.14	
JAN 16	43889	-13.73	3.07	-7.3	6.01	-0.09	-11.27	
JAN 26	43899	-12.14	3.19	-7.5	5.94	0.11	-11.38	
FEB 5	43909	-10.49	3.20	-7.7	5.99	0.20	-11.37	
FEB 15	43919	-8.78	3.40	-7.7	5.92	0.11	-11.43	
FEB 25	43929	-7.29	3.40	-8.0	5.94	0.17	-11.28	
MAR 7	43939	-5.63	3.34	-6.0	5.69	0.12	-11.50	
MAR 17	43949	-4.15	3.54	-6.1	5.65	0.14	-11.53	
MAR 27	43959	-2.54	3.42	-6.1	5.59	0.04	-11.39	
APR 6	43969	-0.95	3.16	-6.1	5.63	-0.05	-11.29	
APR 16	43979	0.77	3.20	-6.0	5.62	-0.07	-11.48	
APR 26	43989	2.45	3.05	-5.9	5.40	-0.16	-11.38	
MAY 6	43999	4.08	3.08	-5.9	5.36	-0.26	-11.88	
MAY 16	44009	5.75	3.02	-5.9	5.24	-0.18	-11.52	
MAY 26	44019	7.24	3.04	-5.9	5.18	-0.13	-10.98	
JUN 5	44029	8.85	2.98	-6.2	5.05	0.00	-11.08	
JUN 15	44039	10.41	2.83	-6.9	4.83	-0.06	-10.94	
JUN 25	44049	11.99	2.70	-7.4	4.63	-0.02	-10.97	
JUL 5	44059	-2.12	2.62	-8.1	4.48	-0.01	-10.83	
JUL 15	44069	-2.15	2.56	-8.7	4.20	0.02	-10.70	
JUL 25	44079	-2.12	2.59	-9.3	4.05	0.14	-10.70	
AUG 4	44089	-2.00	2.36	-10.0	3.70	0.28	-10.66	
AUG 14	44099	-1.98	2.24	-10.8		0.53	-10.55	
AUG 24	44109	-1.96	2.10	-11.7		0.68	-10.36	
SEP 3	44119	-1.85	2.18	-12.4		0.79	-10.20	
SEP 13	44129	-1.78	2.18	-13.2	5.19	0.98	-10.20	
SEP 23	44139	-1.68	2.10	-14.0	4.28	1.04	-9.98	
OCT 3	44149	-1.53	2.10	-14.9	4.13	1.10	-9.90	
OCT 13	44159	-1.45	2.16	-15.7	3.98	1.03	-9.70	
OCT 23	44169	-1.25	2.14	-16.4	3.93	0.62	-9.62	-9.23
NOV 2	44179	-0.96	2.48	-17.0	3.75	0.11	-9.69	-9.12
NOV 12	44189	-0.67	2.61	-17.6	3.73	-0.44	-9.86	-8.91
NOV 22	44199	-0.53	2.88	-18.3	3.65	-0.98	-9.85	-8.69
DEC 2	44209	-0.24	2.81	-19.0	3.51	-1.37	-10.00	-8.72
DEC 12	44219	-0.10	3.03	-19.7	3.61	-1.59	-10.08	-8.54
DEC 22	44229	0.24	2.81	-20.3	3.42	-1.84	-10.22	-8.57

TABLE 17 - (CONT.)

UNIT IS ONE MICROSECOND

DATE 1979		MJD	UTC - UTC(I)*						
			IGMA (4)	ILOM (5)	NBS	NPL	NPRL (6)	NRC	OMH (7)
JAN	6	43879	0	-45.0	-3.53	-0.96	34	-6.54	-38.06
JAN	16	43889	-1	-45.7	-3.43	-0.96	40	-6.56	-37.70
JAN	26	43899	1	-46.4	-3.16	-1.10	39	-6.68	-37.59
FEB	5	43909	0	-47.3	-3.13	-1.01	34	-6.75	-37.30
FEB	15	43919	-1	-47.9	-3.01	-1.02	37	-6.89	-36.90
FEB	25	43929	-2	17.2	-2.50	-0.82	36	-6.96	-36.67
MAR	7	43939	0	14.3	-2.03	-0.62	34	-7.03	-36.17
MAR	17	43949	-1	11.1	-1.92	-0.37	33	-7.09	-35.70
MAR	27	43959	-1	8.5	-1.53	-0.24	32	-7.18	-35.63
APR	6	43969	0	5.7	-1.28	-0.07	32	-7.21	-35.15
APR	16	43979	-1	2.6	-0.94	0.12	29	-7.26	-34.37
APR	26	43989	-1	-14.1	-0.58	0.50	32	-7.29	-34.20
MAY	6	43999	0	-15.1	-0.32	0.86	31	-7.38	-33.90
MAY	16	44009	0	-16.0	0.05	1.49	35	-7.41	-33.81
MAY	26	44019	-1	-16.6	0.11	2.06	35	-7.55	-33.83
JUN	5	44029	-1	-16.8	0.21	2.62	34	-7.64	-33.49
JUN	15	44039	-1	-17.2	0.40	3.05	34	-7.80	-32.99
JUN	25	44049	-1	-17.5	0.74	3.75	34	-7.89	-32.97
JUL	5	44059	-1	-17.7	0.99	4.12	33	-7.99	-32.64
JUL	15	44069	0	-18.5	0.89	4.44	33	-8.10	-32.12
JUL	25	44079	0	-19.0	0.83	4.80	35	-8.19	-31.44
AUG	4	44089	-1	-19.3	0.84	4.96	31	-8.29	-31.31
AUG	14	44099	-2	-19.9	0.66	5.15	35	-8.41	-31.10
AUG	24	44109	-7	-20.6	0.71	5.19	32	-8.50	-30.89
SEP	3	44119	-8	-21.2	0.65	5.39	31	-8.56	-30.52
SEP	13	44129	-9	-21.5	0.66	5.53	33	-8.60	-30.52
SEP	23	44139	-8	-21.7	0.58	5.72	33	-8.66	-30.02
OCT	3	44149	-8	-22.2	0.48	5.84	33	-8.77	-30.04
OCT	13	44159	-9	-22.7	0.61	5.97	31	-8.94	-30.46
OCT	23	44169	-9	-23.2	0.55	6.04	30	-9.09	-29.78
NOV	2	44179	-9	-23.8	0.69	5.99	33	-9.20	-28.91
NOV	12	44189	-9	-24.2	0.83	5.97	34	-9.26	-28.96
NOV	22	44199	-9	-24.9	1.00	5.87	30	-9.35	-28.70
DEC	2	44209	-7	-25.4	1.22	5.79	29	-9.48	-28.58
DEC	12	44219	-9	-25.9	1.23	5.82	30	-9.52	-28.30
DEC	22	44229	-9.00	-26.5	1.35	5.65	27	-9.57	-28.00

TABLE 17 - (CONT.)

UNIT IS ONE MICROSECOND

DATE 1979	MJD	UTC - UTC(I)* OMSF	ON	OP	ORB	PKNM	PTB	PTCH (8) (-25.8)
JAN 6	43879	-2.80	15.35	-0.72	8.56	1.60	0.03	~~27.30~~ +1.5
JAN 16	43889	-2.79	15.35	-0.66	8.07	1.43	0.10	27.91
JAN 26	43899	-2.59	15.19	-0.71	7.42	1.74	0.24	28.29
FEB 5	43909	-2.62	15.04	-0.71	7.02	1.57	0.32	28.83
FEB 15	43919	-2.43	14.85	-0.79	6.31	1.69	0.34	29.21
FEB 25	43929	-2.39	15.05	-0.73	5.24	1.51	0.38	29.73
MAR 7	43939	-2.48	14.90	-0.70	5.02	1.56	0.36	30.28
MAR 17	43949	-2.23	14.91	-0.68	4.89	1.67	0.36	30.41
MAR 27	43959	-2.35	14.87	-0.68	4.28	1.00	0.21	30.79
APR 6	43969	-2.19	14.96	-0.64	3.82	1.09	0.16	31.28
APR 16	43979	-2.28	14.81	-0.58	4.09	1.01	0.14	31.83
APR 26	43989	-2.19	14.78	-0.52	4.61	0.65	0.13	32.33
MAY 6	43999	-2.28	14.72	-0.48	5.21	0.83	0.09	32.98
MAY 16	44009	-2.30	14.68	-0.37	5.57	0.59	0.04	33.57
MAY 26	44019	-2.03	14.80	-0.32	5.65	0.37	0.02	33.93
JUN 5	44029	-1.95	14.83	-0.20	6.02	0.52	-0.01	33.80
JUN 15	44039	-1.82	14.87	-0.15	6.72	0.58	0.04	33.88
JUN 25	44049	-1.80	14.76	-0.01	7.11	0.29	0.12	33.52
JUL 5	44059	-1.66	14.78	0.11	7.23	0.25	0.27	33.35
JUL 15	44069	-1.57	14.80	0.21	7.98	0.21	0.40	35.09
JUL 25	44079	-1.59	14.72	0.36	8.70	0.02	0.55	36.85
AUG 4	44089	-1.57	14.67	0.48	9.35	-0.35	0.61	38.35
AUG 14	44099	-1.39	14.69	0.55	9.67	-0.32	0.81	40.14
AUG 24	44109	-1.27	14.77	0.61	10.47	-0.59	0.90	41.83
SEP 3	44119	-1.36	14.82	0.71	10.45	-0.76	1.01	43.61
SEP 13	44129	-1.43	14.83	0.96	11.19	-0.96	1.16	45.30
SEP 23	44139	-1.34	14.90	1.18	11.23	-0.99	1.17	47.06
OCT 3	44149	-1.36	14.97	1.35	11.10	-1.16	1.19	48.87
OCT 13	44159	-1.66	15.10	1.53	11.38	-0.98	1.09	50.68
OCT 23	44169	-1.59	15.10	1.61	11.88	-0.99	0.96	52.53
NOV 2	44179	-1.38	15.09	1.71	11.39	-0.93	0.75	54.49
NOV 12	44189	-1.61	15.01	1.73	11.27	-1.15	0.63	56.56
NOV 22	44199	-1.48	15.09	1.70	11.27	-1.50	0.61	58.92
DEC 2	44209	-1.58	15.04	1.61	11.04	-1.75	0.44	61.01
DEC 12	44219	-1.63	15.08	1.61	11.20	-1.62	0.36	63.20
DEC 22	44229	-1.39	15.11	1.40	11.08	-1.89	0.12	~~65.28~~ 39.45

TABLE 17 - (CONT.)

