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All communications should be addressed to :
M. le Directeur, Bureau International de l'Heure - 61, avenue de l'Observatoire - 75014 Paris

Table 9 - Offsets and step adjustments of UTC, until 1981 Dec. 31

Date (at 0h UTC)	Offsets	Steps
1961 Jan. 1	-150×10^{-10}	
Aug. 1	"	+ 0.050s
1962 Jan. 1	-130×10^{-10}	
1963 Nov. 1	"	- 0.100s
1964 Jan. 1	-150×10^{-10}	
April 1	"	- 0.100s
Sept. 1	"	- 0.100s
1965 Jan. 1	"	- 0.100s
March 1	"	- 0.100s
July 1	"	- 0.100s
Sept. 1	"	- 0.100s
1966 Jan. 1	-300×10^{-10}	
1968 Feb. 1	"	+ 0.100s
1972 Jan. 1	0	- 0.107 7580s
July 1	"	- 1s
1973 Jan. 1	"	- 1s
1974 Jan. 1	"	- 1s
1975 Jan. 1	"	- 1s
1976 Jan. 1	"	- 1s
1977 Jan 1	"	- 1s
1978 Jan. 1	"	- 1s
1979 Jan. 1	"	- 1s
1980 Jan. 1	"	- 1s
1981 July 1	"	- 1s

Table 10 - Relationship between TAI and UTC, until 1981 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 - 1981 July 1	19.000 000 0 s
1981 July 1	20.000 000 0 s

Table 11 - Atomic time, collaborating laboratories

AOS	Astronomical Latitude Observatory, Borowiec, Polska
APL	Applied Physics Laboratory, Laurel, USA
ASMW	Amt für Standardisierung, Messwesen und Warenprüfung, Berlin, Deutsche Demokratische Republik
ASUA	Allgemeine Schweizerische Uhrenindustrie AG, Bienne, Suisse
ATC	Australian Telecommunications Commission, Melbourne, Australia
BEV	Bundesamt für Eich - und Vermessungswesen, Wien, Österreich
CSAO	Shaanxi Astronomical Observatory, Lintong, China
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
NIM	National Institute of Metrology, Beijing, China
NIS	National Institute for Standards, Cairo, Arab Republic of Egypt
NPL	National Physical Laboratory, Teddington, U.K.
NPLI	National Physical Laboratory, New-Dehli, India
NPRL	National Physical Research Laboratory, Pretoria, South Africa
NRC	National Research Council of Canada, Ottawa, Canada
NRLM	National Research Laboratory of Metrology, Tsukuba, Japan
OAB	Observatoire Astronomique Bouzaréah, 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
SO	Shanghaï Observatory, Shanghaï, China
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)	4 Ind. Cs	year 1980	(3)
F(4)	16 Ind. Cs	year 1980	TA(F) - UTC(OP) is published in Bulletin H by OP
NBS	13 Ind. Cs 2 lab. Cs 2 H. Masers (5)	44239 - 44330	19.045 071 150 $+ (3.1 \times 10^{-9})$ (MJD - 44239)
		44330 - 44421	19.045 071 432 $- (46.9 \times 10^{-9})$ (MJD - 44330) $+ (11.83 \times 10^{-12})$ (MJD - 44330)^2
		44421 - 44605	19.045 067 262 $- (9.74 \times 10^{-9})$ (MJD - 44421) $+ (11.83 \times 10^{-12})$ (MJD - 44421)^2
NRC	2 Ind. Cs 1 2.1 m lab. Cs 3 1.m lab. Cs (6)	year 1980	18.999 968 931
PTB	11 Ind. Cs 1 lab. Cs 1 H. Maser (7)	year 1980	published in PTB Time Service Bulletin
RGO	7 Ind. Cs	year 1980	18.999 926 09
RRL	6 Ind. Cs 2 H. Masers	year 1980	published in RRL Standard Frequency and Time Service Bulletin
USNO	25 Ind. Cs 1 H. Maser	year 1980	A.1 (USNO, MEAN) - UTC(USNO, MC) : provisional values in USNO series 7 ; final values in USNO series 11. (8)

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 : 3 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 1980).

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)	5 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) to within 0.1 μs.

(6) The 2.1 meter primary cesium clock, CsV, operated continuously during 1980, 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 primary standards during 1980.

(7) TA(PTB) and UTC(PTB) are derived directly from a local oscillator monitored by the primary clock CS1. UTC(PTB) + 1h = MEZ(D) is the legal time (in Central European Time) of the Federal Republic of Germany which is disseminated, e.g., by the LF transmitter DCF77. Two Cs stds and one Rb std provide the reference for DCF77.

CS1 has been operating continuously since August 1978.

(8) TA(USNO) is designated by A.1 (USNO, MEAN) in USNO publications.

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
AOS	1 Ind. Cs	1 Cs		DCF77, OMA 50, HBG75	PKNM, TP, ZIPE
APL (4)	3 Ind. Cs	1 Cs + microstepper			USNO
ASMW	3 Ind. Cs	corrected mean of 3Cs	7970-W	DCF77, OMA	ZIPE, TP, PTB, PKNM, SU
ASUA	4 Ind. Cs 4 prototype Cs		7970-W 7990-Z		
BEV	1 Ind. Cs	1 Cs	7970-W 7990-M 7990-X 7990-Y (5)	GBR, OMA50, MSF60, HBG, DCF77	TUG, lab in Czechoslovakia
CSAO	3 Ind. Cs 2 H Masers	1 Cs	9970-Y	NWC, GBR,	lab. in China
DHI	2 Ind. Cs	1 Cs	7970-W	DCF77	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 7990-X	GBR	other lab. in Italy
IFAG	3 Ind. Cs	1Cs	7970-W		
IGMA	3 Ind. Cs	Cs		OMEGA/ A	ONBA, other lab. in Argentina
ILOM	4 Ind. Cs	1 Cs	9970-M	OMEGA/ H	RRL, TAO, NRLM
NBS	see Table 12	8 Cs 1 lab. Cs	9940-M 9960-Z	OMEGA/ND, OMEGA/ H	NRC, USNO
NIM	4 Ind. Cs	all the Cs	9970-Y		lab. in China
NPL	6 Ind. Cs 1 lab. Cs	1 Cs	7970-W	GBR, MSF60	RGO, transmitting station at Rugby
NPLI	3 Ind. Cs	1 Cs		GBR, OMEGA/ J, OMEGA/ LR	
NPRL	1 Inds. Cs	1 Cs		GBR, OMEGA/ L	
NRC(7)	see Table 12	Cs V	9960-M		NBS, USNO
NRLM	3 Ind. Cs 2 lab. Cs	1 Cs	9970-M		ILOM, RRL, TAO
OAB	2 Ind. Cs	1 Cs	7990-Z		

Table 13 - (cont.)

Laboratory (i)	Equipment (1)	Source of UTC(i)	LORAN–C receptions (2)	VLF and LF receptions (3)	Television link with
OMH	1 Ind. Cs	1 Cs			TP
OMSF	6 Ind. Cs	all the Cs	7990-Z		
ON	5 Ind. Cs	all the Cs	7970-W 7990-Z		
ONBA	2 Ind. Cs	2 Cs		OMEGA/T	IGMA
ONRJ	2 Ind. Cs	2 Cs		GBR, OMEGA	other lab. in Brasil
OP(7)	5 Ind. Cs	1 Cs	7970-W 7990-Z		19 lab. in France, ORB, Hewlett-Packard (Switzerland), PTCH
ORB	2 Ind. Cs	1 Cs	7970-W		OP
PKNM	4 Ind. Cs	corrected mean of 4 Cs	7970-W (5)	DCF77, OMA50, RBU66	ASMW, ZIPE, AOS
PTB(7)	see Table 12	2 Cs	7970-W	GBR, DCF77	ASMW, DHI, TP, ZIPE 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, NRLM
SO	1 lab. Cs 3 H Masers	1 Rb + microstepper	9970-Y		lab. in China
STA	4 Ind. Cs	1 Cs	7970-W		other lab. in Sweden
SU	6 Ind. Cs 3 H Masers 2 H clocks	3 Cs 3 H Masers 2 H clocks	7990-X 7990-Y 9970-M	GBR, OMA50, RBU, OMEGA/J	other lab. in URSS, ASMW
TAO	5 Ind. Cs	1 Cs	9970-M	NWC	ILOM, RRL, NRLM
TL	3 Ind. Cs	all the Cs	9970-M	NDT, NWC	
TP	1 Ind. Cs	1 Cs + microstepper		DCF77	DHI, PTB, AOS ZIPE, ASMW, OMH
TUG	2 Ind. Cs	1 Cs	7970-W 7990-M	OMEGA, GBR, DCF77	BEV

Table 13 - (cont.)

Laboratory (i)	Equipment (1)	Source of UTC(i)	LORAN–C receptions (2)	VLF and LF receptions (3)	Television link with
USNO(8)	see Table 12	Cs	(9)	(9)	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, AOS

Notes

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

(2) LORAN–C stations :

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

(3) OMEGA stations :

/A	Argentina	/H	Hawaii	/J	Japan
/L	Liberia	/LR	La Réunion	/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) Microwave link with Orroral facility of NASA (National Aeronautics and Space Administration).

(7) Satellite link via Symphonie between NRC, OP and PTB.

(8) 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.

(9) 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
the VLF stations GBR , NLK
the US TV Networks

