1970-74

PROPOSED AMERICAN NATIONAL STANDARD

Representation for Calendar Date for Machine-to-Machine Data Interchange*

CACM EDITOR'S NOTE

A previous version of this proposed American National Standard was published for public comment in COMM. 11, 4 (Apr. 1968). It was subsequently sent out by American National Standards (formerly USASI) Committee X3, Computers and Information Processing, for letter ballot. A number of comments were received with the responses, and these were submitted for evaluation to the author of the proposed standard, Subcommittee X3.8, Data Elements, Codes, and Formats. As a result of their deliberations, X3.8 withdrew its support of the original version and drafted the current one. This version, published here, is substantively different from the original in that alternative representations for calendar date are provided to include century and ordinal type dates. The section of the original version entitled "Expository Remarks" (which is not part of the proposed standard) was not changed substantively, and is therefore not reprinted here.

This proposed American Standard has been accepted for publication by American National Standards Committee X3. In order that the final version of the proposed standard reflect the largest public consensus, X3 authorized publication of this document to elicit comment and general public reaction, with the understanding that such a working document is an intermediate result in the standardization process and is subject to change, modification, or withdrawal in part or in whole. Comments should be addressed to the X3 Secretary, Business Equipment Manufacturers Association, 235 East 42 Street, New York, NY 10017.—C.K.

Key Words and Phrases: calendar date, machine-to-machine interchange, month, year, day, representation coded
CR Categories: 3.70, 3.73, 3.74, 3.9

Foreword

(*This foreword is not a part of the American National Standard Representation for Calendar Date for Machine-to-Machine Data Interchange.*)

This proposed American National Standard presents a standard representation for a calendar date for use in the interchange of data from machine-to-machine among data systems.

1. Purpose and Scope

1.1 The purpose of this standard is to provide a standard means of representing a calendar data to facilitate interchange of data between the machines of data systems.
1.2 The scope of this standard is limited to such interchange of data between the machines of data systems.

2. Specifications

2.1 Calendar date is a representation composed of the time elements year, month of year, and day of month.
2.2 Year shall be represented by the two low order digits of the conventional numeric representation of the Gregorian calendar year.
2.3 Month of year shall be represented by the ordinal numbers 01, 02, ···, 12, representing the first through the twelfth months.
2.4 Day of month shall be represented by the ordinal numbers 01, 02, ···, 31, representing the first through the thirty-first days.
2.5 The sequence of the time elements shall be from high order to low order (left to right), year, month of year, and day of month.
2.6 No separators shall be used between the time elements.

* ANSI (USASI) Document X.38/139, 1969 January 22; X3.8.2/122, 1969 January 21.

3. Example

3.1 1967 July 1, 1 July 1967, and July 1, 1967 would be expressed as 670701.

4. Qualifications

4.1 In certain applications it may be necessary to represent the year by its full four digits. In these instances the calendar date may be represented as an eight character string of digits wherein the high order four digit (left most) represent the year, e.g. 1967 July 1 would be represented as 19670701.
4.2 The ordinal representation of the day of the year in lieu of a month-day of month representation is commonly used in applications where frequent computation is employed to determine the number of elapsed days between two dates. In these instances the day of the year should be represented by a numeric string of three digits wherein January 1, the first day of the year would be represented as 001, through December 31, the last day of the year, which would be represented as 365 (366 in a leap year). This three digit representation of the day of the year may be used with a one, two, or four digit representation of the year to yield the identification of the date (Ordinal Date). e.g. 1967 January 1 would be represented as 7001, 67001, or 1967001 depending upon the requirements of the specific application.
4.3 The time elements, year, month of year, day of month, and day of year may be represented and used independently or collectively as required. When used collectively the high to low sequence must be maintained. i.e. year-month of year, month of year-day of month, year-month of year-day of month, or year-day of year.
4.4 In the interchange of data between data systems it is essential that the sender provide the recipient of the data a description of the format and contents of the data involved. When calendar dates are involved in interchange, the specific representations employed must be fully described.
4.5 This standard does not specify standard means of representing calendar dates for man-to-machine (or machine-to-man) or man-to-man interchange. The representations of calendar date in these environments will be the subject of future standards now under consideration.