UNIT IS ONE MICROSECOND

DATE 1979	MJD	UTC - UTC(I)*						
		RGO	RRL (9)	STA (10)	SU (11)	TAO (12)	TL	TP
JAN 6	43879	-3.01	-20.3	40.40	8.6	-1.7	74.2	-0.33
JAN 16	43889	-2.96	-20.7	38.26	7.6	-1.8	73.2	-0.02
JAN 26	43899	-2.88	-21.0	36.10	7.9	-2.0	71.8	0.03
FEB 5	43909	-2.80	-21.3	33.92	7.1	-2.2	70.7	0.28
FEB 15	43919	-2.75	-21.5	31.57	8.3	-2.2	69.5	0.37
FEB 25	43929	-2.67	-22.2	29.32	9.4	-2.6	67.6	0.17
MAR 7	43939	-2.65	-22.6	27.01	7.4	-2.7	65.7	0.11
MAR 17	43949	-2.71	-23.2	24.77	8.9	-3.1	63.7	0.18
MAR 27	43959	-2.91	-23.3	22.45	8.9	-3.1	62.5	-0.09
APR 6	43969	-3.03	-23.4	20.15	9.4	-3.2	61.5	-0.15
APR 16	43979	-3.12	-23.4	17.76	9.8	-3.4	59.9	0.01
APR 26	43989	-3.06	-23.5	15.41	9.9	-3.4	58.4	-0.01
MAY 6	43999	-3.00	-23.5	13.22	10.9	-3.6	56.8	-0.18
MAY 16	44009	-2.91	-23.6	10.98	10.5	-3.7	55.5	-0.08
MAY 26	44019	-2.93	-23.5	8.67	10.6	-3.9	54.0	-0.24
JUN 5	44029	-2.82	-23.3	6.38	9.0	-3.9	52.7	-0.30
JUN 15	44039	-2.79	-23.1	4.03	10.0	-3.9	51.5	-0.18
JUN 25	44049	-2.74	-22.7	1.74	9.6	-3.6	50.3	-0.21
JUL 5	44059	-2.79	-22.3	-0.55	9.1	-3.4	49.3	-0.17
JUL 15	44069	-2.70	-22.5	-2.77	9.7	-3.9	47.5	-0.07
JUL 25	44079	-2.57	-22.5	-4.89	10.6	-4.0	46.8	-0.02
AUG 4	44089	-2.47	-22.3	-7.11	11.4	-4.0	46.9	-0.09
AUG 14	44099	-2.35	-22.4	-9.34	10.0	-4.2	47.1	0.01
AUG 24	44109	-2.37	-22.5	-11.55	9.5	-4.6	47.1	0.11
SEP 3	44119	-2.27	-22.6	-13.68	10.8	-4.8	47.1	0.36
SEP 13	44129	-2.13	-22.4	-15.82	9.9	-4.7	47.3	0.55
SEP 23	44139	-2.00	-22.1	-18.05	9.6	-4.6	47.6	0.69
OCT 3	44149	-1.89	-22.0	-20.24	9.7	-4.7	47.9	0.83
OCT 13	44159	-1.84	-21.9	-22.29	10.6	-4.8	47.5	0.74
OCT 23	44169	-1.83	-21.9	-24.62	10.5	-4.9	47.8	0.75
NOV 2	44179	-1.89	-22.0	-27.11	11.1	-5.1	47.7	0.59
NOV 12	44189	-1.99	-21.8	-29.26	11.0	-5.0	48.1	0.32
NOV 22	44199	-2.13	-21.7	-31.26	11.5	-5.2	47.0	0.12
DEC 2	44209	-2.20	-21.6	-33.45	10.2	-5.1	48.2	-0.16
DEC 12	44219	-2.27	-21.6	-35.44	12.3	-5.2	48.3	-0.22
DEC 22	44229	-2.43	-21.6	-37.72	11.9	-5.2	48.2	-0.60

TABLE 17 - (CONT.)

UNIT IS ONE MICROSECOND

DATE 1979		MJD	UTC - UTC(I)* TUG (13)	USNO	VSL (14)	ZIPE
JAN	6	43879	6.49	-1.51	-0.63	0.30
JAN	16	43889	2.11	-1.59	-0.45	-0.29
JAN	26	43899	2.67	-1.63	-0.62	-0.27
FEB	5	43909	3.10	-1.64	-0.43	-0.30
FEB	15	43919	3.49	-1.59	-0.51	-0.14
FEB	25	43929	3.90	-1.77	-0.43	-0.01
MAR	7	43939	4.03	-1.77	-0.45	0.10
MAR	17	43949	4.28	-1.92	-0.36	0.35
MAR	27	43959	4.26	-1.93	-0.44	0.77
APR	6	43969	4.55	-1.99	-0.24	1.23
APR	16	43979	4.75	-1.94	-0.04	1.69
APR	26	43989	4.81	-1.89	0.08	1.87
MAY	6	43999	5.08	-1.93	0.11	2.05
MAY	16	44009	5.27	-1.94	0.28	1.94
MAY	26	44019	5.52	-2.06	0.39	2.19
JUN	5	44029	5.78	-2.11	0.50	2.60
JUN	15	44039	5.91	-2.14	0.34	2.86
JUN	25	44049	6.08	-2.11	0.48	2.96
JUL	5	44059	6.19	-2.12	0.45	2.65
JUL	15	44069	6.44	-2.13	0.36	2.44
JUL	25	44079	0.59	-2.10	0.19	2.02
AUG	4	44089	0.72	-2.02	0.14	1.74
AUG	14	44099	0.96	-2.01	0.13	2.03
AUG	24	44109	0.95	-1.98	0.22	2.19
SEP	3	44119	0.94	-1.85	0.32	2.42
SEP	13	44129	0.98	-1.79	0.32	2.74
SEP	23	44139	1.09	-1.73	0.47	2.87
OCT	3	44149	1.26	-1.67	0.53	2.69
OCT	13	44159	1.34	-1.66	0.77	2.85
OCT	23	44169	1.48	-1.55	0.70	3.03
NOV	2	44179	1.59	-1.44	0.73	3.18
NOV	12	44189	1.80	-1.26	0.82	3.32
NOV	22	44199	1.90	-1.22	1.00	3.26
DEC	2	44209	2.10	-1.09	1.38	2.88
DEC	12	44219	2.62	-1.09	1.53	2.95
DEC	22	44229	2.80	-0.93	1.47	2.61

TABLE 17 - (CONT.)

NOTES

* In general, the uncertainties are of the order of ten times larger than the unit of the last reported digit. See Table 18.

(1) APL. A time step of UTC(APL) of 317.001 μs was made by APL on 1979 Jan. 2. A time step of UTC(APL) of 15.494 μs was made by APL on 1979 July 3.

(2) AUS. UTC(AUS) is the coordinated universal time of Australia kept by DNM.

(3) BEV. From 1979 August 9 till 1979 September 11, no clock was available at BEV.

(4) IGMA. Arbitrary origin on MJD = 43 879. The clock transportations between IGMA and ONBA, USNO and ONBA end November 1979 fixed the origin from MJD = 44 109.

(5) ILOM. On 1979 February 20 and April 19, changes of master clock. From the latter date the origin of UTC-UTC(ILOM) is fixed by the clock transportation between TAO and RRL on 1979 October 31.

(6) NPRL. Results obtained by VLF. The origin was given by a clock transportation on 1974 April 9.

(7) OMH. The first three values were obtained by interpolation.

(8) PTCH. On 1979 May 16 and July 5, changes of master clock.

(9) RRL. A bias of about 3 μs between the BIH values of UTC(USNO) - UTC(RRL) and the corresponding values obtained by clock transportation has been corrected using the clock transportation results of 1979 November 8. In order to restore continuity, the data of previous BIH Annual Reports should be corrected by addition of 3 μs.

(10) STA. A time step of UTC(STA) of - 90.00 μs was made by STA on 1979 January 1.

(11) SU. UTC-UTC(SU) was computed using the TV link between TP and SU except during the intervals 43879-43899, 43929-43959 and 44129-44149 where the GBR signal was used. The values of UTC-UTC(SU) missing in the Annual Report for 1978 are :

MJD	UTC-UTC(SU)
43 849	56.9 μs
43 859	59.2 μs
43 869	59.0 μs

A time step of UTC(SU) of + 50 μs was made by SU on 1979 January 1.

(12) TAO. A bias of about 3 μs between the BIH values of UTC(USNO)-UTC(TAO) and the corresponding values obtained by clock transportation has been corrected using the clock transportation results of 1979 November 13. In order to restore continuity, the data of previous BIH Annual Reports should be corrected by addition of 2.7 μs.

(13) TUG. A time step of UTC(TUG) of + 5.0 μs was made on 1979 January 10. A time step of UTC(TUG) of + 6.0 μs was made on 1979 July 23.

(14) VSL. A time step of UTC(VSL) of - 54.271 μs was made by VSL on 1979 January 1.

TABLE 18 - COMPARISONS BETWEEN THE CLOCK TRANSPORTATIONS AND THE BIH RESULTS

THE TABLE GIVES THE DIFFERENCES BETWEEN THE CLOCK TRANSPORTATION RESULTS AND THOSE DERIVED FROM THE DATA OF TABLE 17 (BEFORE ROUNDING-OFF)

DATE 1979	MJD	TIME COMPARISONS	DIFFERENCE CLOCK TR. - BIH (UNIT : 1 MICROSECOND)
FEB 1	43906.0	UTC(USNO) - UTC(NBS)	0.2
FEB 27	43931.3	UTC(USNO) - UTC(NPL)	0.4
FEB 28	43932.3	UTC(USNO) - UTC(OP)	0.3
MAR 8	43940.7	UTC(USNO) - UTC(IEN)	0.3
MAR 15	43947.5	UTC(USNO) - UTC(OMSF)	-0.4
APR 5	43968.3	UTC(ILOM) - UTC(RRL)	0.0*
MAY 25	44018.0	UTC(TAO) - UTC(RRL)	0.04
JUN 8	44032.0	UTC(TAO) - UTC(ILOM)	-0.08
JUN 18	44042.3	UTC(USNO) - UTC(VSL)	-0.2
JUN 19	44043.2	UTC(USNO) - UTC(ORB)	0.0
JUN 19	44043.6	UTC(ORB) - UTC(OP)	0.25
JUN 20	44044.2	UTC(USNO) - UTC(OP)	0.3
JUN 21	44045.6	UTC(USNO) - UTC(RGO)	0.2
JUN 22	44046.3	UTC(USNO) - UTC(NPL)	0.0
AUG 7	44092.7	UTC(OP) - UTC(NRC)	-0.27
AUG 8	44093.4	UTC(ASMW) - UTC(ZIPE)	0.04
AUG 16	44101.6	UTC(USNO) - UTC(NBS)	-0.4
SEP 18	44134.6	UTC(USNO) - UTC(PTB)	0.3
SEP 19	44135.3	UTC(USNO) - UTC(DHI)	0.6
SEP 21	44137	UTC(NBS) - UTC(USNO)	0.5
SEP 25	44141.3	UTC(USNO) - UTC(TUG)	0.3
SEP 25	44141.6	UTC(USNO) - UTC(BEV)	0.3
SEP 28	44144.3	UTC(USNO) - UTC(ON)	0.5
OCT 3	44149.3	UTC(USNO) - UTC(NPL)	0.1
OCT 24	44170.8	UTC(OP) - UTC(TP)	-0.11
OCT 24	44170.8	UTC(ASMW) - UTC(OP)	0.01
OCT 31	44177.1	UTC(TAO) - UTC(ILOM)	0.0*
NOV 8	44185.2	UTC(USNO) - UTC(RRL)	0.0*
NOV 13	44190.2	UTC(USNO) - UTC(TAO)	0.0*
NOV 20	44197.0	UTC(TAO) - UTC(RRL)	-0.05
NOV 20	44197	UTC(PKNM) - UTC(SU)	-0.15
DEC 1	44208	UTC(NBS) - UTC(USNO)	0.1
DEC 1	44208	UTC(NBS) - UTC(USNO)	0.2
DEC 11	44218.1	UTC(OP) - UTC(NRC)	-0.34