TABLE 14 - TIME COMPARISONS BETWEEN LABORATORIES BY CLOCK TRANSPORTATION IN 1980

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

DATE		MJD	TIME COMPARISONS		UNCERT.	SOURCE
1980			(UNIT : 1 MICROSECOND)			
JAN	9	44247	UTC(NBS) - UTC(USNO) =	-2.4	0.3	NBS BULL 267
JAN	10	44248.9	UTC(NBS) - UTC(USNO) =	-2.44	0.05	USNO DPV 676 (1)
FEB	6	44275	UTC(NBS) - UTC(USNO) =	-2.9	0.3	NBS BULL 267
FEB	20	44289.5	UTC(ASMW) - UTC(ZIPE) =	-1.700	0.010	ASMW LETTER
MAR	12	44310.9	UTC(NBS) - UTC(USNO) =	-3.59	0.3	NBS BULL 269
MAR	13	44311.9	UTC(USNO) - UTC(NBS) =	3.6	0.2	USNO DPV 688
MAY	20	44379.1	UTC(TAO) - UTC(NRLM) =	-88.72	0.02	TAO LETTER
MAY	22	44381.1	UTC(TAO) - UTC(RRL) =	-12.85	0.01	TAO LETTER
MAY	23	44382.2	UTC(USNO) - UTC(IEN) =	-13.0	0.2	USNO DPV 696
MAY	24	44383.4	UTC(USNO) - UTC(NPL) =	5.9	0.2	USNO DPV 696
MAY	27	44386.1	UTC(TAO) - UTC(ILOM) =	-32.15	0.05	TAO LETTER
MAY	31	44390.7	UTC(NBS) - UTC(USNO) =	-2.0	0.3	NBS BULL 271
JUN	6	44396.0	UTC(USNO) - UTC(TAO) =	-2.4	0.2	USNO DPV 700
JUN	6	44396.1	UTC(USNO) - UTC(RRL) =	-14.6	0.2	USNO DPV 700
JUN	15	44405.8	UTC(USNO) - UTC(CSIR) =	-57.0	0.2	USNO DPV 700 (2)
JUN	17	44407.9	UTC(NBS) - UTC(USNO) =	-1.15	0.3	NBS BULL 272
JUN	18	44408.3	UTC(NBS) - UTC(OP) =	0.31	0.3	NBS BULL 272
JUN	27	44417.4	UTC(NBS) - UTC(OP) =	0.58	0.3	NBS BULL 272
JUN	27	44417.9	UTC(NBS) - UTC(USNO) =	-0.81	0.3	NBS BULL 272
SEP	15	44497.8	UTC(USNO) - UTC(ONRJ) =	-60.9	0.3	ONRJ LETTER
SEP	16	44498.5	UTC(ASMW) - UTC(TP) =	0.300	0.030	ASMW LETTER
SEP	21	44503.0	UTC(USNO) - UTC(NPLI) =	-25.3	0.2	USNO DPV 713
SEP	23	44505.2	UTC(USNO) - UTC(OP) =	0.8	0.2	USNO DPV 713
SEP	24	44506.4	UTC(NBS) - UTC(OP) =	1.1	0.3	NBS BULL 275
SEP	25	44507.4	UTC(USNO) - UTC(NPL) =	5.9	0.2	USNO DPV 713
SEP	26	44508.9	UTC(NBS) - UTC(USNO) =	0.35	0.3	NBS BULL 275
OCT	21	44533.1	UTC(NRLM) - UTC(RRL) =	72.01	0.01	TAO LETTER
OCT	21	44533.1	UTC(TAO) - UTC(NRLM) =	-77.24	0.01	TAO LETTER
OCT	29	44541.0	UTC(USNO) - UTC(TAO) =	-3.8	0.5	USNO DPV 722
OCT	29	44541.1	UTC(USNO) - UTC(RRL) =	-8.8	0.5	USNO DPV 722
NOV	5	44548.6	UTC(IGMA) - UTC(ONBA) =	89.284		IGMA LETTER
NOV	11	44554.3	UTC(PKNM) - UTC(TP) =	2.497		PKNM LETTER
NOV	18	44561.0	UTC(TAO) - UTC(ILOM) =	-38.71	0.05	TAO LETTER
NOV	18	44561.5	UTC(PKNM) - UTC(ASMW) =	3.235		PKNM LETTER
NOV	25	44568.0	UTC(TAO) - UTC(NRLM) =	-74.58	0.02	TAO LETTER
NOV	26	44569.5	UTC(PKNM) - UTC(SU) =	19.027		PKNM LETTER
DEC	1	44574.8	UTC(NBS) - UTC(USNO) =	0.82	0.3	NBS BULL 277
DEC	7	44580.8	UTC(USNO) - UTC(IEN) =	-11.8	0.2	USNO DPV 728
DEC	10	44583.6	UTC(ONBA) - UTC(USNO) =	-74.15		IGMA LETTER
DEC	11	44584.3	UTC(USNO) - UTC(OMSF) =	-1.3	0.2	USNO DPV 728
DEC	12	44585.6	UTC(IGMA) - UTC(ONBA) =	89.405		IGMA LETTER
DEC	12	44585.6	UTC(USNO) - UTC(NPL) =	5.6	0.2	USNO DPV 728

COMPLEMENTARY RESULTS FOR THE PREVIOUS YEAR

1979						
AUG	9	44094.6	UTC(STA) - UTC(PTB) =	9.47	0.10	STA LETTER
DEC	14	44222.0	UTC(USNO) - UTC(CSIR) =	-55.8	0.2	USNO DPV 674 (2)
DEC	21	44228	UTC(SU) - UTC(OP) =	-10.65		SU LETTER

(1) UTC(USNO) IS WRITTEN INSTEAD OF UTC(USNO MC)
DPV: DAILY PHASE VALUES, SERIES 4, PUBLISHED BY USNO

(2) CSIR IS AN ABBREVIATION INSTEAD OF CSIRO : COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANIZATION, AUSTRALIA

TABLE 15 - INDEPENDENT ATOMIC TIMES

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

UNIT IS ONE MICROSECOND

DATE 1980	MJD	TAI - TA(I) DDR	F	NBS	NRC
JAN 1	44239	29.15	-73.27	-45069.61	21.39
JAN 11	44249	29.92	-72.99	-45069.45	21.34
JAN 21	44259	30.38	-72.68	-45069.35	21.35
JAN 31	44269	30.99	-72.35	-45069.16	21.36
FEB 10	44279	31.69	-71.98	-45069.04	21.48
FEB 20	44289	32.28	-71.64	-45068.89	21.56
MAR 1	44299	33.01	-71.34	-45068.70	21.63
MAR 11	44309	33.60	-70.97	-45068.59	21.75
MAR 21	44319	34.30	-70.66	-45068.41	21.87
MAR 31	44329	34.96	-70.33	-45068.25	21.98
APR 10	44339	35.66	-69.94	-45068.00	22.11
APR 20	44349	36.48	-69.64	-45067.84	22.19
APR 30	44359	37.03	-69.36	-45067.62	22.29
MAY 10	44369	37.81	-69.04	-45067.46	22.38
MAY 20	44379	38.53	-68.82	-45067.34	22.45
MAY 30	44389	39.31	-68.44	-45067.15	22.59
JUN 9	44399	40.08	-68.17	-45067.02	22.60
JUN 19	44409	40.84	-67.83	-45066.93	22.67
JUN 29	44419	41.62	-67.49	-45066.87	22.73
JUL 9	44429	42.37	-67.20	-45066.77	22.75
JUL 19	44439	43.19	-66.78	-45066.73	22.80
JUL 29	44449	44.00	-66.40	-45066.81	22.86
AUG 8	44459	44.75	-65.99	-45066.72	22.93
AUG 18	44469	45.52	-65.64	-45066.67	22.98
AUG 28	44479	46.25	-65.31	-45066.45	23.01
SEP 7	44489	47.17	-64.95	-45066.36	23.05
SEP 17	44499	48.06	-64.59	-45066.35	23.07
SEP 27	44509	49.04	-64.25	-45066.24	23.11
OCT 7	44519	50.05	-63.87	-45066.21	23.07
OCT 17	44529	51.13	-63.54	-45066.12	23.06
OCT 27	44539	52.34	-63.16	-45066.05	23.01
NOV 6	44549	53.49	-62.80	-45066.13	22.91
NOV 16	44559	54.54	-62.40	-45065.96	22.84
NOV 26	44569	55.73	-62.09	-45065.80	22.83
DEC 6	44579	57.02	-61.81	-45065.79	22.82
DEC 16	44589	57.93	-61.51	-45065.63	22.82
DEC 26	44599	59.00	-61.16	-45065.58	22.82

TABLE 15 - (CONT.)

UNIT IS ONE MICROSECOND

DATE 1980	MJD	TAI - TA(I) PTB	RGO	RRL	USNO
JAN 1	44239	-363.51	71.38	0.2	-34433.34
JAN 11	44249	-363.43	71.26	0.9	-34433.71
JAN 21	44259	-363.36	71.14	1.0	-34434.04
JAN 31	44269	-363.20	71.05	0.8	-34434.38
FEB 10	44279	-363.09	71.22	1.1	-34434.72
FEB 20	44289	-362.99	71.22	1.4	-34435.15
MAR 1	44299	-362.96	71.07	1.9	-34435.42
MAR 11	44309	-362.89	71.13	2.2	-34435.86
MAR 21	44319	-362.83	71.04	2.3	-34436.31
MAR 31	44329	-362.76	71.24	2.2	-34436.70
APR 10	44339	-362.77	71.29	2.4	-34437.21
APR 20	44349	-362.80	71.25	2.7	-34437.62
APR 30	44359	-362.85	71.30	3.2	-34437.98
MAY 10	44369	-362.73	71.29	3.3	-34438.38
MAY 20	44379	-362.65	71.37	3.5	-34438.75
MAY 30	44389	-362.55	71.35	4.2	-34439.08
JUN 9	44399	-362.57	71.25	4.5	-34439.41
JUN 19	44409	-362.51	71.15	5.3	-34439.77
JUN 29	44419	-362.47	71.20	5.9	-34440.11
JUL 9	44429	-362.50	71.17	6.2	-34440.43
JUL 19	44439	-362.51	71.12	6.3	-34440.76
JUL 29	44449	-362.52	71.05	6.7	-34441.03
AUG 8	44459	-362.52	71.00	6.8	-34441.36
AUG 18	44469	-362.52	71.00	7.0	-34441.66
AUG 28	44479	-362.53	70.88	7.4	-34442.03
SEP 7	44489	-362.58	70.76	7.3	-34442.36
SEP 17	44499	-362.68	70.77	7.2	-34442.73
SEP 27	44509	-362.72	70.58	7.5	-34442.99
OCT 7	44519	-362.69	70.44	7.5	-34443.30
OCT 17	44529	-362.74	70.37	7.6	-34443.62
OCT 27	44539	-362.77	70.34	7.9	-34443.92
NOV 6	44549	-362.86	70.14	8.4	-34444.27
NOV 16	44559	-362.88	70.23	9.0	-34444.57
NOV 26	44569	-362.90	70.13	9.4	-34444.91
DEC 6	44579	-362.90	69.93	9.7	-34445.32
DEC 16	44589	-362.86	69.98	9.8	-34445.64
DEC 26	44599	-362.87	69.90	10.1	-34445.88

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 $\pm$ 0.01 μs.

TABLE 16 - PRIMARY STANDARDS USED AS CLOCKS

UNIT IS ONE MICROSECOND

TAI-LAB.STD.

DATE 1980		MJD	PTB CS1	NRC CSV	NRC CSVI A	NRC CSVI B	NRC CSVI C
JAN	1	44239	-361.39	41.30	40.34	39.28	39.40
JAN	11	44249	-361.34	41.24	40.15	39.23	39.24
JAN	21	44259	-361.36	41.25	39.99	39.17	39.14
JAN	31	44269	-361.19	41.25	39.84	39.16	39.07
FEB	10	44279	-361.09	41.35	39.82	39.26	39.09
FEB	20	44289	-360.99	41.42	39.86	39.33	39.09
MAR	1	44299	-360.98	41.48	39.83	39.35	39.06
MAR	11	44309	-360.88	41.59	39.84	39.43	39.05
MAR	21	44319	-360.80	41.70	39.84	39.42	39.03
MAR	31	44329	-360.71	41.81	39.85	39.42	39.01
APR	10	44339	-360.67	41.93	39.85	39.41	39.01
APR	20	44349	-360.64	41.99	39.81	39.37	38.96
APR	30	44359	-360.61	42.09	39.79	39.34	38.95
MAY	10	44369	-360.56	42.16	39.68	39.29	38.91
MAY	20	44379	-360.55	42.22	39.56	39.33	38.86
MAY	30	44389	-360.50	42.35	39.50	39.54	38.83
JUN	9	44399	-360.53	42.36	39.32	39.61	38.69
JUN	19	44409	-360.49	42.41	39.28	39.78	38.66
JUN	29	44419	-360.48	42.46	39.24	39.94	38.59
JUL	9	44429	-360.50	42.48	39.17	40.07	38.48
JUL	19	44439	-360.51	42.52	39.07	40.19	38.42
JUL	29	44449	-360.52	42.52	39.00	40.25	38.35
AUG	8	44459	-360.54	42.62	38.91	40.26	38.29
AUG	18	44469	-360.52	42.67	38.83	40.24	38.24
AUG	28	44479	-360.53	42.68	38.69	40.20	38.15
SEP	7	44489	-360.58	42.72	38.55	40.19	38.09
SEP	17	44499	-360.68	42.73	38.39	40.12	38.03
SEP	27	44509	-360.73	42.75	38.30	40.05	38.02
OCT	7	44519	-360.71	42.71	38.19	40.00	38.00
OCT	17	44529	-360.74	42.69	38.10	40.11	38.03
OCT	27	44539	-360.76	42.63	38.02	40.25	38.08
NOV	6	44549	-360.83	42.52	37.90	40.35	38.06
NOV	16	44559	-360.89	42.44	37.79	40.49	38.07
NOV	26	44569	-360.88	42.42	37.74	40.63	38.15
DEC	6	44579	-360.90	42.40	37.67	40.72	38.18
DEC	16	44589	-360.86	42.39	37.60	40.69	38.22
DEC	26	44599	-360.87	42.38	37.51	40.67	38.29

NOTES

(1) The primary frequency standard CS 1 of PTB, operating continuously as a clock during 1980, produces a scale of proper time. The time scale under the headline PTB CS 1 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 scales under the headline NRC CsV, Cs VI A, Cs VI B, Cs VI C are the scales of proper time PT(NRC CsV), PT(NRC Cs VI A), PT(NRC Cs VI B), PT(NRC Cs VI C) produced directly by the primary frequency standards Cs V, Cs VI A, Cs VI B, Cs VI C of NRC used as clocks. The gravitational frequency correction to these time scales of proper time to obtain coordinate times at sea level is - 0.00097 μs/d.