APPENDIX

(*This Appendix is not part of the foregoing standard, but is included to facilitate its use.*)

A1. Intended Use of the Standard Representations

A1.1 The Standard Representation for Calendar Date is intended for use in interchange of data between the machines of data systems. This interchange is the counterpart of the present interchange of conventional business transaction documents: bid requests, purchase orders, invoices, shipping notices, payments, etc.

A2. Projected Standard Representations for Time Elements

A2.1 The Standard Representation for Calendar Date is intended to be a member of a family of representations for time elements to be developed for the full range of needs for representing time elements in the interchange of data.
A2.2 Additional members of the projected family of data codes for times include the following:

1. Year and week of year.
2. Julian Day number.
3. Year and quarter of year.
4. Time of day carried to hours, minutes, seconds, and time zone.
5. General time intervals. These are arbitrary intervals and intervals corresponding to established units of calendar and civil time.
6. Period-to-date intervals. These are—special cases of (5) above. The period for which the to-date interval is to be identified may be, for example, a year, half-year, quarter-year, month, or week.
7. Times of the type "This time period last year" where the time period may be, for example, a day, week, or month.

Genomskrift sker genom ifyllande av översta blanketten med anilin- eller kulspetspenna. Uppgifter om avflyttning måste ifyllas särskilt.

Stora bokstäver, texta!
In block letters!
In Blockschrift!
Använd hårt underlag vid utskrift!

01 Efternamn — Surname — Familienname

Rum nr | 02 Löp nr

A

03 Samtliga förnamn — All first names — Sämtliche Vornamen

04 Födelsetid — Date of birth — Geburtsdatum

År / Year / Jahr	Månad / Month / Monat	Dag / Day / Tag

Kod

Medborgare i — Citizen of — Staatsbürger in

05 Kod

Yrke / titel — Occupation / title — Beruf / Titel

Födelseland — Native country — Geburtsland

Hemland och hemort där — Country and place of domicile — Wohnsitz (Land und Ort)

Inrest i Norden den
Entered the Nordic area 1) on
Eingereist in den Norden 2) am

06

Ankom den
Arrived on
Angekommen am

07

från (senaste nattuppehåll)
from (last overnight stay)
von (letzte Übernachtung)

Inrest i Sverige den
Entered Sweden on
Eingereist in Schweden am

08

Avflyttade den

09

till

Bostadsupplåtarens namn, adress, telefon

10

1) Sweden, Denmark, Finland, Iceland and Norway 2) Schweden, Dänemark, Finnland, Island und Norwegen

RPS 571:3 a. 1. 71. 750.000 set SRA 08713

a. GÄSTFÖRTECKNING enligt hotellförordningen
(utomnordiska gäster)

2569 1970 July 9 M2

Information Systems Programs

E. H. Clamons

TO: Walker Dix

FROM: R. W. Bemer

The outside world is telling us that it is time to change the machine representation of the date. I have written a draft for your convenience (and expected considerable modification) of what might be necessary to get in step without falling down.

As noted, I think it would be better if all ISED got the word, and perhaps you could speak to Feldman about it. However, we could settle for just setting the example now.

po

bcc: Chris Kilgour

D R A F T   O F   D I R E C T I V E

1970 July 9

Desired Priority: (1) Feldman to all
(2) Dix to Engineering

Subject: Machine representation of the date

There are three forthcoming standards for the machine representation of the date, and one existing, as follows:

1. International Standards Organization

   Document is DATCO (Central Secretariat 9)10E

2. American National Standards Institute

   Document is X3.8/139
   (See Communications ACM, 1970 January p. 55)
   Voting period closed this June 30, likely issuance by ANSI about September

3. Information Systems Group Draft Standard A00.3

4. U.S. Department of Defense

   Memorandum of the Assistant Secretary of Defense, 1966 October 27, stating implementation no later than 1970 January 1.

All of these standards prescribe the writing and recording of the date in the order year, month, day. The written input form is:

YY-MM-DD

and the internal machine representation, on storage media in particular is

YYMMDD

It is obvious that:

1. Machine processing is simpler, particularly for ordering (sorting)*

2. Federal Information Processing Standards will eventually require that the date field in all files submitted to the Federal Government be in this form.