COMPLEMENTARY RESULTS FOR THE PREVIOUS YEAR

1978			
FEB 16	43553.7	UTC(IGMA) - UTC(OP)	-1.46
FEB 17	43556.7	UTC(IGMA) - UTC(RGO)	-1.07
FEB 23	43562.7	UTC(IGMA) - UTC(USNO)	-1.56
JUL 13	43702.3	UTC(ILOM) - UTC(RRL)	-0.7
OCT 6	43787.3	UTC(ILOM) - UTC(RRL)	-0.4

* NEW ORIGIN _ SEE TABLE 17

TABLE 19 - INTERNATIONAL ATOMIC TIME , BI-MONTHLY RATES OF TAI-CLOCK FOR 1979

THE RATES ARE AVERAGED OVER INTERVALS OF TWO MONTHS ENDING AT THE GIVEN DATES

UNIT IS NS/DAY , 0.0 DENOTES THAT THE CLOCK WAS NOT USED

LAB.	CLOCK	43929	43989	44049	44109	44169	44229
APL	14 773	76.13	94.93	75.79	73.91	72.92	77.99
APL	14 793	0.0	160.54	160.67	164.53	174.95	182.16
APL	24 121	-139.57	-139.48	-137.56	-136.71	-132.39	-131.15
ASMW	13 29	88.86	70.49	90.59	100.77	113.02	135.80
ASMW	16 76	24.16	18.50	-5.05	-19.45	-15.54	-0.78
BEV	16 71	0.0	-5.75	-14.30	0.0	0.0	-4.21
F	12 133	47.07	66.37	72.99	110.54	119.83	116.65
F	12 158	148.55	151.57	167.35	181.32	186.82	188.75
F	12 206	122.92	181.01	271.97	321.31	0.0	0.0
F	12 231	-83.47	-93.33	-17.22	6.50	-32.44	-70.49
F	12 347	-67.42	-43.80	-37.66	-36.95	-55.54	-40.18
F	12 439	122.22	103.69	123.74	155.49	0.0	0.0
F	12 594	-48.87	-43.98	-40.97	-37.62	-30.67	-28.66
F	14 51	22.02	31.66	28.39	36.50	30.60	40.91
F	14 134	-5.53	-4.70	0.0	0.0	0.0	0.0
F	14 753	85.54	91.33	106.47	133.77	125.88	85.14
F	16 80	0.0	0.0	0.0	0.0	-128.34	-114.29
F	22 120	27.30	23.61	16.24	14.52	5.82	3.22
F	24 407	-94.95	-123.72	-121.03	-116.42	-137.45	-149.14
IEN	12 303	-57.30	-59.07	-51.33	-51.99	-48.13	-49.35
IEN	12 469	-35.81	-19.75	2.19	10.85	12.76	-14.06
IEN	12 609	-114.64	-102.27	-126.12	-118.31	-108.61	-99.79
IEN	14 893	-5.49	-0.62	7.78	9.27	11.26	-6.70
IEN	16 84	133.28	0.0	0.0	0.0	0.0	0.0
IFAG	16 131	0.0	0.0	0.0	0.0	0.0	14.78
IFAG	16 138	0.0	0.0	0.0	0.0	0.0	-129.17
NBS	11 137	0.0	0.0	0.0	0.0	12.78	24.74
NBS	11 167	-546.82	-544.83	-553.34	-562.33	-549.32	-534.85
NBS	14 316	-52.28	-38.27	-46.07	-46.67	-46.18	-38.79
NBS	14 323	-101.41	-75.58	-65.17	-45.83	-23.54	15.80
NBS	14 324	-61.65	-47.46	-42.15	-27.25	-29.59	-37.40
NBS	14 601	-23.02	-11.61	-20.99	-24.60	-28.91	-29.29
NBS	16 61	-118.88	-133.70	-168.64	0.0	0.0	0.0
NBS	91 4	-21.36	-7.43	0.0	0.0	0.0	0.0
NPL	12 316	-181.90	-186.00	-181.96	-184.05	-194.23	-169.65
NPL	12 418	-94.63	-78.79	-47.62	-55.98	-57.87	-73.82
NPL	12 832	-78.92	-50.93	44.31	75.45	59.10	27.65
NPL	14 334	0.0	0.0	0.0	0.0	0.0	-96.21
NRC	12 122	0.0	-399.71	-397.26	-406.37	-400.74	-416.97
NRC	14 267	0.0	-19.09	-22.09	-31.19	-31.74	-33.91
NRC	90 5	-8.65	-7.69	-9.03	-11.92	-9.02	-12.76
OMH	22 67	24.03	41.86	19.39	36.73	12.81	27.74
OMSF	14 896	0.0	4.30	7.18	8.12	-6.49	3.53
OMSF	16 121	6.52	12.27	17.45	22.90	-30.12	-12.91
OMSF	22 223	189.35	167.52	170.81	166.15	174.80	185.45

TABLE 19 - (CONT.)

LAB.	CLOCK	43929	43989	44049	44109	44169	44229
ON	12 285	-76.85	-84.79	-82.69	-89.48	-76.30	-73.42
ON	13 14	16.15	-1.51	-17.37	-31.84	-34.26	-5.46
ON	14 863	-149.81	-136.04	-135.91	-124.44	-149.40	-143.85
ON	16 69	0.0	-47.03	-65.86	-64.77	-83.46	-63.59
ON	16 77	-97.17	-103.11	-120.87	-129.41	-134.86	-104.67
ON	16 114	16.22	14.56	2.70	1.30	42.63	24.25
ON	24 156	-22.38	-21.61	-3.47	6.87	0.0	0.0
ON	99 4	50.68	50.11	49.67	48.46	46.02	43.02
ON	99 7	0.0	-50.97	-73.02	-71.55	-67.01	-40.39
ORB	12 205	0.0	0.0	0.0	-15.39	18.82	-14.26
ORB	12 804	-0.40	21.97	37.64	58.81	56.39	41.77
PKNM	16 124	1.09	-17.81	0.0	0.0	0.0	0.0
PKNM	16 125	-67.04	-100.62	-118.66	-137.46	-78.47	-14.28
PKNM	24 144	-5.77	-6.42	-5.44	-8.68	-5.93	-8.62
PTB	12 320	0.0	0.0	-72.80	-53.79	-35.99	-14.82
PTB	12 389	31.29	37.37	18.42	49.59	24.74	26.02
PTB	12 394	-319.28	-320.06	-329.84	0.0	0.0	0.0
PTB	12 462	10.52	17.74	36.41	52.64	45.39	38.60
PTB	14 395	0.0	0.0	0.0	-92.40	-91.32	-78.14
PTB	14 867	-230.75	-235.33	-204.94	-212.44	-212.92	-206.71
PTB	16 67	80.41	71.56	53.39	60.53	65.90	77.31
PTB	24 103	-47.51	-51.40	-59.34	0.0	0.0	-20.94
PTB	92 1	-2.06	-1.94	-7.10	-5.72	-9.92	-2.44
PTB	40 20	0.0	0.0	0.0	0.0	0.0	-0.61
PTCH	16 64	51.01	42.64	0.0	0.0	176.66	217.71
PTCH	16 140	82.90	64.92	0.0	0.0	-8.94	60.93
RGO	11 123	-189.63	-207.09	-205.59	-203.32	-192.74	-196.45
RGO	11 199	-47.67	-34.86	-19.98	-37.88	-39.29	-32.78
RGO	12 348	0.0	0.0	0.0	106.80	109.49	101.99
RGO	14 202	-170.88	-170.58	0.0	0.0	0.0	0.0
RGO	14 484	-330.66	-339.96	-330.69	-325.13	-331.73	-351.24
STA	14 900	-131.54	-142.67	-137.43	-134.27	-139.12	-142.45
STA	16 137	-66.88	-74.71	-77.77	-80.31	-68.75	-56.97
STA	24 376	-224.38	-231.01	-230.12	-220.16	-218.54	-211.78
TP	12 335	-164.42	-175.51	-176.30	-176.35	-195.49	-192.37
TUG	12 524	48.03	16.54	19.72	16.35	8.39	25.43
USNO	11 207	-7.69	-30.15	-14.31	-28.01	-28.92	-43.94
USNO	12 147	-87.24	-91.64	-89.98	-93.77	-98.78	-119.23
USNO	12 345	18.32	20.16	-47.69	-57.85	-69.94	0.0
USNO	12 346	125.81	104.27	52.06	0.0	0.0	0.0
USNO	12 532	-45.44	-41.68	-41.52	-48.95	-49.66	-52.19
USNO	12 549	-142.01	-138.63	-140.18	-155.19	-149.23	-153.98
USNO	12 573	0.0	-66.79	-51.92	-45.72	-42.35	-68.47
USNO	12 591	164.43	159.20	145.00	133.20	139.82	130.96
USNO	12 752	0.0	0.0	0.0	0.0	-162.83	-150.59
USNO	12 761	48.11	0.0	0.0	0.0	-230.35	0.0
USNO	14 571	44.14	0.0	18.40	24.41	34.06	34.25
USNO	14 656	-41.90	-34.73	-31.86	-28.26	0.0	0.0
USNO	14 834	-88.34	-91.91	-82.20	-78.92	-78.13	-83.62
USNO	14 871	-82.26	-61.25	0.0	0.0	0.0	0.0

TABLE 19 - (CONT.)