(3) The NBS-4 primary frequency standard operated as a clock during much of 1980. 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 1980	MJD	UTC - UTC(I)* AOS	APL	ASMW	AUS (1)	BEV (2)	CSAO (3)	DHI
JAN 1	44239		0.38	2.66	-0.9	3.36		-1.94
JAN 11	44249		0.37	2.76	-0.8	3.35		-2.03
JAN 21	44259		0.48	2.56	-0.7	3.11		-2.25
JAN 31	44269		0.49	2.45	-0.7	2.88		-2.28
FEB 10	44279		0.50	2.36	-0.7	2.64		-2.07
FEB 20	44289		0.37	2.13	-0.8	2.61		-1.95
MAR 1	44299		0.48	2.05	-0.7	2.57	0.3	-1.88
MAR 11	44309		0.44	1.87	-0.8	2.46	0.3	-1.72
MAR 21	44319		0.41	1.78	-0.8	2.36	0.4	-1.67
MAR 31	44329		0.46	1.68	-0.7	2.17	0.1	-1.60
APR 10	44339		0.46	1.56	-0.8	2.13	0.1	-1.44
APR 20	44349		0.51	1.53	-0.8	2.12	-0.3	-1.30
APR 30	44359		0.61	1.25	-0.7	2.03	0.0	-1.38
MAY 10	44369	-1.85	0.68	1.21	-0.8	2.04	0.0	-1.22
MAY 20	44379	-1.45	0.69	1.10	-0.7	1.88	0.2	-1.15
MAY 30	44389	-1.70	0.78	0.98	-0.7	1.83	0.4	-1.12
JUN 9	44399	-1.38	0.89	0.88	-0.6	1.70	0.3	-1.12
JUN 19	44409	-1.49	0.92	0.69	-0.5	1.65	0.4	-1.09
JUN 29	44419	-1.28	0.91	0.54	-0.5	1.69	0.5	-0.99
JUL 9	44429	-1.14	0.96	0.36	-0.4	1.36	0.7	-0.85
JUL 19	44439	-0.99	1.04	0.25	-0.4	1.30	0.5	-0.66
JUL 29	44449	-0.76	1.15	0.10	-0.2	1.21	0.5	-0.42
AUG 8	44459	-0.80	1.20	-0.15	3.3	1.05	0.6	-0.13
AUG 18	44469	-0.74	1.26	-0.38	3.6		0.7	0.08
AUG 28	44479	-0.81	1.28	-0.35	3.8		0.9	0.26
SEP 7	44489	-0.90	1.30	-0.11	4.0		0.8	0.40
SEP 17	44499	-1.14	1.33	0.13	4.2		0.7	0.37
SEP 27	44509	-1.04	1.44	0.41	4.5		0.6	0.33
OCT 7	44519	-1.18	1.54	0.73	4.7		0.6	0.17
OCT 17	44529	-1.09	1.62	0.96	4.9		0.5	-0.09
OCT 27	44539	-0.99	1.70	1.22	5.1		0.7	-0.20
NOV 6	44549	-1.08	1.74	1.41	5.3		1.1	-0.46
NOV 16	44559	-1.28	1.80	1.38	5.6		1.6	-0.62
NOV 26	44569	-1.38	1.94	1.43	5.8	0.24	2.0	-0.75
DEC 6	44579	-1.23	1.98	1.64	6.0	1.07	2.3	-1.02
DEC 16	44589	-1.49	2.04	1.45	6.2	1.42	2.2	-1.11
DEC 26	44599	-1.69	2.27	1.37	6.5	2.07	2.4	-1.05

TABLE 17 - (CONT.)

UNIT IS ONE MICROSECOND

DATE 1980	MJD	UTC - UTC(I)* IEN	IFAG	IGMA (4)	ILOM (5)	NBS	NIM (6)	NPL
JAN 1	44239	-10.34	-8.38	-8	-27.0	1.54		5.60
JAN 11	44249	-10.53	-8.24	-11	-27.0	1.73		5.45
JAN 21	44259	-11.03	-8.24	-9	-27.7	1.86		5.41
JAN 31	44269	-11.44	-8.05	-10	-28.7	2.08		5.53
FEB 10	44279	-11.90	-8.11	-10	-29.0	2.24		5.58
FEB 20	44289	-12.25	-8.09	-10	-29.5	2.42		5.50
MAR 1	44299	-12.58	-8.08	-9	-29.9	2.64		5.45
MAR 11	44309	-12.89	-8.20		-30.2	2.77		5.45
MAR 21	44319	-13.12	-8.19	-9	-30.8	2.98		5.33
MAR 31	44329	-13.46	-8.24	-9	-31.7	3.17		5.19
APR 10	44339	-13.77	-8.23	-8	-32.5	3.01		5.07
APR 20	44349	-13.84	-8.19	-9	-33.0	2.71		5.16
APR 30	44359	-13.72	-8.30	-9	-33.3	2.46		5.00
MAY 10	44369	-13.83	-8.30	-10	-34.1	2.15		5.01
MAY 20	44379	-13.83	-8.46	-9	-34.7	1.82		5.04
MAY 30	44389	-13.98	-8.53	-9	-35.0	1.56		5.18
JUN 9	44399	-13.95	-8.83	-10	-35.4	1.23		5.19
JUN 19	44409	-14.02	-9.11	-10	-35.4	0.87		5.37
JUN 29	44419	-13.99	-9.29	-10	-35.7	0.47		5.34
JUL 9	44429	-13.78	-9.49	-10	-36.1	0.41	-0.4	5.46
JUL 19	44439	-13.76	-9.71	-12	-36.8	0.36	-0.6	5.46
JUL 29	44449	-13.58	-9.85	-8	-37.3	0.18	-0.6	5.56
AUG 8	44459	-13.42	-10.03	-8	-38.0	0.19	-0.7	5.63
AUG 18	44469	-13.35	-10.07	-10	-38.4	0.15	-0.8	5.64
AUG 28	44479	-12.84	-10.27	-9	-39.0	0.29	-0.9	5.73
SEP 7	44489	-12.49	-10.48	-10	-39.7	0.30	-1.1	5.82
SEP 17	44499	-12.41	-10.71	-9	-35.7	0.22	-1.3	6.02
SEP 27	44509	-12.46	-11.08	-11	-37.0	0.25	-1.5	6.29
OCT 7	44519	-12.31	-11.28	-11	-38.5	0.21	-1.6	6.33
OCT 17	44529	-12.25	-11.48	-10	-40.0	0.23	-1.9	6.34
OCT 27	44539	-12.05	-11.71	-9	-40.6	0.22	-1.9	6.42
NOV 6	44549	-11.93	-11.72	-10	-41.2	0.08	-1.9	6.40
NOV 16	44559	-11.91	-12.05	-10	-41.8	0.18	-1.6	6.46
NOV 26	44569	-11.86	-12.47	-9	-42.7	0.28	-1.6	6.26
DEC 6	44579	-11.35	-12.40	-9	-43.8	0.23	-1.7	5.95
DEC 16	44589	-11.14	-12.78	-11	-44.8	0.33	-1.9	5.93
DEC 26	44599	-10.93	-13.17	-10	-45.7	0.32	-1.7	5.74

TABLE 17 - (CONT.)

UNIT IS ONE MICROSECOND

DATE 1980	MJD	UTC - UTC(I)* NPRL (7)	NRC	NRLM (8)	OAB (9)	OMH (10)	OMSF	ON
JAN 1	44239	28	-9.68		-23.55	-0.33	-1.37	15.27
JAN 11	44249	29	-9.73		-24.55	-0.77	-1.21	15.44
JAN 21	44259	24	-9.71		-25.72	-0.60	-1.39	15.54
JAN 31	44269	25	-9.70		-26.85	0.11	-1.48	15.31
FEB 10	44279	26	-9.59		-27.77	-1.31	-1.55	15.24
FEB 20	44289	26	-9.51		-29.01	-1.43	-1.31	15.26
MAR 1	44299	24	-9.44	-87.3	-30.10	-1.87	-1.31	15.23
MAR 11	44309	25	-9.32	-87.7	-30.97	-2.15	-1.20	15.38
MAR 21	44319	24	-9.20	-88.2	-31.87	-2.40	-0.92	15.51
MAR 31	44329	25	-9.09	-89.0	-32.94	-2.66	-1.15	15.57
APR 10	44339	27	-8.95	-89.6	-34.10	-2.87	-1.21	15.48
APR 20	44349	33	-8.88	-90.0	-35.07	-2.89	-1.15	15.51
APR 30	44359	38	-8.78	-90.3	-36.15	-3.41	-1.07	15.61
MAY 10	44369	36	-8.69	-90.9	-71.13	-2.69	-1.15	15.57
MAY 20	44379	33	-8.62	-91.4	-73.21	-3.34	-1.01	15.59
MAY 30	44389	34	-8.48	-91.3	-75.63	-3.57	-1.09	15.53
JUN 9	44399	37	-8.47	-90.5	-77.94	-2.91	-1.16	15.52
JUN 19	44409	36	-8.40	-89.2	-79.65	-2.84	-1.15	15.53
JUN 29	44419	37	-8.34	-88.2	-82.39	-2.74	-1.22	15.47
JUL 9	44429	34	-8.32	-87.4	-84.52		-1.14	15.55
JUL 19	44439	34	-8.26	-86.9	-86.53		-1.16	15.61
JUL 29	44449	33	-8.21	-86.2	-88.57		-1.23	15.56
AUG 8	44459	33	-8.14	-85.6	-90.84		-1.35	15.50
AUG 18	44469	39	-8.09	-84.9	-93.14		-1.30	15.47
AUG 28	44479	40	-8.06	-84.3	-95.36		-1.33	15.45
SEP 7	44489	37	-8.01	-83.8	-97.46		-1.21	15.39
SEP 17	44499	34	-8.00	-83.3	-99.73		-1.24	15.31
SEP 27	44509	30	-7.96	-82.7	-102.04		-1.19	15.16
OCT 7	44519	28	-8.00	-82.2	-104.17		-0.89	15.15
OCT 17	44529	25	-8.01	-81.9	-106.25		-1.05	15.06
OCT 27	44539	23	-8.06	-80.9	-108.07		-1.08	14.93
NOV 6	44549	31	-8.16	-80.0	-109.64		-0.78	14.77
NOV 16	44559	29	-8.23	-78.7	-111.77		-1.02	14.48
NOV 26	44569	22	-8.24	-77.8	-114.35		-0.96	14.26
DEC 6	44579	22	-8.25	-76.9	-116.32		-0.78	14.20
DEC 16	44589	22	-8.25	-76.1	-118.28		-1.05	13.84
DEC 26	44599	19	-8.25	-75.1	-120.29		-1.20	13.54

TABLE 17 - (CONT.)