*See Alan Taylor's article on the overhead engendered in COBOL from the 3-element handling of the date field, in the 1970 June 3 issue of Computerworld.

For these reasons, a survey shall be taken of all usage of date fields in data files of ISED, as well as in customer-use software such as operating systems. These uses shall be tabulated.

A systematic gradual modification shall be undertaken to convert these date fields during processing, and clear indication of being in old or new standard form shall be placed

1. on the data file medium
2. in the documentation relating to the programs using the data
3. on the master list of date usage

A notification with explanation shall be prepared for internal and external customers affected by these changes.

______________________________ has the additional duties of project management for this conversion.

ISO Central Secretariat
1, rue de Varembé
1211 - Geneva 20 - Switzerland
Cable : Isorganiz - Telex : 23887

Voting on this Draft
ISO Recommendation
will terminate on 23 May 1970

DRAFT ISO RECOMMENDATION 2014

proposed by Technical Committee DATCO

Secretariat held by Central Secretariat

WRITING OF CALENDAR DATES IN ALL-NUMERICAL FORM

UDC 529.2:003.35

DRAFT ISO RECOMMENDATION NO. 2014

WRITING OF CALENDAR DATES IN ALL-NUMERICAL FORM

INTRODUCTION

In all forms of international traffic and exchange, dates must be clearly understood and should be subject to comparison without any ambiguity.

This ISO Recommendation for the numerical writing of calendar dates has been prepared to obviate the confusion arising from misinterpretation of the significance of the numerals in a date written with numerals only; it is considered that similar confusion does not arise when the month is spelled out, either in full or in abbreviated form.

The occasions on which an all-numerical date might be used have been examined and the advantages for these occasions of the descending order year-month-day have been found to outweigh those for the ascending order day-month-year, established in many parts of the world.

These advantages include the ease with which the whole date may be treated as a single number for the purpose of filing and classification (e.g. for insurance or social security systems); arithmetic calculation, particularly in a computer; the possibility of continuing the order by adding digits for hour-minute-second.

1. SCOPE

This ISO Recommendation specifies the writing of dates of the Gregorian calendar in all-numerical form, signified by the elements year, month, day.

2. FIELD OF APPLICATION

This ISO Recommendation should be applied whenever a calendar date containing the elements year, month, day is written in an all-numerical form.

3. RULES FOR WRITING CALENDAR DATES

3.1 Sequence

An all-numerical date should be written in the following order:

year - month - day.

3.2 Characters

An all-numerical date should be expressed exclusively in Arabic numerals.

3.3 Elements

An all-numerical date should consist of

- 4 digits to represent the year. 2 digits may be used where no possible confusion can arise from the omission of the century.

  Note:- 4 digits are especially recommended to clearly indicate that the descending order is used.

- 2 digits to represent the month;
- 2 digits to represent the day.

3.4 Separator

Where a separator is used in an all-numerical date, a hyphen should be used between year and month, and between month and day.

Example of writing the 1st July 1969:

1969-07-01 or 19690701.

ISO

International Organization for Standardization
Organisation Internationale de Normalisation
Международная Организация по Стандартизации

CENTRAL SECRETARIAT
1, rue de Varembé
1211 GENEVA 20, Switzerland

Telephone 34 12 40

Cable address : ISORGANIZ

ANKARA·1970

Our Ref. : ISO/DATCO

15 July 1970

Mr. R. Bemer,
General Electric Company
13430 N. Black Canyon Hwy.
Phoenix, Arizona 85029

Dear Bob,

Many thanks for sending me the clipping on the German Identity Numbering system. Rest assured that I am not going to let such a thing happen without intervening. It remains, however, to be seen whether my intervention has any effect or if the project has already gone too far for any changes.

Regardless of my intervention, once again thanks for alerting me!

Yours sincerely,

Olle

Olle Sturen
Secretary-General

GENERAL ELECTRIC

COMPANY

13430 NORTH BLACK CANYON HIGHWAY, PHOENIX, ARIZONA 85029 . . . TEL. AREA 602—941-2900

Information Systems

1970 August 27

Editor
Science Magazine
1515 Massachusetts Ave NW
Washington, DC 20005

I note that your magazine uses the day-month-year sequence for the writing of dates. This has legal status in Europe, and used to have legal status in the U.S. Defense Department. I am unaware of legal status for this form in the U.S., and I should be ashamed if it had de facto status in the scientific community, which is supposed to be logical.