LAB.	CLOCK	43929	43989	44049	44109	44169	44229
USNO	14 875	-100.07	-99.17	-101.39	-103.86	-98.97	-94.02
USNO	16 68	-81.15	-114.15	0.0	0.0	74.76	76.32
USNO	16 78	0.0	0.0	0.0	0.0	-55.26	0.0
USNO	22 114	30.40	29.38	24.82	34.40	50.07	46.79
USNO	22 362	-3.65	-1.70	-6.14	5.85	10.97	5.36
USNO	22 450	-93.23	-104.41	-90.16	-77.32	-71.59	-101.98
USNO	22 585	0.0	0.0	0.0	0.0	0.0	39.99
USNO	22 604	0.0	0.0	0.0	0.0	0.0	250.88
USNO	24 25	0.0	0.0	0.0	0.0	0.0	-5.53
USNO	24 28	0.0	0.0	0.0	0.0	10.02	0.0
USNO	24 94	-171.10	-176.92	-184.42	-180.59	-176.96	-175.93
USNO	24 104	-70.41	-93.17	-236.74	-240.09	-274.31	-272.58
USNO	24 118	-172.19	-167.91	-157.11	-149.35	0.0	0.0
USNO	24 264	110.60	102.41	93.10	99.97	103.76	97.53
USNO	24 301	0.0	0.0	0.0	0.0	-246.77	-235.75
USNO	24 305	-20.97	-25.96	-14.48	-8.02	13.45	3.87
USNO	24 343	12.74	17.04	14.57	18.29	32.78	26.49
USNO	24 377	0.0	-162.51	-172.42	-173.24	-166.32	-162.84
USNO	24 423	0.0	0.0	0.0	-98.63	0.0	0.0
USNO	24 449	28.81	25.19	31.05	38.13	48.04	0.0
USNO	24 586	0.0	0.0	0.0	0.0	0.0	-168.56
USNO	24 605	0.0	0.0	0.0	0.0	0.0	63.95
USNO	40 10	231.75	0.0	155.92	0.0	0.0	0.0
VSL	14 503	-175.34	-155.30	-164.47	-190.48	-194.11	0.0
VSL	22 34	18.74	27.70	26.25	22.32	35.61	46.60
VSL	22 489	0.0	0.0	326.77	304.29	265.65	272.16
VSL	24 190	0.0	0.0	-12.95	-16.12	0.0	0.0
ZIPE	12 979	-164.77	-128.32	-76.05	-78.98	-89.33	-89.71

THE CLOCKS ARE DESIGNATED BY THEIR MODEL (2 DIGITS) AND SERIAL NO.
THE CODES FOR THE MODELS ARE

11	HEWLETT-PACKARD 5060A	
12 AND 22	HEWLETT-PACKARD 5061A	(22 001 EQUIVALENT TO 12 1001)
13	EBAUCHES OSCILLATOM. B 5000	
14 AND 24	HEWLETT-PACKARD 5061A OPT.4	(24 001 EQUIVALENT TO 14 1001)
16 AND 26	EBAUCHES 3200	(26 001 EQUIVALENT TO 16 1001)
25	HEWLETT-PACKARD 5062C	(ADD 1000 TO THE SERIAL NO.)
40	HYDROGEN MASER	
90	LABORATORY CESIUM STANDARD NRC CS V	
91	LABORATORY CESIUM STANDARD NBS 4	
92	LABORATORY CESIUM STANDARD PTB CS 1	
99	PROTOTYPE CS	

TABLE 20 - INTERNATIONAL ATOMIC TIME , WEIGHTS OF THE CLOCKS FOR 1979

THE WEIGHTS ARE GIVEN FOR INTERVALS OF TWO MONTHS ENDING AT THE GIVEN DATES

*** DENOTES THAT THE CLOCK WAS NOT USED

LAB.	CLOCK	43929	43989	44049	44109	44169	44229
APL	14 773	43	61	61	68	100	100
APL	14 793	***	0	100	100	100	100
APL	24 121	100	100	100	100	100	100
ASMW	13 29	24	37	59	61	49	24
ASMW	16 76	0	100	30	18	20	28
BEV	16 71	***	0	100	***	***	0
F	12 133	50	52	50	20	12	12
F	12 158	42	100	87	62	43	39
F	12 206	0	1	0	0	***	***
F	12 231	73	45	0	7	7	6
F	12 347	13	21	35	46	68	69
F	12 439	7	7	7	7	***	***
F	12 594	100	100	100	100	100	100
F	14 51	0	99	100	100	100	100
F	14 134	62	67	***	***	***	***
F	14 753	43	44	88	33	26	23
F	16 80	***	***	***	***	0	81
F	22 120	91	66	61	67	69	75
F	24 407	54	47	54	51	29	24
IEN	12 303	100	100	100	100	100	100
IEN	12 469	94	86	60	35	27	29
IEN	12 609	8	12	30	36	97	100
IEN	14 893	100	100	100	100	100	80
IEN	16 84	0	***	***	***	***	***
IFAG	16 131	***	***	***	***	***	0
IFAG	16 138	***	***	***	***	***	0
NBS	11 137	***	***	***	***	0	98
NBS	11 167	100	100	100	97	96	93
NBS	14 316	83	90	100	100	100	100
NBS	14 323	51	16	11	9	8	6
NBS	14 324	98	76	75	42	39	75
NBS	14 601	100	95	100	100	100	100
NBS	16 61	19	22	19	***	***	***
NBS	91 4	0	65	***	***	***	***
NPL	12 316	72	60	52	67	92	73
NPL	12 418	98	87	21	17	20	33
NPL	12 832	1	1	0	3	2	3
NPL	14 334	***	***	***	***	***	0
NRC	12 122	***	0	100	97	100	83
NRC	14 267	***	0	100	97	100	100
NRC	90 5	100	100	100	100	100	100
OMH	22 67	44	36	74	62	67	74
OMSF	14 896	***	0	100	100	86	100
OMSF	16 121	38	32	39	64	11	21
OMSF	22 223	64	75	100	94	96	100

TABLE 20 - (CONT.)

LAB.	CLOCK	43929	43989	44049	44109	44169	44229
ON	12 285	92	100	100	90	95	100
ON	13 14	12	18	19	21	18	24
ON	14 863	100	91	100	99	66	90
ON	16 69	***	0	36	59	31	45
ON	16 77	23	29	34	43	36	38
ON	16 114	100	100	95	100	40	50
ON	24 156	100	100	82	82	***	***
ON	99 4	100	100	100	100	100	100
ON	99 7	***	0	26	44	71	50
ORB	12 205	***	***	***	0	12	19
ORB	12 804	22	23	22	21	22	22
PKNM	16 124	8	9	***	***	***	***
PKNM	16 125	0	11	11	9	5	0
PKNM	24 144	100	100	100	100	100	100
PTB	12 320	***	***	0	43	26	16
PTB	12 389	100	81	81	51	66	74
PTB	12 394	100	100	99	***	***	***
PTB	12 462	100	100	81	44	39	43
PTB	14 395	***	***	***	0	100	95
PTB	14 867	0	100	27	40	58	72
PTB	16 67	92	100	65	79	100	99
PTB	24 103	76	72	100	***	***	0
PTB	92 1	100	100	100	100	100	100
PTB	40 20	***	***	***	***	***	0
PTCH	16 64	0	0	***	***	0	8
PTCH	16 140	0	39	***	***	0	0
RGO	11 123	100	84	100	100	100	100
RGO	11 199	40	73	38	38	59	100
RGO	12 348	***	***	***	0	100	100
RGO	14 202	100	100	***	***	***	***
RGO	14 484	33	26	36	48	100	77
STA	14 900	100	96	100	100	100	100
STA	16 137	24	29	40	100	99	98
STA	24 376	100	100	100	100	100	100
TP	12 335	82	42	39	51	33	54
TUG	12 524	41	48	51	50	45	47
USNO	11 207	68	36	48	47	89	47
USNO	12 147	97	82	100	100	100	54
USNO	12 345	100	100	0	8	5	***
USNO	12 346	17	13	5	***	***	***
USNO	12 532	100	100	100	100	100	100
USNO	12 549	85	100	97	85	100	100
USNO	12 573	***	0	56	71	89	59
USNO	12 591	17	39	31	31	37	42
USNO	12 752	***	***	***	***	0	97
USNO	12 761	100	***	***	***	0	***
USNO	14 571	100	***	0	100	100	100
USNO	14 656	100	100	100	100	***	***
USNO	14 834	100	100	99	100	100	100
USNO	14 871	15	24	***	***	***	***

TABLE 20 - (CONT.)

LAB.	CLOCK	43929	43989	44049	44109	44169	44229
USNO	14 875	100	100	100	100	100	100
USNO	16 68	16	40	***	***	0	100
USNO	16 78	***	***	***	***	0	***
USNO	22 114	37	43	100	100	90	100
USNO	22 362	100	100	100	98	100	100
USNO	22 450	21	22	37	49	57	56
USNO	22 585	***	***	***	***	***	0
USNO	22 604	***	***	***	***	***	0
USNO	24 25	***	***	***	***	***	0
USNO	24 28	***	***	***	***	0	***
USNO	24 94	30	37	53	100	100	100
USNO	24 104	100	60	0	1	1	1
USNO	24 118	88	100	96	100	***	***
USNO	24 264	97	100	100	100	100	100
USNO	24 301	***	***	***	***	0	99
USNO	24 305	43	46	95	100	47	57
USNO	24 343	26	32	96	100	93	100
USNO	24 377	***	0	99	100	100	100
USNO	24 423	***	***	***	0	***	***
USNO	24 449	100	100	100	100	100	***
USNO	24 586	***	***	***	***	***	0
USNO	24 605	***	***	***	***	***	0
USNO	40 10	0	***	0	***	***	***
VSL	14 503	20	24	85	47	33	***
VSL	22 34	9	31	100	100	95	100
VSL	22 489	***	***	0	21	7	9
VSL	24 190	***	***	0	100	***	***
ZIPE	12 979	22	21	12	9	9	9

THE CLOCKS ARE DESIGNATED BY THEIR MODEL (2 DIGITS) AND SERIAL NO.
THE CODES FOR THE MODELS ARE

11	HEWLETT-PACKARD 5060A	
12 AND 22	HEWLETT-PACKARD 5061A	(22 001 EQUIVALENT TO 12 1001)
13	EBAUCHES OSCILLATOM. B 5000	
14 AND 24	HEWLETT-PACKARD 5061A OPT.4	(24 001 EQUIVALENT TO 14 1001)
16 AND 26	EBAUCHES 3200	(26 001 EQUIVALENT TO 16 1001)
25	HEWLETT-PACKARD 5062C	(ADD 1000 TO THE SERIAL NO.)
40	HYDROGEN MASER	
90	LABORATORY CESIUM STANDARD NRC CS V	
91	LABORATORY CESIUM STANDARD NBS 4	
92	LABORATORY CESIUM STANDARD PTB CS 1	
99	PROTOTYPE CS	

TABLE 21 - MEASUREMENTS OF THE EAL AND TAI FREQUENCY

GRAVITATIONAL FREQUENCY CORRECTIONS ARE APPLIED . THE FREQUENCIES ARE EXPRESSED AT SEA LEVEL .