UNIT IS ONE MICROSECOND

DATE 1980	MJD	UTC - UTC(I)* OP	ORB	PKNM	PTB	PTCH (11)	RGO	RRL
JAN 1	44239	1.28	11.20	-1.98	0.00	46.68	-2.52	-21.4
JAN 11	44249	1.21	10.78	-2.04	0.04	48.94	-2.65	-20.7
JAN 21	44259	1.15	11.07	-2.02	0.05	51.30	-2.77	-20.6
JAN 31	44269	1.09	11.03	-2.25	0.20	53.43	-2.85	-20.7
FEB 10	44279	1.12	11.12	-2.48	0.31	55.66	-2.69	-20.2
FEB 20	44289	1.12	11.40	-2.44	0.41	57.80	-2.69	-19.6
MAR 1	44299	1.01	11.22	-2.57	0.44	59.97	-2.84	-19.0
MAR 11	44309	0.94	11.30	-2.58	0.51	62.26	-2.78	-18.4
MAR 21	44319	0.85	11.55	-2.42	0.57	64.51	-2.87	-18.1
MAR 31	44329	0.79	11.43	-2.59	0.63	66.70	-2.67	-18.0
APR 10	44339	0.82	11.46	-2.29	0.63	68.88	-2.61	-17.6
APR 20	44349	0.76	11.49	-2.16	0.60	71.14	-2.66	-17.2
APR 30	44359	0.70	11.38	-2.45	0.55	73.36	-2.61	-16.5
MAY 10	44369	0.68	11.49	-2.55	0.67	75.36	-2.62	-16.2
MAY 20	44379	0.49	11.59	-2.59	0.75	77.44	-2.54	-15.7
MAY 30	44389	0.56	11.44	-3.42	0.85	79.71	-2.56	-15.0
JUN 9	44399	0.55	11.66	-3.09	0.83	81.46	-2.66	-14.5
JUN 19	44409	0.55	11.61	-3.23	0.89	83.76	-2.76	-13.6
JUN 29	44419	0.55	11.83	-3.64	0.93	85.82	-2.71	-12.8
JUL 9	44429	0.57	11.95	-3.89	0.90	87.51	-2.74	-12.4
JUL 19	44439	0.65	11.93	-3.90	0.89	89.42	-2.79	-12.2
JUL 29	44449	0.73	12.19	-4.18	0.88		-2.86	-11.7
AUG 8	44459	0.83	12.85	-4.62	0.88	92.79	-2.91	-11.3
AUG 18	44469	0.92	12.60	-4.93	0.88	94.87	-2.91	-11.0
AUG 28	44479	0.92	12.87	-4.91	0.87	96.91	-3.03	-10.4
SEP 7	44489	0.84	12.76	-4.77	0.82	-0.36	-3.15	-10.3
SEP 17	44499	0.77	13.16	-4.68	0.72	-0.84	-3.14	-10.2
SEP 27	44509	0.67	13.47	-4.42	0.68	-1.49	-3.33	-9.8
OCT 7	44519	0.65	13.17	-4.31	0.71	-2.04	-3.47	-9.6
OCT 17	44529	0.67	13.23	-4.06	0.66	-2.34	-3.54	-9.4
OCT 27	44539	0.73	13.53	-3.63	0.63	-2.56	-3.57	-9.0
NOV 6	44549	0.70	12.97	-2.94	0.54	-2.42	-3.77	-8.5
NOV 16	44559	0.74	12.70	-2.38	0.52	-2.47	-3.68	-7.9
NOV 26	44569	0.77	12.81	-2.01	0.50	-2.72	-3.78	-7.4
DEC 6	44579	0.83	12.42	-1.41	0.50	-2.51	-3.98	-7.2
DEC 16	44589	0.90	11.98	-0.89	0.54	-2.71	-3.93	-7.0
DEC 26	44599	0.91	11.49	-0.52	0.53	-2.99	-4.01	-6.7

TABLE 17 - (CONT.)

UNIT IS ONE MICROSECOND

DATE 1980	MJD	UTC - UTC(I)* SO (12)	STA (13)	SU (14)	TAO	TL	TP	TUG (15)
JAN 1	44239	1.0	44.35	9.6	-5.2	48.2	-0.88	3.22
JAN 11	44249	2.0	42.28	8.0	-4.4	48.8	-0.92	3.69
JAN 21	44259	1.5	40.29	7.7	-4.3	49.4	-1.08	3.88
JAN 31	44269	0.7	38.43	9.7	-4.5	50.0	-0.88	3.93
FEB 10	44279	-0.4	36.56	12.3	-4.1	50.5	-0.63	4.11
FEB 20	44289	-0.6	34.55	11.1	-3.7	51.1	-0.39	4.34
MAR 1	44299	0.7	32.49	10.1	-3.2	50.8	-0.19	4.64
MAR 11	44309	1.4	30.58	11.3	-2.9	49.9	0.04	4.89
MAR 21	44319	1.2	28.56	11.6	-2.7	49.4	0.24	5.26
MAR 31	44329		26.65	11.7	-2.9	47.4	0.36	5.84
APR 10	44339		24.70	11.4	-2.8	45.5	0.42	6.53
APR 20	44349		22.67	11.2	-2.8	45.1	0.49	7.27
APR 30	44359		20.58	11.4	-2.6	44.4	0.33	0.94
MAY 10	44369		18.61	11.2	-2.8	43.4	0.26	1.60
MAY 20	44379		16.66	11.2	-2.7	43.0	0.05	2.34
MAY 30	44389		14.75	11.9	-2.5	43.7	0.03	3.00
JUN 9	44399		13.16	12.2	-2.4	44.1	-0.01	3.49
JUN 19	44409		11.19	13.2	-2.1	44.7	0.08	4.13
JUN 29	44419		9.14	13.9	-2.0	45.4	0.18	5.32
JUL 9	44429		7.23	14.6	-1.9	45.7	0.30	6.45
JUL 19	44439		5.24	14.7	-2.2	46.1	0.35	7.63
JUL 29	44449		3.30	15.4	-2.3	46.6	0.34	8.55
AUG 8	44459		1.44	15.3	-2.5	47.3	0.22	9.54
AUG 18	44469		-0.52	15.9	-2.7	48.3	0.22	10.70
AUG 28	44479		-2.47	16.2	-2.8	49.7	0.30	3.82
SEP 7	44489		-4.47	16.2	-3.2	50.1	0.35	5.04
SEP 17	44499		-6.40	15.7	-3.4	50.9	0.51	6.27
SEP 27	44509		-8.45	15.4	-3.5	51.9	0.65	7.21
OCT 7	44519		-10.42	15.6	-3.7	51.8	0.69	1.43
OCT 17	44529		-12.30	15.8	-4.0	50.8	0.49	2.41
OCT 27	44539		-14.10	16.2	-3.9	50.1	0.30	3.27
NOV 6	44549		-16.09	16.4	-3.7	50.0	0.49	4.31
NOV 16	44559		-18.00	16.8	-3.3	50.3	0.23	5.26
NOV 26	44569		-19.96	17.1	-3.1	49.5	0.06	5.73
DEC 6	44579		-21.96	17.1	-3.0	48.9	-0.20	5.39
DEC 16	44589		-23.85	17.3	-2.9	48.9	-0.69	4.60
DEC 26	44599		-25.82	17.7	-2.7	49.1	-1.01	4.02

TABLE 17 - (CONT.)

UNIT IS ONE MICROSECOND

DATE 1980	MJD	UTC - UTC(I)* USNO	VSL	ZIPE
JAN 1	44239	-0.92	1.66	2.32
JAN 11	44249	-0.78	1.81	1.90
JAN 21	44259	-0.74	1.96	1.13
JAN 31	44269	-0.71	2.38	0.65
FEB 10	44279	-0.68	2.93	0.57
FEB 20	44289	-0.76	3.13	0.42
MAR 1	44299	-0.69	3.01	0.33
MAR 11	44309	-0.75	3.12	0.07
MAR 21	44319	-0.77	3.14	-0.09
MAR 31	44329	-0.73	3.33	-0.03
APR 10	44339	-0.77	3.42	0.25
APR 20	44349	-0.78	3.38	0.59
APR 30	44359	-0.74	3.38	0.51
MAY 10	44369	-0.75	3.54	0.56
MAY 20	44379	-0.74	3.41	0.58
MAY 30	44389	-0.65	3.34	0.85
JUN 9	44399	-0.59	3.14	1.01
JUN 19	44409	-0.52	2.94	1.23
JUN 29	44419	-0.48	2.77	1.35
JUL 9	44429	-0.42	2.59	1.14
JUL 19	44439	-0.35	2.41	0.93
JUL 29	44449	-0.20	2.27	1.12
AUG 8	44459	-0.11	2.16	0.95
AUG 18	44469	-0.02	2.14	0.84
AUG 28	44479	0.07	2.00	0.37
SEP 7	44489	0.11	1.89	0.62
SEP 17	44499	0.15	1.86	0.75
SEP 27	44509	0.26	1.76	1.33
OCT 7	44519	0.31	1.70	1.39
OCT 17	44529	0.39	1.66	1.41
OCT 27	44539	0.48	1.54	1.59
NOV 6	44549	0.53	1.31	1.69
NOV 16	44559	0.60	1.20	1.51
NOV 26	44569	0.68	1.12	1.61
DEC 6	44579	0.69	0.97	1.35
DEC 16	44589	0.78	1.11	1.32
DEC 26	44599	0.94	1.06	1.26

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) AUS. The UTC-UTC(AUS) are directly computed from the predicted values UTC(USNO MC) - UTC(AUS) of Bulletin E of DNM. Time steps in the UTC-UTC(AUS) values reflect that clock transportation results were taken into account by DNM.

(2) BEV. From 1980 August 13 till 1980 November 17, no clock was available at BEV.

(3) CSAO. The UTC-UTC(CSAO) are obtained using a computed value of the Loran-C signal time delay.

(4) IGMA. Results obtained by VLF. The clock transportation between IGMA and ONBA, USNO and ONBA end November 1979 fixed the origin from MJD = 44 109.

(5) ILOM. Change of master clock on 1980 September 17.

(6) NIM. The UTC-UTC(NIM) are obtained using a computed value of the Loran-C signal time delay.

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

(8) NRLM. The origin was fixed using the clock transportation between TAO and NRLM on 1980 May 20.

(9) OAB. The origin of UTC-UTC(OAB) was fixed by the clock transportation between OP and OAB on 1979 May 30. A time step of UTC(OAB) of + 32.900 μs was made by OAB on 1980 May 1.

(10) OMH. A time step of UTC(OMH) of -27.294 μs was made by OMH on 1980 January 1. From 1980 June 29 till end 1980 no clock was available at OMH.

(11) PTCH. The origin of UTC-UTC(PTCH) was fixed by the clock transportation between PTCH and ON on 1978 December 13. From MJD = 43 859 till MJD = 44 229, the values UTC-UTC(PTCH) published in the BIH Annual Reports for 1978 and 1979 have to be corrected by -25.80 μs. A time step of UTC(PTCH) of + 98 μs was made by PTCH on 1980 September 1.