People concerned with information processing have recognized that this is a nontrivial matter. The extra cost to order files by date is of the magnitude of a million dollars a year if the date is not recorded mechanically in the logical format, which is year-month-day. With this sequence, a single subtraction suffices to determine precedence. For finer divisions of time, the sequence year-month-day-hour-minute-second, etc. is consistent.

The International Standards Organization has a Draft Recommendation on Writing of Calendar Dates in All-Numerical Form (DATCO 10E), and a companion Draft Recommendation for Numbering of Weeks (DATCO 11E). Final adoption will help to reconcile the European and U.S. methods, eliminating many difficulties of understanding in international business and travel.

From this it is but a short step to using a common alphabetic form. Educational institutions and banks will have the most influence upon adoption. I am writing because SCIENCE can also play a role in advancing adoption. Perhaps this practice and the metric system go hand-in-hand.

RBemer

R. W. Bemer

po

SCIENCE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE
1515 MASSACHUSETTS AVENUE, NW, WASHINGTON, D.C. 20005 • 387-7171

September 11, 1970

Dr. R. W. Bemer
General Electric Company
13430 North Black Canyon Highway
Phoenix, Arizona 85029

Dear Dr. Bemer:

Thank you for your comments on the dating system used at Science. We have used day-month-year since 1954 July 2 or, as we express it, 2 July 1954.

I think the system was adopted because of Science's extensive international circulation, and because it saved keystrokes in typesetting. I am pretty certain that no thought was given to the advantages of a logical sequence ordered in the same way as hours, minutes, and seconds are usually ordered. I do not think much thought was given to the legal status, or lack thereof, of any of the various ways of expressing dates.

Your proposal makes good sense, and we shall consider adopting it. Adoption probably depends on our willingness to depart from convention and answer letters of criticism.

Sincerely,

Robert V. Ormes
Robert V. Ormes
Managing Editor

RVO/pu

RECEIVED
1970 SEP 14
R. W. BEMER

the five areas involved—management, systems, programming, operations and users? In evaluating a system we ask again, does it provide all of the elements of good documentation previously mentioned? Is it available? Is it usable, directly by the persons involved? Does it have good quality—is it current, accurate, clear, objective, reliable, valid? Is it complete? Is it standardized, or is there further room for increasing efficiency? And finally, is it well suited to the intended purpose with the correct level of detail, the correct organization, function and relevancy?

But the evaluation must not end there. For there is a need for a continuing review and maintenance if the new system is to have lasting success. There should be a permanently assigned responsibility, not on the part of the original project team that should have been reassigned shortly after cutover. Nevertheless, there should, at any point in time, be a designated person known to all those concerned as being responsible for accepting suggestions and coordinating corrections and improvements in the system.

It is highly appropriate to continue to systematically consider input from all quarters. It is necessary to have continuing management support and enforcement from the very bottom of line supervision on up. It is necessary to have continuing education and training, both the new people in the organization as well as the old. And, of course, it is necessary to use the normal good sound management practices—communication, discipline, etc. —in the implementation and continual effective utilization of this program as with any other.

SUMMARY

In this presentation we addressed first of all just what documentation is, stating that it is essentially anything in written fashion that is used for communication. The elements of good documentation were identified. The justification, the purpose and the objectives were discussed. We said that economics is the primary consideration and good communication the primary use of sound documentation. Next, the contents of a good documentation program were reviewed with some examples that can be considered by any organization. Fourth, we considered a method for implementing a good documentation program, treating it as part of a more general standards program and conducting the implementation as if this were just another standard project with all of the attendant methods and controls normally used by good management in conducting such a project. And finally, in evaluating the installed documentation system, the question was asked, "Does the system meet the prescribed objectives and does it do the job effectively?" Of course, it is necessary to continually upgrade, review and maintain the program so that it will have lasting success in its usefulness to the organization. ■

Information Processing Standards

by R. W. Bemer
General Electric Co.