INTERVAL MJD	CENTRAL DATE	F(EAL)-F(NBS6) IN 10**-13	F(EAL)-F(NRC CSV) IN 10**-13	F(EAL)-F(PTB CS1) IN 10**-13
43479_43599	1978 JAN31	9.00		
43509_43589	1978 FEB10		9.23	
43538_43618	1978 MAR11			8.97
43589_43669	1978 MAY 1		8.52	
43626_43706	1978 JUN 7			8.09
43669_43749	1978 JUL20		8.12	
43749_43829	1978 OCT 8		7.49	7.68(2)
43769_43849	1978 OCT28	8.48	7.93(1)	
43829_43909	1978 DEC27		8.10	8.61
43909_43989	1979 MAR17		8.24	8.80
43989_44069	1979 JUN 5		7.72	8.24
44064-44116	1979 AUG 5	8.5		
44069_44149	1979 AUG24		7.79	7.64
44149_44229	1979 NOV12		7.05(1)	8.07

INTERVAL MJD	CENTRAL DATE	F(TAI)-F(NBS6) IN 10**-13	F(TAI)-F(NRC CSV) IN 10**-13	F(TAI)-F(PTB CS1) IN 10**-13
43479_43599	1978 JAN31	-0.20		
43509_43589	1978 FEB10		0.03	
43538_43618	1978 MAR11			-0.23
43589_43669	1978 MAY 1		-0.68	
43626_43706	1978 JUN 7			-1.11
43669_43749	1978 JUL20		-1.08	
43749_43829	1978 OCT 8		-1.66	-1.47(2)
43769_43849	1978 OCT28	-0.62	-1.17(1)	
43829_43909	1978 DEC27		-0.91	-0.39
43909_43989	1979 MAR17		-0.76	-0.20
43989_44069	1979 JUN 5		-1.23	-0.71
44064-44116	1979 AUG 5	-0.3		
44069_44149	1979 AUG24		-0.91	-1.06
44149_44229	1979 NOV12		-1.40(1)	-0.38

(1) COMPUTED JUST AFTER A FULL EVALUATION OF NRC-CSV

(2) THE THREE LAST CALIBRATION RESULTS VIA PTB-CS1 PUBLISHED TABLE 22 (ANNUAL REPORT 1978) ARE REPLACED BY THE VALUES SHOWN IN THIS TABLE

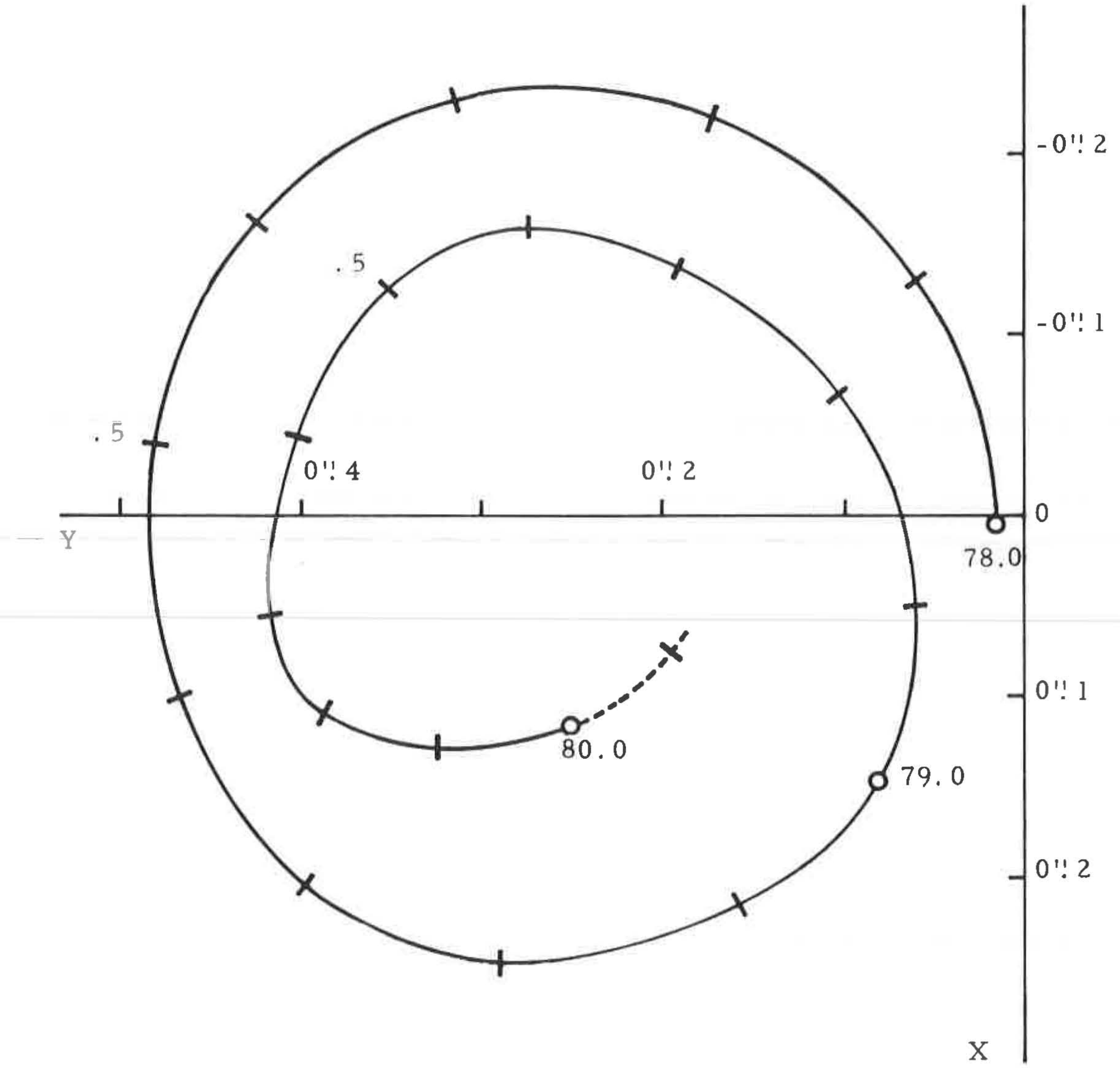

Fig. 1 Path of the pole from 1978.0 to 1980.0

Smoothed values of Table 6C, obtained by the Vondrak's method, with the coefficient of smoothing which equalizes the internal and external standard deviations in x and y.

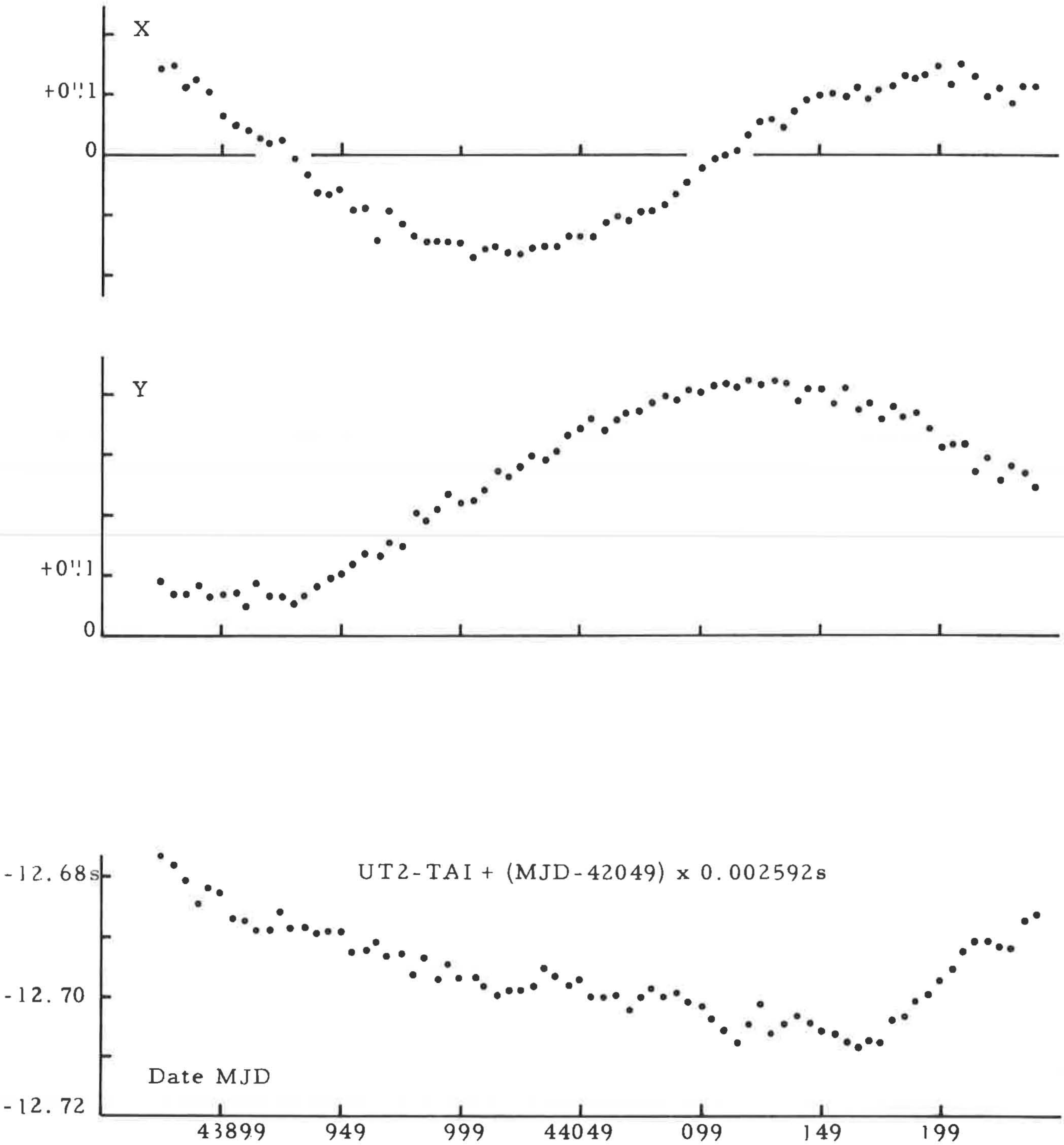

Fig. 2 - Raw data of x, y. UT2-TAI (table 6C for 1979), 5-day means (In this figure, UT2 is corrected for the terms due to zonal tides with periods smaller than 32 days, the maximum correction being 0.0015s in 1979).

PART C

TIME SIGNALS (1980)

The time signal emissions, unless otherwise stated, follow the UTC system, in accordance with the Recommendation 460-2 of the International Radio Consultative Committee (CCIR), reproduced thereafter.

The information on time signals is based on inquiries made in February 1980.

RECOMMENDATION 460-2

STANDARD-FREQUENCY AND TIME-SIGNAL EMISSIONS

(Question 1/7)

(1970 - 1974 - 1978)

The CCIR,

CONSIDERING

(a) that the Administrative Radio Conference, Geneva, 1959, allocated the frequencies 20 kHz ± 0.05 kHz, 2.5 MHz ± 5 kHz (2.5 MHz ± 2 kHz in Region 1), 5 MHz ± 5 kHz, 10 MHz ± 5 kHz, 15 MHz ± 10 kHz, 20 MHz ± 10 kHz and 25 MHz ± 10 kHz to the standard-frequency and time-signal service, requesting the CCIR to study the question of establishing and operating a world-wide standard-frequency and time-signal service;

(b) that additional standard frequencies and time signals are emitted in other frequency bands;

(c) the provisions of Article 44, Section IV, of the Radio Regulations;

(d) the continuing need for close cooperation between Study Group 7 and the Inter-Governmental Maritime Consultative Organization (IMCO), the International Civil Aviation Organization (ICAO), the General Conference of Weights and Measures (CGPM), the Bureau International de l'Heure (BIH) and the concerned Unions of the International Council of Scientific Unions (ICSU);

(e) the desirability of maintaining world-wide coordination of standard-frequency and time-signal emissions;

(f) the need to disseminate standard frequencies and time signals in conformity with the second as defined by the 13th General Conference of Weights and Measures (1967);

(g) the continuing need to make Universal Time (UT) inmmediately available to an accuracy of one-tenth of a second,

UNANIMOUSLY RECOMMENDS

1. that all standard-frequency and time-signal emissions conform as closely as possible to Coordinated Universal Time (UTC) (see Annex I); that the time signals should not deviate from UTC by more than one millisecond; that the standard frequencies should not deviate by more than 1 part in 10^{10}, and that the time signals emitted from each transmitting station should bear a known relation to the phase of the carrier;

2. that standard-frequency and time-signal emissions, and other time-signal emissions intended for scientific applications (with the possible exception of those dedicated to special systems) should contain information on the difference between UT1 and UTC (see Annexes I and II);

3. that this document be transmitted by the Director, CCIR, to all Administrations Members of the ITU, to IMCO, ICAO, the CGPM, the BIH, the International Union of Geodesy and Geophysics (IUGG), the International Union of Radio Science (URSI) and the International Astronomical Union (IAU);

4. that the standard-frequency and time-signal emissions should conform to RECOMMENDS 1 and 2 above as from 1 January 1975.