(12) SO. A satellite time comparison via Symphonie was carried out between OP and SO on 1979 June 18. The result was used to fix the origin of UTC-UTC(SO). Values of UTC-UTC(SO) in 1979 :

MJD	UTC-UTC(SO)	MJD	UTC-UTC(SO)	MJD	UTC-UTC(SO)
44 059	- 1.6	44 119	- 0.4	44 179	0.6
44 069	- 1.5	44 129	- 0.7	44 189	1.1
44 079	- 1.4	44 139	- 0.6	44 199	1.2
44 089	- 0.8	44 149	0.1	44 209	0.3
44 099	- 0.2	44 159	0.7	44 219	- 0.4
44 109	0.2	44 169	0.7	44 229	0.1

(13) STA. A time step of UTC(STA) of - 84 μs was made by STA on 1980 January 1.

(14) SU. UTC-UTC(SU) was computed using the Northwest Pacific chain of Loran-C except during the interval 44 239 - 44 319 where the GBR signal was used. Time continuity was ensured using the clock transportation between PKNM and SU on 1980 November 26.

(15) TUG. Time steps of UTC(TUG) of + 7.00 and + 8.00 μs were made by TUG respectively on 1980 April 25 and August 22.

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	MJD	TIME COMPARISONS	DIFFERENCE CLOCK TR. - BIH (UNIT : 1 MICROSECOND)
1980			
JAN 9	44247	UTC(NBS) - UTC(USNO)	0.1
JAN 10	44248.9	UTC(NBS) - UTC(USNO)	0.07
FEB 6	44275	UTC(NBS) - UTC(USNO)	0.0
FEB 20	44289.5	UTC(ASMW) - UTC(ZIPE)	0.011
MAR 12	44310.9	UTC(NBS) - UTC(USNO)	-0.02
MAR 13	44311.9	UTC(USNO) - UTC(NBS)	0.0
MAY 20	44379.1	UTC(TAO) - UTC(NRLM)	0.0*
MAY 22	44381.1	UTC(TAO) - UTC(RRL)	0.07
MAY 23	44382.2	UTC(USNO) - UTC(IEN)	0.2
MAY 24	44383.4	UTC(USNO) - UTC(NPL)	0.1
MAY 27	44386.1	UTC(TAO) - UTC(ILOM)	0.23
MAY 31	44390.7	UTC(NBS) - UTC(USNO)	0.1
JUN 6	44396.0	UTC(USNO) - UTC(TAO)	-0.6
JUN 6	44396.1	UTC(USNO) - UTC(RRL)	-0.6
JUN 17	44407.9	UTC(NBS) - UTC(USNO)	0.29
JUN 18	44408.3	UTC(NBS) - UTC(OP)	0.65
JUN 27	44417.4	UTC(NBS) - UTC(OP)	0.56
JUN 27	44417.9	UTC(NBS) - UTC(USNO)	0.19
SEP 16	44498.5	UTC(ASMW) - UTC(TP)	-0.082
SEP 23	44505.2	UTC(USNO) - UTC(OP)	0.3
SEP 24	44506.4	UTC(NBS) - UTC(OP)	0.6
SEP 25	44507.4	UTC(USNO) - UTC(NPL)	-0.1
SEP 26	44508.9	UTC(NBS) - UTC(USNO)	0.34
OCT 21	44533.1	UTC(NRLM) - UTC(RRL)	-0.25
OCT 21	44533.1	UTC(TAO) - UTC(NRLM)	0.29
OCT 29	44541.0	UTC(USNO) - UTC(TAO)	0.6
OCT 29	44541.1	UTC(USNO) - UTC(RRL)	0.6
NOV 11	44554.3	UTC(PKNM) - UTC(TP)	-0.501
NOV 18	44561.0	UTC(TAO) - UTC(ILOM)	0.0
NOV 18	44561.5	UTC(PKNM) - UTC(ASMW)	-0.446
NOV 25	44568.0	UTC(TAO) - UTC(NRLM)	0.21
NOV 26	44569.5	UTC(PKNM) - UTC(SU)	0.0*
DEC 1	44574.8	UTC(NBS) - UTC(USNO)	0.39
DEC 7	44580.8	UTC(USNO) - UTC(IEN)	0.2
DEC 11	44584.3	UTC(USNO) - UTC(OMSF)	0.4
DEC 12	44585.6	UTC(USNO) - UTC(NPL)	0.4

COMPLEMENTARY RESULTS FOR THE PREVIOUS YEAR

DATE	MJD	TIME COMPARISONS	DIFFERENCE
1979			
AUG 9	44094.6	UTC(STA) - UTC(PTB)	0.39
DEC 21	44228	UTC(SU) - UTC(OP)	-0.13

* NEW ORIGIN _ SEE TABLE 17

TABLE 19 - INTERNATIONAL ATOMIC TIME , BI-MONTHLY RATES OF TAI-CLOCK FOR 1980

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	44289	44359	44419	44479	44539	44599
AOS	19 7	0.0	0.0	14.04	8.45	-3.34	-10.26
APL	14 121	-124.00	-123.33	-120.93	-116.64	-110.00	-105.31
APL	14 773	65.12	57.54	50.48	63.34	63.99	64.63
APL	14 793	186.09	188.35	191.62	192.65	193.50	194.89
ASMW	13 29	135.15	141.92	155.25	182.14	228.93	0.0
ASMW	16 76	7.11	-0.44	-16.32	-30.12	-33.77	-4.22
ASMW	16 165	0.0	-45.11	-43.93	-56.52	-23.51	-14.03
ASUA	16 69	0.0	0.0	0.0	-122.29	-130.56	-122.27
ASUA	16 77	0.0	0.0	0.0	-121.85	-124.64	-36.25
ASUA	17 206	0.0	0.0	0.0	30.24	26.35	33.05
ASUA	17 208	0.0	0.0	0.0	-214.86	-208.36	-180.83
ASUA	99 1	0.0	0.0	0.0	12.87	24.13	6.85
ASUA	99 2	0.0	0.0	0.0	272.98	300.92	309.62
ASUA	99 4	0.0	0.0	0.0	33.43	42.24	10.13
ASUA	99 5	0.0	0.0	0.0	-59.57	-27.44	-22.03
BEV	16 71	-15.60	-8.86	-7.00	0.0	0.0	0.0
F	12 133	100.32	94.38	134.14	186.62	0.0	0.0
F	12 158	188.12	192.51	208.65	224.30	234.78	227.71
F	12 195	0.0	0.0	0.0	0.0	0.0	226.50
F	12 206	0.0	0.0	0.0	0.0	-6.27	12.34
F	12 231	-59.64	0.0	0.0	0.0	0.0	0.0
F	12 347	-61.63	-59.45	-68.28	-21.57	-33.76	-81.47
F	12 439	-60.47	-55.65	-72.14	-78.44	0.0	0.0
F	12 594	-30.97	-31.71	-28.57	-19.33	0.0	0.0
F	14 51	38.22	37.08	35.93	36.36	30.93	0.0
F	14 753	70.14	0.0	0.0	0.0	0.0	0.0
F	16 80	-99.58	-102.08	-111.41	-122.84	-127.37	-116.32
F	22 120	-0.85	3.42	9.84	4.83	-0.57	-5.82
F	24 407	-145.98	-147.77	-158.81	-171.59	0.0	0.0
F	24 645	0.0	0.0	-85.41	-70.36	-67.36	-61.79
IEN	12 303	-55.52	-46.22	-49.00	-33.65	-45.73	-32.96
IEN	12 469	-39.77	0.0	0.0	9.08	2.67	-25.16
IEN	12 609	-141.47	0.0	0.0	0.0	0.0	-91.05
IEN	14 893	5.57	19.47	10.31	31.36	25.14	34.28
IFAG	16 131	7.84	-2.56	-17.67	-15.81	-24.70	-24.40
IFAG	16 138	0.0	0.0	0.0	167.83	170.17	169.61
IFAG	16 173	0.0	67.60	84.05	116.86	129.31	151.67
NBS	11 137	17.98	-3.95	-13.35	-31.01	-36.65	-29.64
NBS	11 167	-539.28	-545.18	-552.72	-553.55	-547.35	-548.03
NBS	12 352	-583.97	-606.02	-647.92	-647.17	0.0	0.0

TABLE 19 - (CONT.)

LAB.	CLOCK	44289	44359	44419	44479	44539	44599
NBS	14 316	-32.31	-25.77	-29.90	-33.58	-30.94	-25.33
NBS	14 323	42.61	0.0	-112.37	-123.70	-137.03	0.0
NBS	14 324	-31.84	-30.62	-23.61	-25.02	0.0	-122.57
NBS	16 61	0.0	0.0	0.0	-77.95	-50.92	0.0
NBS	18 8	0.0	0.0	0.0	0.0	0.0	914.57
NBS	22 375	0.0	0.0	0.0	0.0	117.42	114.41
NBS	91 4	9.63	9.74	6.91	1.93	6.84	7.39
NPL	12 316	-44.34	-23.30	-35.02	31.28	34.34	-20.37
NPL	12 418	-73.03	-78.12	-64.07	-65.05	-58.52	-73.79
NPL	12 832	0.0	0.0	0.0	0.0	179.13	180.46
NPL	14 334	-115.60	-168.29	-134.32	-132.08	-132.41	-125.97
NRC	12 122	-421.11	-416.02	-416.71	-425.30	-439.52	-442.76
NRC	14 267	-28.39	-31.12	-28.42	-31.52	-27.70	-27.36
NRC	90 5	0.41	9.93	6.34	4.09	-0.86	-3.76
NRC	90 61	-12.04	-0.57	-9.65	-8.83	-11.07	-7.96
NRC	90 62	-1.21	0.13	10.78	4.20	-0.37	7.83
NRC	90 63	-7.87	-1.97	-6.37	-6.96	-1.26	3.78
OAB	16 146	-199.03	-209.68	-220.63	-216.07	0.0	0.0
OMH	22 67	-14.74	-25.39	0.0	0.0	0.0	0.0
OMSF	14 896	-1.18	2.60	-2.18	-2.96	5.04	-2.34
OMSF	16 113	0.0	0.0	0.0	-105.28	-91.52	-66.64
OMSF	16 121	-30.97	-29.89	-34.62	0.0	0.0	0.0
OMSF	16 177	0.0	0.0	29.38	16.69	18.05	23.72
OMSF	22 223	175.75	171.73	182.33	174.58	173.70	173.55
OMSF	24 569	0.0	23.06	43.93	40.88	38.71	20.27
ON	12 285	-76.25	-69.81	0.0	15.41	1.52	-9.36
ON	12 863	0.0	0.0	0.0	0.0	0.0	-69.54
ON	13 14	16.03	5.56	-2.14	4.70	34.49	-10.96
ON	14 863	-153.53	-143.05	-144.16	0.0	0.0	0.0
ON	16 69	-43.10	0.0	0.0	0.0	0.0	0.0
ON	16 77	-97.03	0.0	0.0	0.0	0.0	0.0
ON	16 114	15.10	18.52	12.50	1.55	-4.30	19.61
ON	24 156	0.0	0.0	0.0	4.70	0.98	-19.93
ON	99 4	50.84	0.0	0.0	0.0	0.0	0.0
ON	99 7	-42.39	0.0	0.0	0.0	0.0	0.0
ORB	12 205	9.44	17.13	21.98	-3.02	-10.33	7.56
ORB	12 804	54.60	51.95	56.11	69.20	61.07	36.47
PKNM	16 124	-44.80	-43.46	-58.52	-96.06	-60.63	-19.78
PKNM	16 125	3.41	15.60	0.05	-22.84	-9.92	19.01
PKNM	16 154	-6.91	2.85	-64.13	-82.88	-77.92	-22.27
PKNM	24 144	-3.16	-2.29	-8.88	-13.56	-7.06	-14.74
PTB	12 320	-3.72	-25.84	-38.03	-44.60	-49.24	-40.86
PTB	12 389	29.14	11.08	-4.21	0.0	0.0	0.0
PTB	12 462	38.05	0.0	0.0	0.0	0.0	-4.72
PTB	14 394	-59.74	-56.66	-57.00	-53.76	-49.94	-54.94

TABLE 19 - (CONT.)