Even if one thinks that the topic of standardization is dull and useless, standards can be important, as the owners of a German ocean liner believe (from a news story in the *New York Times*, September 13, 1966):

"Inquiry Studies Hanseatic Fire — The city's fireboats are not equipped with the so-called international hose connections, which the liner had, and therefore could not provide water to the liner's firefighting system, including both hoselines and sprinklers, a witness said . . ."

Perhaps the New York City Fire Commissioners had taken the commonplace attitude described in the August 26, 1968, issue of the *American Machinist Magazine*, asking if the reader's definition of a standard was:

"A dull document produced by a committee of dull people who argue interminably and consume reams of paper in letter ballots before they produce a consensus on a position that is already obsolete when it is adopted."

The preferred definition is that of Dr. A. V. Astin, former Director of the National Bureau of Standards:

"A standard is an arbitrary solution to a recurring problem."

Standardization is not really a dull topic; it just seems that way. We are all concerned with standards more than we realize; they are all around us, serving quietly and for the most part unnoticeably, except when one gets in trouble for lack of them.

Let's look at a few examples. Perhaps you have had correspondence from Europe, and have noted the odd size of the paper. I get quite a lot of it and have to keep a cutting board in my office to trim it to fit our ring binders, or to reproduce it to send around the company. Since it is 7/10 of an inch longer than U.S. paper, and the European secretaries type as close to the bottom of the page as do our own, it is often quite difficult not to trim off some copy. So our secretaries complain about this paper, which is called ISO A4 (ISO is the International Standardization Organization, based in Geneva, Switzerland). Why don't the Europeans use the standard size, they ask?

What makes secretaries think that 8-1/2 in. by 11 in. is standard? It isn't to the U.S. Goverment. For them it is 8 in. by 10-1/2 in., set by law. The British have had a still different size, but now they are going to A4 size in their metrication program. The ISO size has a very sound basis, if we look at the problem of photoreduction or enlargement, or paper stock cutting. This is something that secretaries can relate to, for the U.S. paper size has always given them problems in this matter.

The reason is apparent if one cuts or folds a piece of 8-1/2 in. by 11 in. paper in half horizontally. Turn it vertically and you will notice that the ratio (aspect ratio) of width to height for the half sheet is not the same as for the full sheet (5-1/2 in. to 8-1/2 in. + 8-1/2 in. to 11 in.). It is therefore not projective (as for photoreduction by camera), and that is where the difficulty lies. The ISO A4 size, when folded, is projective, for the simple reason that the height of 297 mm is $\sqrt{2}$ times the width of 210 mm.

Perhaps, like the metric system, this is so logical that we should change. All we would have to do is replace or modify all of the office equipment in this country — like hole punches, ring binders, briefcases, bookshelves, file folders, file drawers, etc. Would such a small difference (easily handled by paper cutters) have any effect upon international computer usage? Absolutely. In a former position as coordinator of systems engineering (and standards), I found a non-impact printer for computer output very nearly in production. Unlike the present impact printers with the wide sheets, this device produced normal page sizes, cut from a continuous roll of paper. I asked what the maximum length of cut was, and the reply was 11 inches. The company confirmed that they planned to market it in Europe. I am afraid that my explanation at that time was not gentle, for the maximum length was built into the physical frame and was not possible to increase.

One international standardization topic should be of considerable interest to the DPMA, for it has partial impetus from computer usage. That is the way one writes the date. In Europe (and formerly in the U.S. Armed Forces) it is written as day-month-year. Much of the U.S. public uses month-day-comma-year. Perhaps this doesn't seem earthshaking, but I was once almost unable to attend an important conference in Europe because I could not get into the country with a smallpox vaccination certificate that expired on 9/3/59, and it was already June!

The ISO has agreed, after eight years, on the Swedish proposal for an ordering of year-month-day. The U.S. Department of Defense has adopted this method effective the first of 1970. The American Bankers Association has made no move as yet to make the forms of checks conform to this change, but that could have a tremendous influence on adoption by the public. Perhaps they remember the public outcries about MICR digits, and the vocal rebellion when all-digit numbers were introduced by the telephone companies. To convert the general public to writing the date in this form will take considerable public relations work.