ANNEX I

TIME SCALES

A. Universal Time (UT)

In applications in which an imprecision of a few hundredths of a second cannot be tolerated, it is necessary to specify the form of UT which should be used:

UT0 is the mean solar time of the prime meridian obtained from direct astronomical observation;

UT1 is UT0 corrected for the effects of small movements of the Earth relative to the axis of rotation (polar variation);

UT2 is UT1 corrected for the effects of a small seasonal fluctuation in the rate of rotation of the Earth;

UT1 is used in this document, since it corresponds directly with the angular position of the Earth around its axis of diurnal rotation. (GMT may be regarded as the general equivalent of UT.)

B. International Atomic Time (TAI)

The international reference scale of atomic time (TAI), based on the second (SI), as realized at sea level, is formed by the Bureau International de l'Heure (BIH) on the basis of clock data supplied by cooperating establishments. It is in the form of a continuous scale, e.g. in days, hours, minutes and seconds from the origin 1 January 1958 (adopted by the CGPM 1971).

C. Coordinated Universal Time (UTC)

UTC is the time-scale maintained by the BIH which forms the basis of a coordinated dissemination of standard frequencies and time signals. It corresponds exactly in rate with TAI but differs from it by an integral number of seconds.

The UTC scale is adjusted by the insertion or deletion of seconds (positive or negative leap-seconds) to ensure approximate agreement with UT1.

D. DUT1

The value of the predicted difference UT1-UTC, as disseminated with the time signals is denoted DUT1; thus DUT1 ≈ UT1 − UTC. DUT1 may be regarded as a correction to be added to UTC to obtain a better approximation to UT1.

The values of DUT1 are given by the BIH in integral multiples of 0.1 s.

The following operational rules apply:

1. Tolerances

1.1 The magnitude of DUT1 should not exceed 0.8 s.

1.2 The departure of UTC from UT1 should not exceed ± 0.9 s. *

1.3 The deviation of (UTC plus DUT1) should not exceed ± 0.1 s.

2. Leap-seconds

2.1 A positive or negative leap-second should be the last second of a UTC month, but first preference should be given to the end of December and June, and second preference to the end of March and September.

2.2 A positive leap-second begins at $23^h\ 59^m\ 60^s$ and ends at $0^h\ 0^m\ 0^s$ of the first day of the following month. In the case of a negative leap-second, $23^h\ 59^m\ 58^s$ will be followed one second later by $0^h\ 0^m\ 0^s$ of the first day of the following month (see Annex III).

2.3 The BIH should decide upon and announce the introduction of a leap-second, such an announcement to be made at least eight weeks in advance.

3. Value of DUT1

3.1 The BIH is requested to decide upon the value of DUT1 and its date of introduction and to circulate this information one month in advance. **

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* The difference between the maximum value of DUT1 and the maximum departure of UTC from UT1 represents the allowable deviation of (UTC + DUT1) from UT1 and is a safeguard for the BIH against unpredictable changes in the rate of rotation of the Earth.

** In exceptional cases of sudden change in the rate of rotation of the Earth, the BIH may issue a correction not later than two weeks in advance of the date of its introduction.

3.2 Administrations and organizations should use the BIH value of DUT1 for standard-frequency and time-signal emissions, and are requested to circulate the information as widely as possible in periodicals, bulletins, etc.

3.3 Where DUT1 is disseminated by code, the code should be in accordance with the following principles (except § 3.5 below):

- the magnitude of DUT1 is specified by the number of emphasized second markers and the sign of DUT1 is specified by the position of the emphasized second markers with respect to the minute marker. The absence of emphasized markers indicates DUT1 = 0;
- the coded information should be emitted after each identified minute if this is compatible with the format of the emission. Alternatively the coded information should be emitted, as an absolute minimum, after each of the first five identified minutes in each hour.

Full details of the code are given in Annex II.

3.4 Alternatively, DUT1 may be given by voice or in Morse code.

3.5 DUT1 information primarily designed for, and used with, automatic decoding equipment may follow a different code but should be emitted after each identified minute if this is compatible with the format of the emission. Alternatively, the coded information should be emitted, as an absolute minimum, after each of the first five identified minutes in each hour.

3.6 Other information which may be emitted in that part of the time-signal emission designated in §§ 3.3 and 3.5 for coded information on DUT1 should be of a sufficiently different format that it will not be confused with DUT1.

3.7 In addition, UT1 – UTC may be given to the same or higher precision by other means, for example, in Morse code or voice, by messages associated with maritime bulletins, weather forecasts, etc.; announcements of forthcomming leap-seconds may also be made by these methods.

3.8 The BIH is requested to continue to publish, in arrears, definitive values of the differences UT1 – UTC, UT2 – UTC.

ANNEX II

CODE FOR THE TRANSMISSION OF DUT1

A positive value of DUT1 will be indicated by emphasizing a number (n) of consecutive second markers following the minute marker from second marker one to second marker (n) inclusive; (n) being an integer from 1 to 8 inclusive.

$$DUT1 = (n \times 0.1)\ s$$

A negative value of DUT1 will be indicated by emphasizing a number (m) of consecutive second markers following the minute marker from second marker nine to second marker ($8 + m$) inclusive, (m) being an integer from 1 to 8 inclusive.

$$DUT1 = -(m \times 0.1)\ s$$

A zero value of DUT1 will be indicated by the absence of emphasized second markers.

The appropriate second markers may be emphasized, for example, by lengthening, doubling, splitting or tone modulation of the normal second markers.

Examples:

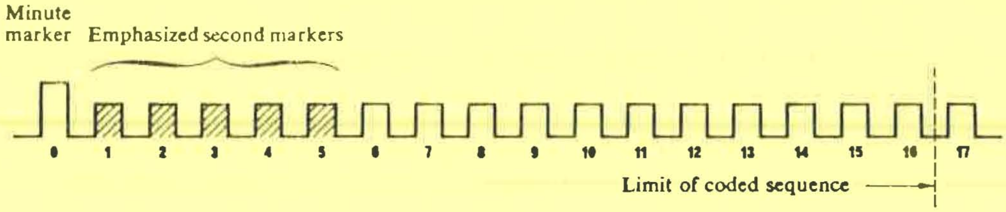

FIGURE 1

DUT1 = +0·5 s

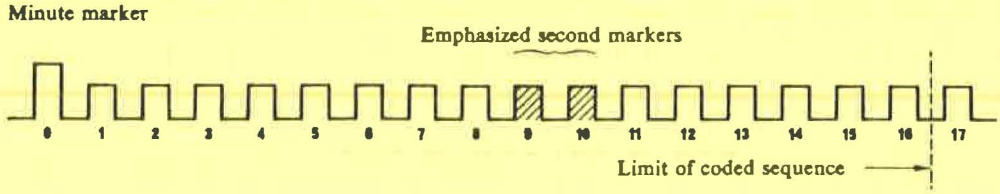

FIGURE 2

DUT1 = −0·2 s

ANNEX III

DATING OF EVENTS IN THE VICINITY OF A LEAP-SECOND

The dating of events in the vicinity of a leap-second shall be effected in the manner indicated in the following figures:

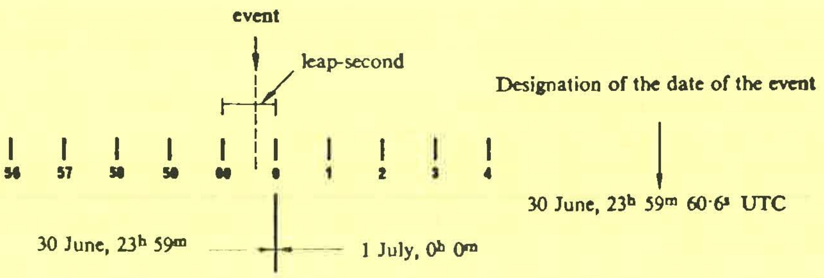

FIGURE 3 – *Positive leap-second*

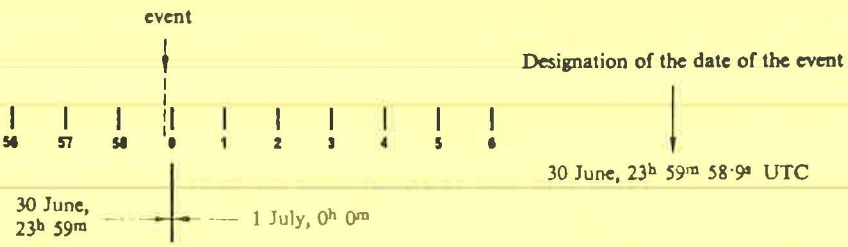

FIGURE 4 - *Negative leap-second*

COMMENTS ON CCIR RECOMMENDATION 460-2

These comments are made by the Director of the BIH.

In Annex I of CCIR Recommendation 460-2, the section D.1 states the tolerances. They must be understood as follows.

In 1.1, the magnitude of DUT 1 shoud not exceed 0.8 s exactly (DUT 1 is given in units of 0.1 s, and no provision in the code is made for transmission of + or – 0.9 s).

In 1.3, the deviation of (UTC plus DUT 1) from UT 1 should not exceed ± 0.100 ...s (0.1 s in the text must be considered as an exact figure, not as a rounded value).

Therefore, the departure of UTC from UT 1 should not exceed ± 0.900 ...s.

EXAMPLE : DUT 1 = + 0.8 s

If the interval for which this value is valid is perfectly predicted by the BIH, DUT 1 covers the values of UT 1 - UTC :

$$0.75\,\text{s} \leqslant \text{UT1} - \text{UTC} \leqslant 0.85\,\text{s}.$$

Therefore 0.85 s is the normal upper limit. The difference between 0.90 s (stated in 1.2, and taking into account the above comments) and 0.85 s is a safeguard against unpredictable changes of the rotation of the Earth.