LAB.	CLOCK	44289	44359	44419	44479	44539	44599
PTB	14 395	-76.63	-76.37	-68.31	-65.03	-66.27	-69.30
PTB	14 867	-195.89	-191.54	-195.97	-206.64	-198.78	-203.24
PTB	16 119	89.41	81.36	67.79	60.40	71.35	85.43
PTB	24 103	-20.66	-21.57	-19.02	-32.05	-18.75	-22.97
PTB	92 1	7.03	6.07	1.93	-0.77	-3.64	-1.43
PTCH	16 64	223.96	222.51	207.93	0.0	-47.19	-6.83
PTCH	16 140	88.32	74.02	36.32	-17.84	-13.05	59.32
RGO	11 123	-191.32	-189.29	-183.30	-176.83	-177.42	-184.77
RGO	11 199	-65.71	-85.23	-53.07	-54.55	-61.51	-55.65
RGO	12 348	109.22	107.70	103.22	114.95	121.16	143.38
RGO	14 202	0.0	0.0	-168.92	-175.94	0.0	0.0
RGO	14 484	-339.32	-345.71	-342.29	-338.62	-357.95	-388.97
RGO	14 560	0.0	-52.91	-62.71	-64.94	-64.80	-62.68
RGO	14 868	-136.46	-130.12	-134.89	-132.30	-135.69	-132.82
STA	11 200	0.0	0.0	0.0	0.0	0.0	-410.77
STA	14 900	-121.15	-124.03	-121.50	-122.89	-130.74	-142.43
STA	16 137	-41.41	-43.64	-36.09	-55.84	-45.68	-37.44
STA	24 376	-195.14	-198.09	-188.00	-193.44	-194.80	-195.19
TP	12 335	-193.00	-196.67	-208.29	-216.19	-216.77	-240.50
TUG	12 524	23.75	52.17	69.18	106.82	108.07	0.0
TUG	24 654	0.0	0.0	0.0	-57.12	-57.41	-57.21
USNO	11 207	-65.30	0.0	0.0	0.0	0.0	0.0
USNO	12 147	-159.90	0.0	-256.30	-248.98	-251.16	-269.30
USNO	12 532	0.0	0.0	0.0	-10.75	-2.27	5.72
USNO	12 549	-149.43	-155.48	-154.21	-151.69	-156.98	177.94
USNO	12 573	-80.29	-70.99	-52.83	-40.54	-48.79	-72.38
USNO	12 591	116.30	118.16	121.72	128.03	131.74	207.28
USNO	12 752	-129.87	-129.00	-131.43	-132.65	-135.41	-139.74
USNO	12 761	-255.98	-222.91	-240.61	-229.02	-244.09	-210.51
USNO	12 778	78.50	201.08	217.68	230.98	237.26	235.03
USNO	12 862	0.0	0.0	-234.91	-238.52	-234.63	-231.45
USNO	12 873	0.0	-92.68	-54.71	-63.35	-78.04	-73.94
USNO	14 571	40.93	0.0	0.0	0.0	0.0	0.0
USNO	14 653	0.0	0.0	0.0	0.0	0.0	-151.29
USNO	14 834	-89.04	-77.39	-83.44	-89.50	-83.73	-89.69
USNO	14 875	-92.83	-91.73	-95.25	-87.39	0.0	0.0
USNO	16 68	86.42	75.63	56.15	0.0	0.0	0.0
USNO	16 107	242.81	-144.74	-139.72	-154.70	0.0	0.0
USNO	16 108	881.93	0.0	164.08	0.0	0.0	0.0
USNO	22 114	32.26	23.89	37.92	47.78	49.54	40.43
USNO	22 362	5.36	-4.34	14.74	0.0	8.24	9.60
USNO	22 450	-128.31	-118.13	0.0	0.0	0.0	0.0
USNO	22 585	43.66	42.39	47.73	43.50	40.37	34.26
USNO	22 604	233.17	211.37	183.02	137.98	0.0	0.0
USNO	22 653	0.0	0.0	0.0	3.34	2.71	6.90

TABLE 19 - (CONT.)

LAB.	CLOCK	44289	44359	44419	44479	44539	44599
USNO	22 710	0.0	0.0	0.0	-60.72	-76.55	-90.61
USNO	24 104	0.0	0.0	0.0	-1.67	-4.50	0.12
USNO	24 117	0.0	-59.22	-55.46	-47.91	-53.44	-63.96
USNO	24 264	85.45	72.88	91.30	97.86	101.46	0.0
USNO	24 301	-226.24	-220.82	-215.73	0.0	0.0	0.0
USNO	24 305	-17.17	-28.56	-6.73	4.56	12.64	0.0
USNO	24 343	15.68	9.34	15.78	0.0	0.0	0.0
USNO	24 377	-160.63	-165.73	-165.19	-166.01	-168.90	-164.21
USNO	24 423	0.0	0.0	0.0	0.0	0.0	-22.77
USNO	24 449	0.0	0.0	-171.14	-162.28	-160.48	-165.27
USNO	24 586	-186.78	-184.70	-177.86	-150.68	-163.02	-183.42
USNO	24 605	66.64	63.52	60.73	61.78	0.0	64.91
USNO	24 688	0.0	0.0	-6.63	-10.00	-11.29	-8.99
VSL	14 503	0.0	0.0	0.0	-244.00	-253.43	-254.49
VSL	22 34	50.04	50.55	41.62	41.22	46.53	46.06
VSL	22 489	276.90	256.34	0.0	0.0	0.0	0.0
VSL	24 190	-12.18	-10.87	-11.34	-9.69	-1.67	6.16
ZIPE	12 979	-110.50	-82.25	-48.89	-24.12	-28.19	-8.90

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	OSCILLOQUARTZ 3200	(26 001 EQUIVALENT TO 16 1001)
17 AND 27	OSCILLOQUARTZ 3000	(27 001 EQUIVALENT TO 17 1001)
18 AND 28	FREQ. AND TIME SYSTEMS INC. 4000	
19	ROHDE AND SCHWARZ XSC	
25	HEWLETT-PACKARD 5062C	(ADD 1000 TO THE SERIAL NO.)
90	LABORATORY CESIUM STANDARD NRC	
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 1980

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

*** DENOTES THAT THE CLOCK WAS NOT USED

LAB.	CLOCK	44289	44359	44419	44479	44539	44599
AOS	19 7	***	***	0	100	91	63
APL	14 121	100	100	100	100	100	100
APL	14 773	74	100	77	89	100	100
APL	14 793	100	100	100	100	100	100
ASMW	13 29	18	27	28	19	7	***
ASMW	16 76	47	100	87	23	20	21
ASMW	16 165	***	0	100	93	43	31
ASUA	16 69	***	***	***	0	100	100
ASUA	16 77	***	***	***	0	100	16
ASUA	17 206	***	***	***	0	100	100
ASUA	17 208	***	***	***	0	100	23
ASUA	99 1	***	***	***	0	96	83
ASUA	99 2	***	***	***	0	16	20
ASUA	99 4	***	***	***	0	100	22
ASUA	99 5	***	***	***	0	12	18
BEV	16 71	94	100	100	***	***	***
F	12 133	22	37	40	9	***	***
F	12 158	60	100	86	45	25	27
F	12 195	***	***	***	***	***	0
F	12 206	***	***	***	***	0	32
F	12 231	7	***	***	***	***	***
F	12 347	71	58	56	27	29	19
F	12 439	0	100	86	73	***	***
F	12 594	100	100	100	100	***	***
F	14 51	100	100	100	100	100	***
F	14 753	15	***	***	***	***	***
F	16 80	40	52	77	84	81	79
F	22 120	74	100	100	100	100	100
F	24 407	39	37	39	65	***	***
F	24 645	***	***	0	57	77	84
IEN	12 303	100	100	100	88	95	95
IEN	12 469	22	***	***	0	100	21
IEN	12 609	36	***	***	***	***	0
IEN	14 893	94	91	100	60	51	78
IFAG	16 131	100	96	41	44	41	58
IFAG	16 138	***	***	***	0	100	100
IFAG	16 173	***	0	45	12	10	8
NBS	11 137	100	54	36	22	16	23
NBS	11 167	100	100	100	100	100	100
NBS	12 352	0	26	7	8	***	***

TABLE 20 - (CONT.)

LAB.	CLOCK	44289	44359	44419	44479	44539	44599
NBS	14 316	100	100	100	100	100	100
NBS	14 323	5	***	0	96	47	***
NBS	14 324	100	100	100	100	***	0
NBS	16 61	***	***	***	0	17	***
NBS	18 8	***	***	***	***	***	0
NBS	22 375	***	***	***	***	0	100
NBS	91 4	0	100	100	100	100	100
NPL	12 316	0	2	2	0	2	9
NPL	12 418	55	48	90	100	100	86
NPL	12 832	***	***	***	***	0	100
NPL	14 334	33	5	9	13	17	32
NRC	12 122	68	73	100	100	90	71
NRC	14 267	100	100	100	100	100	100
NRC	90 5	92	99	100	100	100	100
NRC	90 61	0	94	100	100	100	100
NRC	90 62	0	100	97	100	100	100
NRC	90 63	0	100	100	100	100	100
OAB	16 146	0	97	63	92	***	***
OMH	22 67	55	61	***	***	***	***
OMSF	14 896	100	100	100	100	100	100
OMSF	16 113	***	***	***	0	67	20
OMSF	16 121	14	14	18	***	***	***
OMSF	16 177	***	***	0	76	100	100
OMSF	22 223	99	100	97	100	100	100
OMSF	24 569	***	0	28	57	94	72
ON	12 285	100	100	***	0	65	44
ON	12 863	***	***	***	***	***	0
ON	13 14	29	28	27	36	47	27
ON	14 863	64	69	81	***	***	***
ON	16 69	52	***	***	***	***	***
ON	16 77	44	***	***	***	***	***
ON	16 114	49	49	54	48	86	73
ON	24 156	***	***	***	0	100	38
ON	99 4	100	***	***	***	***	***
ON	99 7	55	***	***	***	***	***
ORB	12 205	29	34	37	47	44	67
ORB	12 804	58	100	100	93	100	68
PKNM	16 124	0	100	89	13	20	16
PKNM	16 125	3	2	3	9	52	41
PKNM	16 154	0	99	0	5	5	7
PKNM	24 144	100	100	100	100	100	100
PTB	12 320	13	18	35	42	31	35
PTB	12 389	72	53	27	***	***	***
PTB	12 462	82	***	***	***	***	0
PTB	14 394	0	100	100	100	100	100

TABLE 20 - (CONT.)