If data processing people will use this format, as specified in document X3/202 of the American National Standards Institute, they will find some interesting savings in computation time. For example, a single subtraction will tell which of two dates is the earlier. General Electric uses the same principle for scheduling on a fiscal week basis, for project control and PERT charts, i.e., 7046 − 7032 is a 14 week difference. This form is also perfect for ordering (sorting) by date. A companion standard gives

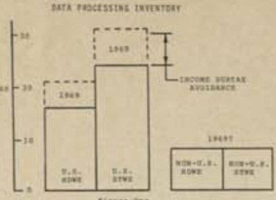


Figure One

Monday as the first day of the fiscal week. Obviously we would have run into strong religious opposition if this had been generalized to more than business usage, for ISO standards are for everything, not just computers.

There are many reasons to be cautious with respect to standardization. Some of these are:

(1) Be careful of the way in which standards are written. They usually give necessary conditions, but these are not always sufficient. Don't presume anything if you don't have to. For example, the British Standards Institution was drafting a standard for electric typewriters in 1960. I made some comments and requests in behalf of IBM. The draft said that the plane of the keyboard would be between 11 and 16 degrees; I asked if that could read "the plane defined by the top and bottom row." They found no reason to object and agreed, but could see no reason why. The draft said that the diameter of the keytop was 9/16 in.; I asked if that could read "the diameter of the finger contact." Again the same result. Then IBM came out with the Selectric, which has a concave keyboard and no keytops as such.

(2) Don't believe things too abjectly, or accept them as obvious. I once gave a paper on program transferability, wherein I said that on the whole it was a healthy phenomenon to get different answers from the same program running on a different computer. One of my co-workers objected to this statement, so I gave him an example:

"The U.S. Army had run a FORTRAN object program on a 7090 for three years. UNIVAC was attempting to sell an 1107. In compiling the source program, a diagnostic message said that there was an entry to the middle of a DO loop, which had not been recognized for those three years of wrong answers."

(3) Don't think that some things are too simple and trivial to be bothered with. Take the example of the COBOL statement:

IF CHARACTER EXCEEDS 'S' THEN NEXT STATEMENT OTHERWISE STOP

Unfortunately the IBM 360 COBOL will give the opposite action from that of the NCR Century COBOL. For this reason, and also because the U.S. Government has made such a directive for file representations, we have now persuaded CODASYL to adopt the ASCII collating sequence for COBOL. But watch out, as this will give spurious solutions for two-case usage.

Going from specifics to the general, there are many reasons for standardization in data and information processing. Some of these are:

- Data interchange and movement
- Multiple use of data (banks)
- Transfer of data problem solutions (programs) and documentation to:
  Additional equipment
  Multiple equipment
  Backup equipment
  Linked equipment
  New equipment
  Different equipment
- Economy of competitive acquisition (interfaces, mixed systems)
- Capture of other work, avoidance of reinvention
- Flexibility in response to changing requirements
- Personnel turnover and training

We can give many more, but they all come down to one thing — money! We are playing in a big game with big dollars, as Figure 1 shows. Accompanying over $5 billion in hardware in 1969 was about $7 billion in software and mechanically recorded data. A major redundancy factor ex-

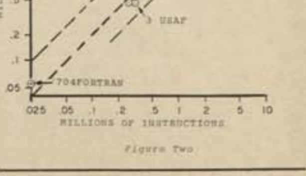
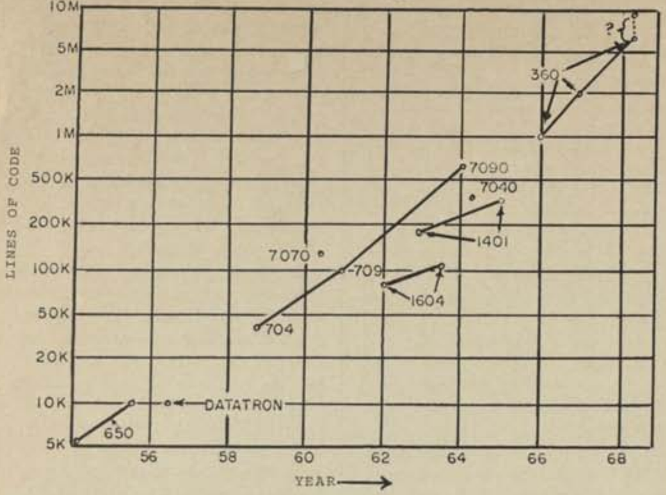