AUTHORITIES RESPONSIBLE FOR THE TIME SIGNAL EMISSIONS

Signal	Authority
ATA	National Physical Laboratory Hillside Road New Dehli – 110012, India
BPV	Time and Frequency Division Shanghaï Observatory Academia Sinica Zi-Ka-Wei, Shanghaï, China
BSF	Telecommunication Laboratories Ministry of Communications P. O. Box 71 – Chung-Li 320 Taiwan, China
CHU	National Research Council, Time and Frequency Section Physics Division (M-36) Ottawa K 1 A OS 1, Ontario, Canada Attn : Dr. C. C. Costain
DAM, DAN, DAO	Deutsches Hydrographisches Institut Postfach 220 2000 Hamburg 4, Federal Republic of Germany
DCF77	Physikalisch-Technische Bundesanstalt, Laboratorium 1-21 Federal Republic of Germany Bundesallee 100 D 33 Braunschweig
DGI, Y3S	Amt für Standardisierung, Messwesen und Warenprüfung Fachabteilung Elektrizität Arbeitsgebiet Zeit und Frequenznormale Wallstrasse 16 DDR 1026 Berlin
EBC	Instituto y Observatorio de Marina San Fernando Cadiz, Spain
FFH	Centre National d'Études des Télécommunications Division : Dispositif de Traîtement de Signal Département : Étalons de fréquence et de temps 38, rue du Général Leclerc 92131 Issy-les-Moulineaux, France

Signal	Authority
FTH42, FTK77, FTN87	Laboratoire Primaire du Temps et des Fréquences Observatoire de Paris 61, avenue de l'Observatoire 75014 Paris, France
GBR	1/ Time information : Royal Greenwich Observatory Herstmonceux Castle Hailsham, East Sussex BN27 1 RP, United Kingdom 2/ Standard Frequency information : National Physical Laboratory Electrical Science Division Teddington, Middlesex TW11 OLW, United Kingdom
HBG	Service horaire HBG Observatoire Cantonal CH – 2000 Neuchâtel, Suisse
IAM	Istituto Superiore delle Poste e delle Telecomunicazioni Ufficio 8°, Rep. 3° - Viale Europa 00100 – Roma, Italy
IBF	Istituto Elettrotecnico Nazionale Galileo Ferraris Strada delle Cacce, 91 10135 – Torino, Italy
JJY, JG2AS	Frequency Standard Division The Radio Research Laboratories Ministry of Posts and Telecommunications Koganei, Tokyo 184, Japan
LOL	Director Observatorio Naval Av. España 2099 1107 – Buenos-Aires, Republica Argentina
LQB9, LQC20	Instituto Geografico Militar (IGMA) Servicio internacional de la Hora Seccion Conservacion de la Hora Calle 38 Gral Savio 865 1650 Villa Maipu, San Martin Pcia de Buenos-Aires Republica Argentina
MSF	National Physical Laboratory Electrical Science Division Teddington, Middlesex TW11 OLW United Kingdom

Signal	Authority
OLB5, OMA	1/ Time information : Astronomický Ústav ČSAV, Budečská 6, 120 23 Praha 2, Vinohrady, Czechoslovakia. 2/ Standard frequency information : Ústav radiotechniky a elektroniky ČSAV, Lumumbova 1, 182 51 Praha 8, Kobylisy, Czechoslovakia
PPE, PPR	Serviço da Hora Observatório Nacional (CNPq) Rua General Bruce, 586 20921 Rio de Janeiro – RJ, Brasil
RBU, RCH RID, RTA, RTZ, RWM UQC3, UTR3	Comité d'État des Normes Conseil des Ministre de l'URSS Moscou 117049, URSS, Leninski prosp., 9
VNG	Time and Frequency Standards Section Australian Telecommunications Commission, Research Laboratories Box 249 Clayton, Victoria 3168, Australia
WWV, WWVH WWVB	Time and Frequency Services Group Time and Frequency Division National Bureau of Standards Boulder, Colorado 80303, U. S. A.
YVTO	Direccion de Hidrografia y Navegacion Observatori Cagigal Apartado Postal N°6745 Caracas, Venezuela
Y3S	See DGI
ZUO	National Physical Research Laboratory P. O. Box 395 Pretoria South Africa

TIME – SIGNALS EMITTED IN THE UTC SYSTEM

Station	Location Latitude Longitude	Frequency (kHz)	Schedule (UT)	Form of time signals
ATA	Greater Kailash Dehli India 28° 34' N 77° 19' E	5 000 10 000 15 000	3 h 30m to 14 h 30m on Monday to Saturday 4 h 30m to 8 h 30m on second Saturday of the month and Sunday, continuous operation projected.	Second pulses of 5 cycles of a 1 kHz modulation. Minute pulses of 100 ms duration.
BPV (1) see p. C-13	Shanghaï China 31° 12' N 121° 26' E	5 000 10 000 15 000	16 h to 1 h continuous 1 h to 16 h	UTC time signal from minutes 1 to 10 and 31 to 40. Second markers of 10 cycles of 1 kHz modulation. Minute marker, beginning of the first pulse of a series of 9 pulses of 10 ms of 1 kHz modulation. UT1 time signal from minutes 10 to 15 and 40 to 45. Second pulses of 100 ms of 1 kHz modulation. The minute marker is prolonged to 500 ms.
BSF	Chung-Li Taiwan China 24° 57' N 121° 9' E	5 000 15 000	0h to 10h	(a) From min. 5 to 10, 15 to 25, 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. Minute pulses are 0.5 s long. A bilingual (Fr. Eng.) announcement of time is made each minute FSK time code on 31st to 39th seconds. Broadcast is single sideband ; upper sideband with carrier reinserted. DUT1 : CCIR code by split pulses.
DAM	Elmshorn Germany, F. R. 53° 46' N 9° 40' E	8 638.5 16 980.4 4 265 8 638.5 6 475.5 12 763.5	11 h 55m to 12 h 06m 23 h 55m to 24 h 06m from 21 Oct. to 20 April 23 h 55m to 24 h 06m from 21 April to 20 Oct.	New international system, then second pulses from minutes 0.5 to 6.0 (minute pulses prolonged). A1 Type DUT1 : CCIR code by doubling, after minute pulses 1 to 5
DAN	Osterloog Germany, F. R. 53° 38' N 7° 12' E	2 614	11 h 55m to 12 h 06m 23 h 55m to 24 h 06m	As DAM (see above)
DAO	Kiel Germany F. R. 54° 26' N 10° 8' E	2 775	11 h 55m to 12 h 06m 23 h 55m to 24 h 06m	As DAM (see above)
DCF77	Mainflingen Germany F. R. 50° 1' N 9° 0' E	77.5	continuous	The second marks are reduction to 1/4 of the carriers's amplitude of 0.1 s duration ; the reference point is the beginning of the pulse modulation. The second 59 marker is omitted. Time code in BCD (year, month, day, hour, minute, day of the week) by lengthning second marks from marks N° 20 to N° 58 every minute. When the reserve antenna is used, second marker 15 is prolonged. No transmission of DUT1.

Station	Location Latitude Longitude	Frequency (kHz)	Schedule (UT)	Form of the time signals
DGI	Oranienburg Germ. Dem. Rep 52° 48' N 13° 24' E	182	5h 59m 30s to 6h 00m 11h 59m 30s to 12h 00m 17h 59m 30s to 18h 00m	A2 type second pulses of 0.1 s duration for seconds 30-40, 45-50, 55-60. The last pulse is prolonged.
EBC	San Fernando Spain 36° 28' N 6° 12' W	12 008 12 008 6 840 6 840	10h 00m to 10h 10m (A_2) 10h 15m to 10h 25m (A_3J) 10h 30m to 10h 40m (A_2) 10h 45m to 10h 55m (A_3J)	Second pulses of 0.1 s duration of 1 kHz modulation Minute pulses of 0.5 s duration of 1 250 Hz modulation DUT1, CCIR code, double pulse. (A_2) amplitude modulation. (A_3J) single sideband, cancelled carrier.
FFH	Ste Assise France 48° 33' N 2° 34' E	2 500	continuous from 8h to 16h 25m except on Sunday	Second pulses of 5 cycles of 1 kHz modulation. Minute pulses prolonged to 0.5 s. DUT1 : CCIR code by lengthening to 0.1 s.
FTH42 FTK77 FTN87	Ste Assise France 48° 33' N 2° 34' E	7 428 10 775 13 873	at 9h and 21h at 8h and 20h at 9h 30m, 13h, 22h 30m,	A1 type second pulses during the 5 minutes preceding the indicated times. Minute pulses are prolonged. DUT1 : in Morse code.
GBR	Rugby United Kingdom 52° 22' N 1° 11' W	16	2h 55m to 3h 00m 8h 55m to 9h 00m 14h 55m to 15h 00m 20h 55m to 21h 00m	A1 type second pulses lasting 100 ms, lengthened to 500 ms at the minute. The reference point is the start of carrier rise. Uninterrupted carrier is transmitted for 24 s from 54m 30s and from 0m 6s. DUT1 : CCIR code by double pulses.
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.
IAM	Rome Italy 41° 47' N 12° 27' E	5 000	7h 30m to 8h 30m 10h 30m to 11h 30m except Sat. afternoon, Sun., and national holidays. Advanced by 1h in summer.	Second pulses of 5 cycles of 1 kHz modulation. Minute pulses of 20 cycles (Announcements 5m before the emission of time signals).
IBF	Torino Italy 45° 2' N 7° 42' E	5 000	During 15m preceding 7h, 9h, 10h, 11h, 12h, 13h, 14h, 15h, 16h, 17h, 18h. Advanced by 1 hour in summer.	Second pulses of 5 cycles of 1 kHz modulation. These pulses are repeated 7 times at the minute. Voice announcements at the beginning and end of each emission. Time announcement (C.E.T.) by Morse code every ten minutes beginning at 0h 0m. DUT1 : CCIR code by double pulse.
JG2AS	Sanwa Ibaraki Japan 36° 11' N 139° 51' E	40	continuous, except interruptions during communications.	A1 type second pulses of 0.5 s duration. Second 59 is of 0.1 s. No DUT1 code.
JJY	Sanwa Ibaraki Japan 36° 11' N 139° 51' E	2 500 5 000 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.

Station	Location Latitude Longitude	Frequency (kHz)	Schedule (UT)	Form of the time signals
LOL1	Buenos-Aires Argentina 34° 37' S 58° 21' W	5 000 10 000 15 000	11h to 12h, 14h to 15h, 17h to 18h, 20h to 21h, 23h to 24h	Second pulses of 5 cycles of 1 000 Hz modulation. Second 59 is omitted. Announcement of hours and minutes every 5 minutes, followed by 3m of 1 000 Hz or 440 Hz modulation. DUT1 : CCIR code by lengthening.
LOL2 LOL3	Buenos-Aires Argentina 34° 37' S 58° 21' W	4 856 8 030 17 180	1h, 13h, 21h,	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.
LQB9 (1) LQC20(1) see p. C-13	Planta Gral Pacheco 34° 26' S 58° 37' W	8 167.5 17 551.5	22h 5m, 23h 50m 10h 5m, 11h 50m	A1 second pulses during the 5 minutes preceding the indicated times. Second 59 is omitted, second 60 is prolonged. After the emission, OK is transmitted if the emission is correct, NV if not correct. 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 10h 0m to 14h 0m 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 interruptions. 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.
MSF	Rugby United Kingdom 52° 22' N 1° 11' W	2 500 5 000 10 000	between minutes 0 and 5, 10 and 15, 20 and 25, 30 and 35, 40 and 45, 50 and 55.	Second pulses of 5 cycles of 1 kHz modulation. Minute pulses are prolonged. DUT1 : CCIR code by double pulse.
OLB5	Poděbrady Czechoslovakia 50° 9' N 15° 9' E	3 170	continuous except from 6h to 12h on the first Wednesday of every month	A1 type, second pulses. No transmission of DUT1.
OMA (2) see p. C- 13	Liblice Czechoslovakia 50° 4' N 14° 53' E	50	continuous except from 6h to 12h on the first Wednesday of every month	Interruption of the carrier of 100ms 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.
OMA	Liblice Czechoslovakia 50° 4' N 14° 53' E	2 500	between minutes 5 and 15 25 and 30, 35 and 40, 50 and 60 of every hour except from 5h to 11h on the first Wednesday of every month	Pulses of 5 cycles of 1 kHz modulation (prolonged for the minutes). The first pulse of the 5th minute is prolonged to 500 cycles. No transmission of DUT1.
PPE	Rio-de-Janeiro Brasil 22° 54' S 43° 13' W	8 721	0h 30m, 11h 30m, 13h 30m, 19h 30m, 20h 30m, 23h 30m,	Second ticks, of A1 type, during the five minutes preceding the indicated hours. The minute ticks are longer. DUT1 : CCIR code by double pulse