LAB.	CLOCK	44289	44359	44419	44479	44539	44599
PTB	14 395	100	100	100	100	100	100
PTB	14 867	70	100	100	97	100	100
PTB	16 119	81	73	92	87	93	81
PTB	24 103	100	100	100	92	92	100
PTB	92 1	100	100	100	100	100	100
PTCH	16 64	12	17	25	***	0	8
PTCH	16 140	3	5	6	5	5	0
RGO	11 123	100	100	100	100	100	100
RGO	11 199	35	15	23	27	33	69
RGO	12 348	100	100	100	95	100	49
RGO	14 202	***	***	0	100	***	***
RGO	14 484	50	32	35	73	80	25
RGO	14 560	***	0	99	100	100	100
RGO	14 868	0	100	100	100	100	100
STA	11 200	***	***	***	***	***	0
STA	14 900	76	100	100	100	100	93
STA	16 137	60	44	38	73	98	100
STA	24 376	80	73	65	78	100	100
TP	12 335	70	76	77	100	77	33
TUG	12 524	100	50	20	8	7	***
TUG	24 654	***	***	***	0	100	100
USNO	11 207	26	***	***	***	***	***
USNO	12 147	12	***	0	100	100	81
USNO	12 532	***	***	***	0	100	100
USNO	12 549	100	100	100	100	100	0
USNO	12 573	38	34	37	35	43	39
USNO	12 591	36	56	92	100	100	0
USNO	12 752	29	32	42	55	100	100
USNO	12 761	0	11	26	38	53	38
USNO	12 778	0	0	1	2	2	3
USNO	12 862	***	***	0	100	100	100
USNO	12 873	***	0	9	18	29	43
USNO	14 571	100	***	***	***	***	***
USNO	14 653	***	***	***	***	***	0
USNO	14 834	100	95	100	100	100	100
USNO	14 875	100	100	100	100	***	***
USNO	16 68	98	97	75	***	***	***
USNO	16 107	0	0	0	0	***	***
USNO	16 108	0	***	0	***	***	***
USNO	22 114	89	89	90	87	95	99
USNO	22 362	100	99	80	***	0	100
USNO	22 450	21	17	***	***	***	***
USNO	22 585	100	100	100	100	100	100
USNO	22 604	39	19	10	5	***	***
USNO	22 653	***	***	***	0	100	100

TABLE 20 - (CONT.)

LAB.	CLOCK	44289	44359	44419	44479	44539	44599
USNO	22 710	***	***	***	0	50	30
USNO	24 104	***	***	***	0	100	100
USNO	24 117	***	0	100	100	100	96
USNO	24 264	94	65	66	76	89	***
USNO	24 301	83	70	64	***	***	***
USNO	24 305	55	42	42	39	42	***
USNO	24 343	96	100	100	***	***	***
USNO	24 377	100	100	100	100	100	100
USNO	24 423	***	***	***	***	***	0
USNO	24 449	***	***	0	100	100	100
USNO	24 586	37	73	100	42	52	47
USNO	24 605	100	100	100	100	***	0
USNO	24 688	***	***	0	100	100	100
VSL	14 503	***	***	***	0	100	100
VSL	22 34	100	92	100	100	100	100
VSL	22 489	12	12	***	***	***	***
VSL	24 190	0	100	100	100	100	100
ZIPE	12 979	24	51	24	10	8	7

THE CLOCKS ARE DESIGNATED BY THEIR MODEL (2 DIGITS) AND SERIAL NO.
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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	OSCILLOQUARTZ 3200	(26 001 EQUIVALENT TO 16 1001)
17 AND 27	OSCILLOQUARTZ 3000	(27 001 EQUIVALENT TO 17 1001)
18 AND 28	FREQ. AND TIME SYSTEMS INC. 4000	
19	ROHDE AND SCHWARZ XSC	
25	HEWLETT-PACKARD 5062C	(ADD 1000 TO THE SERIAL NO.)
90	LABORATORY CESIUM STANDARD NRC	
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
44229_44309	1980 JAN31		8.84	9.31
44249_44329	1980 FEB20	8.60		
44309_44389	1980 APR20		9.57	8.99
44389_44469	1980 JUL 9		8.98	8.45
44469_44549	1980 SEP27		8.35(1)	8.04
44549-44629	1980 DEC16		8.52	8.67

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
44229_44309	1980 JAN31		0.44	0.91
44249_44329	1980 FEB20	0.20		
44309_44389	1980 APR20		1.17	0.59
44389_44469	1980 JUL 9		0.58	0.05
44469_44549	1980 SEP27		-0.05(1)	-0.36
44549-44629	1980 DEC16		0.12	0.27

(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

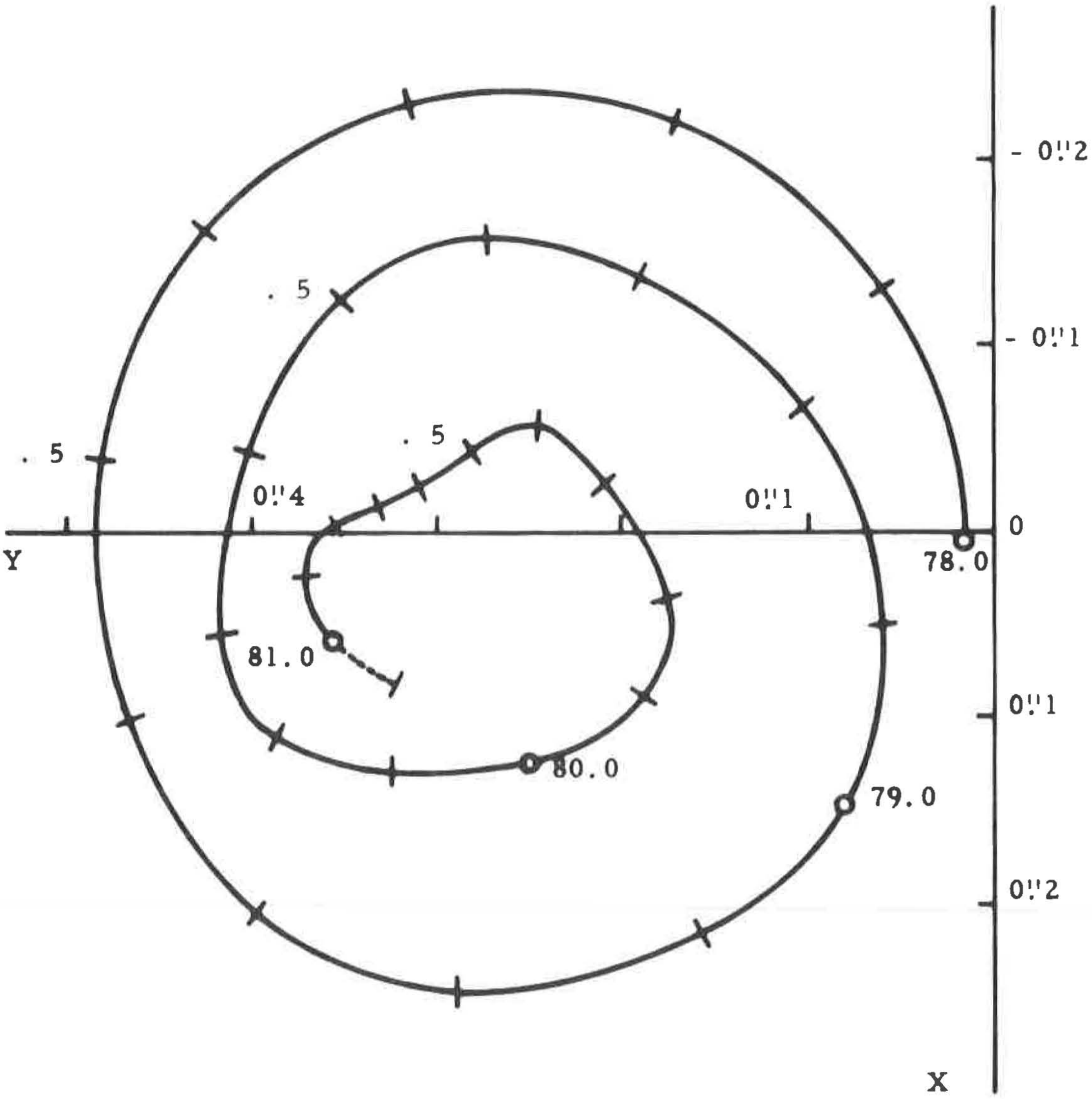

Fig. 1 Path of the pole from 1978.0 to 1981.0

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.

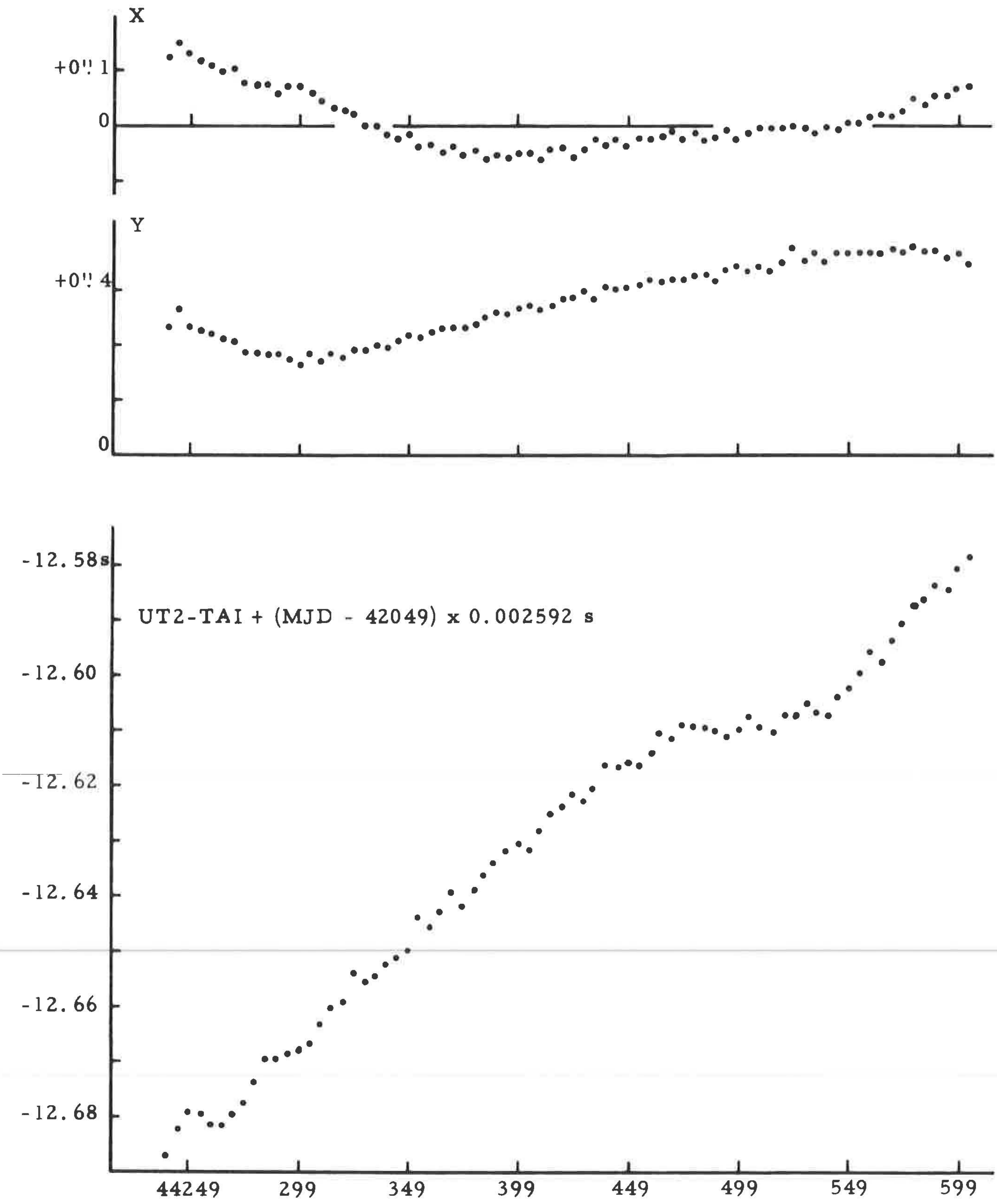

Fig. 2 - Raw data of x, y, UT2-TAI (Table 6 for 1980), 5-day means.