Station	Location Latitude Longitude	Frequency (kHz)	Schedule (UT)	Form of the time signals
PPR	Rio-de-Janeiro Brasil 22° 59' S 43° 11' W	435 4 244 8 634 13 105 17 194.4 22 603	1h 30m, 14h 30m, 21h 30m	Second ticks, of A1 type, during the five minutes preceding the indicated hours. The minute ticks are longer.
RBU (3) see p. C-13	Moscow USSR 55° 48' N 38° 18' E	66 2/3	between minutes 0 and 5 from 0h to 8h 5m from 9h to 13h 5m from 17h to 23h 5 m	A1 type second pulses. The pulses at beginning of the minute are prolonged to 0.5 s.
RCH (3)	Tashkent USSR 41° 19' N 69° 15' E		between minutes 0 and 10, 30 and 40	Second pulses. The pulses at the beginning of the minute are prolonged to 0.5 s.
		2 500	0h to 3h 40m 5h 30m to 23h 40m	
		5 000	0h to 1h 10m 2h to 3h 40m 14h to 17h 10m 18h to 23h 40m	
		10 000	5h 30m to 9h 10m 10h to13h 10m	
RID (3)	Irkutsk USSR 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.	Second pulses. The pulses at the beginning of the minute are prolonged to 0.5 s.
RTA (3)	Novossibirsk USSR 55° 4' N 82° 58' E		between minutes 0 and 10, 30 and 40	Second pulses. The pulses at the beginning of the minute are prolonged.
		10 000	0h to 1h 10m 2h to 4h 40m 14h to 17h 10m 18h to 23h 40m	
		15 000	6h 30m to 9h 10m 10h to 13h 10m	
RWM (3)	Moscow USSR 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	Second pulses. The pulses at the beginning of the minute are prolonged to 0.5s.
RTZ (3)	Irkutsk USSR 52° 26' N 104° 2' E	50	between minutes 0 and 5, from 1h to 23h 5m	A1 type second pulses. The pulses at the beginning of the minute are prolonged to 0.5s.
UQC3	Chabarovsk USSR 48° 30' N 134° 51' E	25	from 0h 43m to 0h 52m, from 3h 43m to 3h 52m from 6h 43m to 6h 52m from 17h 43m to 17h 52m	A1 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 10s. No transmission of DUT1 code.

Station	Location Latitude Longitude	Frequency (kHz)	Schedule (UT)	Form of the time signals
UTR3	Gorki USSR 56° 11' N 43° 58' E	25	from 5h 43m to 5h 52m from 14h 43m to 14h 52m from 18h 43m to 18h 52m	A1 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	Lyndhurst Australia 38° 3' S 145° 16' E	4 500 7 500 12 000	9h 45m to 21h 30m continuous except 22h 30m to 22h 45m 21h 45m to 9h 30m	Second markers of 50 cycles of 1 kHz modulation; 5 cycles only for second markers 55 to 58 ; second marker 59 is omitted ; 500 cycles for minute markers. During the 5th, 10th, 15th, etc... minutes, 5 cycles for second markers 50 to 58. Identification by voice announcement during 15th, 30th, 45th and 60th minutes. DUT1 : CCIR code by 45 cycles of 900 Hz modulation immediately following the normal second markers.
WWV	Fort-Collins 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. 59th and 29th 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 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 and time and of the correction to obtain UT1. No CCIR code.
WWVH	Kauai 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. 59th and 29th 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° 56' W	6 100	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 52 and 57 of each minute, voice announcement of hour, minute and second.
Y3S (4) see p. C-13	Nauen Germ. Dem. Rep. 52° 39' N 12° 55' E	4 525	continuous except from 8h 15m to 9h 45m for maintenance if necessary	A1 type second pulses of 0.1 s duration. Minute pulses prolonged to 0.5 s. DUT1 : CCIR code by double pulse.
ZUO	Olifantsfontein South Africa 25° 58' S 28° 14' E	2 500 5 000	18h to 4h continuous	Pulses of 5 cycles of 1 kHz modulation. Second 0 is prolonged. DUT1 : CCIR code by lengthening.
ZUO	Johannesburg South Africa 26° 11' S 28° 4' E	100 000	continuous	Pulses of 5 cycles of 1 kHz modulation. Second 0 is prolonged. DUT1 : CCIR code by lengthening.

Notes on the characteristics of time signals

(1) No recent information on these time signals.

(2) OMA, 50 kHz

a. The emission continued during 1979 from the main transmitter in Liblice with radiated power of approx. 7 kW. The auxiliary transmitter in Poděbrady is serving as a stand-by transmitter with radiated power of approx. 50 W during the maintenance and failures of the main transmitter.

b. The transmission of the new time code was continued on a regular basis. It is effected every minute. The time of day is transmitted through carrier phase reversals from 200 to 300 ms during certain seconds. The duration of the relative intervals between these seconds is carrying the actual information of hours and minutes of the UT time scale.

As from the beginning of 1980 the existing time code was compatibly supplemented with a marker denoting czechoslovak standard (UT + 1 h) or summer (UT + 2h) time. Additionally a calendar information about the day, month and day of week was included in the code. This information is also transmitted through phase reversals in the interval from 300 to 400 ms of the corresponding second.

The details of this time code will be published in "Nomenclature des stations de radiorepérage et des stations effectuant des services spéciaux - Liste VI, Volume I" de U. I. T. in Geneva.

(3) The radiostations of the USSR emit UT1 information in accordance with the CCIR code. Furthermore they give an additional information dUT1 specifying 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 = + 0.02 s x p. 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 = - 0.02 s x p.

(4) Y3S

DUT1 information in CCIR code.
dUT1 information. This additional information specifies more precisely the difference UT1 - UTC down to multiples of 0.02 s, the total value of the correction being DUT1 + dUT1.

A positive value of dUT1 is indicated by doubling a number (p) of consecutive seconds markers from seconds marker 21 to seconds marker (20 + p) inclusive ; (p) being an integer from 1 to 5 inclusive.

$$dUT1 = p.0.02s.$$

A negative value of dUT1 is indicated by doubling a number (q) of consecutive seconds markers following the minute marker from seconds marker 31 to seconds marker (30 + q) inclusive ; (q) being an integer grom 1 to 5 inclusive.

$$dUT1 = -(q.0.02)s.$$

The seconds marker 28 following the minute marker is doubled as parity bit, if the value of (p) or (q) is an even number or if dUT1 = 0.

Time-information. During the last 20 seconds of each minute in a BCD-code an information about the value "minute" and "hour" in the UTC time scale of the following minute marker is given.

UNCERTAINTY OF THE CARRIER FREQUENCY

The carriers of the following time signals are standard frequencies.

Station	Relative uncertainty of the carrier frequency in 10^{-10}
ATA	0.1
BSF	0.2
CHU	0.05
DCF77	0.005
FFH	0.2
GBR	0.02
HBG	0.02
IAM	0.5
IBF	0.1
JJY, JG2AS	0.1
LOL1	0.1
MSF (60 kHz)	0.02
MSF (h. f.)	0.02
OMA (all frequencies)	0.5
RBU, RTZ	0.05
RCH, RID, RTA, RWM, UQC3, UTR3	0.5
VNG	1
WWV	0.1
WWVB	0.1
WWVH	0.1
ZUO	0.1

TIME OF EMISSION OF THE TIME SIGNALS IN THE UTC SYSTEM, IN 1979

The following deviations of the time of emission of time signals, from UTC, have been reported to the BIH, or observed.

BPV (10 and 15 MHz)	UTC - BPV = 0.0214 s
OLB5	UTC - OLB5 = 0.0008 s
DIZ	On 1979 January 18 and 19, uncertainty of 0.001 s

TIME OF EMISSION OF BPV ON 9351 kHz, 11 h UT.

From receptions made at the Deutsches Hydrographisches Institut, Hamburg at 11 h UT.

Step adjustments, when observed, are marked by - in following table.

UTC – BPV (9351 kHz)
(Unit : 0.0001 s)

1979 Date	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1		- 5040						- 216		+1173	+2057	
2	- 5922	- 5011	- 4150	- 3194			- 808	- 196		+1197	+2092	
3	- 5903			- 3169	- 2306		- 783	- 178	+ 493	+1226		+2915
4	- 5874			- 3138	- 2282		- 760		+ 515	+1259		+2942
5	- 5846	- 4932				- 1358	- 738		+ 537	+1282	+2188	+2976
6		- 4906	- 4010	- 3083		- 1330	- 722	- 125	+ 559		+2211	+3007
7		- 4868	- 3984		- 2193	- 1303		- 95	+ 582		+2245	+3051
8	- 5748	- 4838	- 3953		- 2165	- 1283		- 79		+1368		
9	- 5730	- 4808	- 3912	- 2978	- 2136		- 665	- 53		+1390	+2308	
10	- 5704			- 2954	- 2108		- 644	- 38	+ 449	+1422		+3114
11	- 5675			- 2983	- 2082	- 1209	- 630		+ 445	+1444		+3096
12	- 5644		- 3817			- 1181			+ 467	+1472	+2331	+3119
13		- 4691	- 3785			- 1162	- 588				+2368	+3165
14		- 4658	- 3753		- 1993	- 1135					+2392	+3173
15	- 5563	- 4627	- 3723		- 1965	- 1113				+1560	+2425	
16	- 5535	- 4595	- 3690		- 1937		- 531			+1588	+2460	
17	- 5508			- 2803	- 1908		- 505		+ 786	+1624		+3258
18	- 5481			- 2776	- 1877	- 1032	- 492		+ 821	+1647		+3290
19	- 5450	- 4511	- 3594	- 2738		- 1017	- 479		+ 840	+1675	+2561	+3313
20		- 4482	- 3563	- 2710		- 993	- 451		+ 859		+2583	+3341
21		- 4450	- 3553		- 1733	- 972			+ 891			+3341
22	- 5366	- 4417			- 1704	- 936				+1759	+2641	
23	- 5333	- 4373	- 3487	- 2610	- 1673			+ 258		+1792	+2676	
24	- 5303			- 2582			- 369		+ 978	+1825		
25	- 5278			- 2553	- 1619	- 889			+1010	+1859		
26	- 5250	- 4295	- 3393	- 2526		- 869	- 336		+1028	+1885	+2760	
27		- 4266	- 3364	- 2490			- 312		+1062		+2789	+3511
28		- 4234	- 3331		- 1528	- 824			+1085		+2827	+3539
29	- 5158				- 1505	- 798				+1977	+2859	
30	- 5132		- 3259	- 2384	- 1477					+2012	+2887	
31	- 5100						- 260	+ 432		+2033		