PART C

TIME SIGNALS (1981)

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 1981.

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:

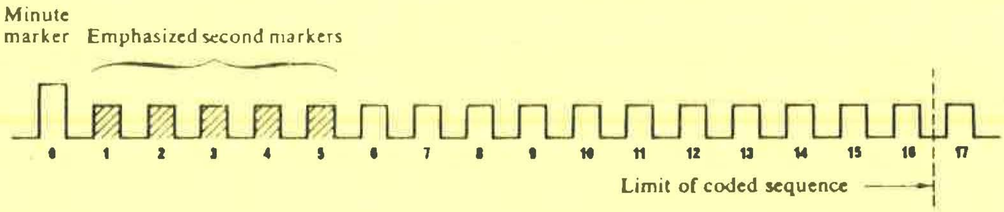

FIGURE 1

DUT1 = +0.5 s

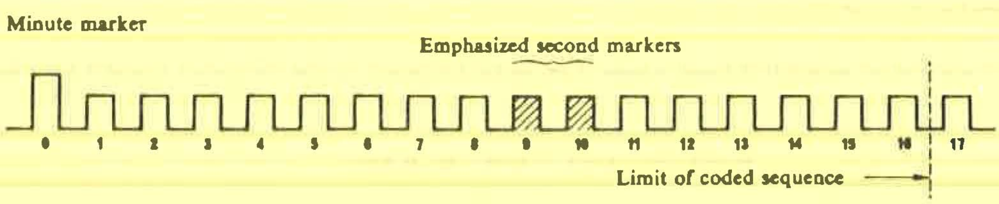

FIGURE 2

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:

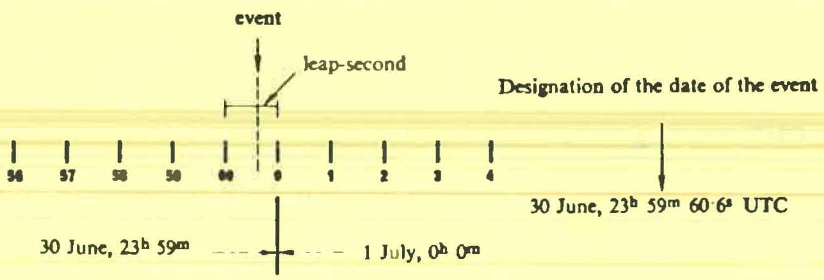

FIGURE 3 – *Positive leap-second*

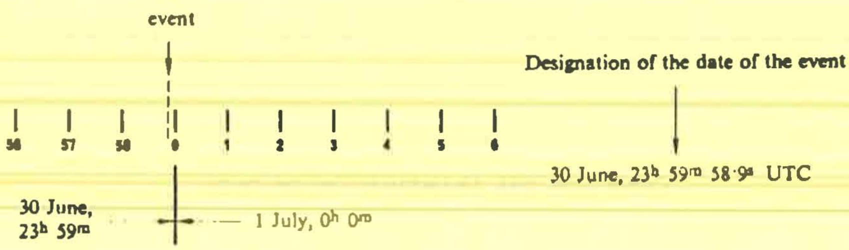

FIGURE 4 – *Negative leap-second*

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 :

$$0.75\,s \leqslant UT1 - UTC \leqslant 0.85\,s.$$

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 Directorate General of Telecommunications Ministry of Communications P. O. Box 71 – Ching-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 und Magnetismus Fachgebiet Zeit und Frequenz Fürstenwalder Damm 388 DDR 1162 Berlin
EBC	Instituto y Observatorio de Marina San Fernando Cadiz, Spain
FFH	Centre National d'Études des Télécommunications Division : Dispositif de Traitement du Signal Département : Étalons de fréquence et de temps 196, rue de Paris 92220 Bagneux, 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 Delhi India 28° 34'N 77° 19'E	5 000 10 000 15 000	3h 30 m to 14h 30 m on Monday to Saturday no transmission on Sundays and Govt Holidays, continuous operation projected.	Second pulses of 5 cycles of a 1 kHz modulation. Minute pulses of 100 ms duration.
BPV (1)	Shanghai China 31° 12'N 121° 26'E	5 000 10 000 15 000	16h to 1h continuous 1h to 16h	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	continuous except interruption between minutes 35 and 40	(a) From min. 5 to 10, 15 to 25, 25 to 30, 45 to 50, 55 to 60, second pulses of 5ms duration without 1 kHz modulation. (b) From min. 0 to 5, 10 to 15, ..., 50 to 55, second pulses of 5ms duration with 1 kHz modulation. The 1 kHz modulation is interrupted 40ms before and after the pulses. (c) Minute pulses are extended to 300ms. (d) DUT1, CCIR code by lengthening.
CHU	Ottawa Canada 45° 18'N 75° 45'W	3 300 7 335 14 670	continuous	Second pulses of 300 cycles of a 1 kHz modulation. Minute pulses are 0.5s 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 (2)	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	11h 55 m to 12h 06m 23h 55m to 24h 06m from 21 Oct. to 27 March 23h 55m to 24h 06m from 28 March 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	11h 55m to 12h 06m 23h 55m to 24h 06m	As DAM (see above)
DAO	Kiel Germany, F.R. 54° 26'N 10° 8'E	2 775	11h 55m to 12h 06m 23h 55m to 24h 06m	As DAM (see above)
DCF77	Mainflingen Germany, F.R. 50° 1'N 9° 0'E	77.5	continuous	At the beginning of each second (except the 59th second) the carrier amplitude is reduced to about 25% for a duration of 0.1s or 0.2s respectively. Coded transmission of year, month, day, hour, minute and day of the week in a BCD code from second marker N° 20 to N° 58 (the second marker durations of 0.1s or 0.2s correspond to a binary 0 or a binary 1 respectively). Zonal time code by the second markers N° 16 to 18. Second marker N° 15 with a duration of 0.2s indicates that the reserve antenna is in use. No transmission of DUT1.

Notes : see p. C-13

Station	Location Latitude Longitude	Frequency (kHz)	Schedule (UT)	Form of 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. (one hour earlier in summer time)
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 a 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 lenghtening 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 (3)	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 100ms, 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 100ms. 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, Sund., 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.

Notes : see p. C-13

Station	Location Latitude Longitude	Frequency (kHz)	Schedule (UT)	Form of 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 3 m 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 8030 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 LQC20	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 100ms for the second pulses, of 500ms 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 (4)	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 1 and 15 16 and 30, 31 and 45, 46 and 60 of every hour except from 6h to 12h on the first Wednesday of every month.	Pulses of 5 cycles of 1 kHz modulation (prolonged for the minutes). 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.

Notes : see p. C-13

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 (1) (5)	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 (1) (5)	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 to 13h 10m	
RID (1) (5)	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 (1) (5)	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 (1) (5)	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 (1) (5)	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 (1)	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 0.025s duration. Second pulses are prolonged to 0.1s ; 10 second pulses are prolonged to 1s and minute pulses are prolonged to 10s. No transmission of DUT1 code.

Notes : see p. C-13

Station	Location Latitude Longitude	Frequency (kHz)	Schedule (UT)	Form of the time signals
UTR3 (1)	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 (6)	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 : see p. C-13

Notes on the characteristics of time signals

(1) No recent information on these time signals.

(2) The DAM time signal transmission will be made from Osterloog from about December 1981 onwards. The final date of change will be announced in due course.

(3) The modulation system used by GBR outside the time-signals is likely to change to a form of minimum-shift keying sometime after the end of 1983. Some standard-frenquency and phase-tracking receivers may not work without modification. Details of the new system are not yet available. No changes are planned in the form of the time-signals.

(4) 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 format of the time code as established since the beginning of 1980 is considered to be final and no changes will be introduced in the near future.

The coding is effected through carrier phase reversals from 200 to 300ms and/or from 300 to 400 ms during certain seconds. The duration of the relative intervals between these seconds is carrying the actual information of minute, hour, day, month, year, day of week and standard (UT + 1h) or summer (UT + 2h) time.

The details of this time code were published in Nomenclature des stations de radiorepérage et des stations effectuant des services spéciaux - Liste VI, Volume I, édition 7 de U. I. T. in Geneva in July 1980. They are also available in english, french,and spanish on writing to the Time Department of Ústav radiotechniky a electroniky ČSAV, Lumumbova 1, 182 51 Praha 8, Kobylisy. Czechoslovakia.

(5) 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 0.02s, 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 21 th and 24 th 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 31 th and the 34 th second, so that dUT1 = -0.02s x p.

(6) Y3S

DUT1 information in CCIR code.
dUT1 information. This additional information specifies more precisely the difference UT1 - UTC down to multiples of 0.02s, 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 from 1 to 5 inclusive.

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

The seconds marker 28 followinp 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	0.005
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 1980

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 = -0.0215 s*
OLB5	UTC - OLB5 = 0.0008 s

* Erratum : Annual Report for 1979, p. C-15, read UTC-BPV = -0.0214 s (the sign - was omitted).

TIME OF EMISSION OF BPV ON 9351 kHz, 11h 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)

1980 Date	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1				-4118			-2061	-1602	-1094	- 341		+ 1284
2	-6354			-4092		-2570	-2042	-1585	-1075	- 314		+ 1312
3	-6320		-4860	-4068		-2558	-2033		-1053	- 289		+ 1340
4	-6293		-4838	-4031		-2535		-1545	-1029	- 264	+ 565	+ 1361
5		-5510	-4813		-3204	-2516		-1537	-1011	-	+ 589	+ 1389
6		-5481	-4786		-3185	-2488		-1521		- 218	+ 618	+ 1424
7	-6206	-5455	-4761		-3157		-1973	-1505		- 182		
8	-6185	-5428		-3916			-1955	-1486	- 944	- 153		+ 1470
9	-6153			-3900	-3109	-2423	-1939		- 923	- 121	-	+ 1496
10	-6125		-4678	-3881		-2397	-1923		- 902	- 100	+ 737	+ 1527
11	-6161	-5350		-3855			-1889	-1404			+ 759	
12		-5324	-4613		-3029	-2372		-1390	- 796		+ 790	+ 1547
13		-5287	-4593		-3000	-2345		-1371		- 18	+ 817	
14	-6074	-5267	-4562	-3768	-2964		-1886	-1348		+ 9	+ 852	
15	-6048	-5240		-3735			-1876	-1330	- 731	+ 32	+ 881	+ 1626
16	-6019			-3705	-2918	-2316			- 709	+ 69		+ 1651
17	-5990			-3693					- 680	+ 96	+ 940	+ 1676
18	-5962	-5143		-3672		-2266	-1834	-1271	- 656		+ 967	+ 1693
19		-5122	-4427		-2842			-1253	- 644			+ 1729
20		-5099	-4406		-2823			-1235		+ 177	+ 1024	
21	-5879	-5069	-4382		-2879			-1216		+ 201	+ 1061	
22	-5850	-5042		-3556	-2856			-1183	- 565	+ 228	+ 1088	+ 1810
23	-5813			-3528	-2831	-2202			- 547	+ 262		+ 1833
24	-5786			-3508		-2174			- 513	+ 285		
25		-4962		-3485		-2141		-1139				
26		-4932	-4282			-2119		-1119	- 464			
27		-4909	-4252		-2731	-2130		-1099	- 366	+ 366		
28	-5675	-4876	-4229		-2701			-1076		+ 394	+ 1264	
29	-5644	-4848		-3354	-2677			-1052	- 392	+ 419		
30	-5614			-3325	-2660	-2072			- 364	+ 463		+ 2018
31	-5582		-4134				-1621			+ 482		