Figure Two

Figure Three



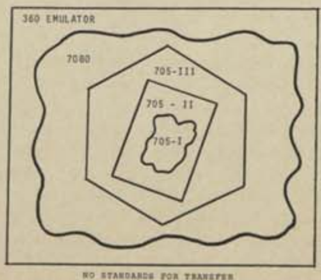
GROWTH IN SOFTWARE REQUIREMENTS

ists, however, when looking at actual and projected figures. The U.S. Government gets from 30 to 50% utilization from their equipment, other users not much more, and they worry about it. But how about that $7 billion in software? No more than $1 billion worth is reusable on other equipment and other people's problems, due to transferability problems. This is an even lower utilization figure.

Perhaps this waste can be avoided by some new miracle. Figure 2 shows how the miracles are coming. This chart is designed to reflect total budget figures on the basis of approximately 30 per cent for design and implementation, 20 per cent for test and 50 per cent for management, documentation and support. It is related to the McClure chart on the size of basic software systems (Figure 3). Using these charts one may extrapolate to 1972 to find a computer system with 25 million instruction software, costing $1.25 billion, constructed by 15,000 programmers. Something has to be done about the difficulties of transferability. Standards are a substantial part of the answer, and that wasted $6 billion a year tells me that they are very important.

Of course we can always get along with the crutch of emulation. We can argue that differences must be perpetuated because it costs too much to change. This is why the U.S. still has not gone metric, yet it costs more each year in waste, and will cost even more to make the inevitable change. See Figure 4.

One of my friends at IBM tried this in the Spring of 1969, except that he put the 702 inside the 705. He reported that the program ran slightly faster on the 360 than it did on the 702, vintage 1954. It is shocking how many people are fooling themselves and running like this. Many do not even use their files in EBCDIC, but rather the old 6-bit code of the 705! It was said that 80 per cent of the 7080s themselves were run with the switch at the 705 MOD I position. Why can't we move to use new equipment at its best? Is it the program or the data that causes the difficulties? I have a little saying that "If the data are not transferable — the program cannot be transferable".



NO STANDARDS FOR TRANSFER
Figure Four

One of the present difficulties in data processing standardization is that we are still working on standards in the areas indicated by the past decade, not in the area of greatest opportunity and payoff in the next decade. The difference may be illustrated by starting with the following definitions:

Data – A representation of facts or ideals in a formalized manner capable of being communicated or manipulated by some process.

Information – The meaning that a human assigns to data by means of the known conventions used in its representation.

The distinction can also be made on the basis that if you can move it, put it away, find it again, transform it and untransform it — without knowing what it meant — it's data!

In the sixties we processed more information than data; in the seventies the processing of data will outweigh by far the processing of information (when the content is changed in any way). The reason for this is, of course, that we shall have more need for simple access, display and data movement — as computers are integrated more directly into human activities. Even now it is difficult to awaken the standardization people to the importance of data — its structure and elements. We are going to have to look at computing as it will be, not as it was. Programmers have been concerned for too many years with algorithms and programming languages. An algorithm is primarily an information process performed upon data. In the past these data have been relatively homogenous and from close or related sources.

Moving to data banks we must consider anew these processes, for the data are no longer necessarily homogenous in structure, nor are they necessarily from related sources. Data will now have to be public in nature; this does not mean free from safeguards of privacy and security, but rather that it can be used by all who have a right to access. The difficulty with our present inventory of mechanically-recorded data is that it is essentially local and private data, hampered by information losses that prevent it from going public. Making public data private is relatively easy; one withdraws it or puts legislative or other controls upon its usage. However, recovering from those information losses to make private data public is unbelievably difficult.

The real purpose of data processing is to have the program and data dance together. One may dance marathon style, or periodically with long and short intermissions. In private a single couple may dance as they please to their own music source, but in public there are constraints as to when the hall and the orchestra are available. This is where operating systems come in. They provide the time, place and facilities for the data and program to dance, as it were. Now communications and data banks make it possible for the same data to dance in many ballrooms, even simultaneously, and with different program partners.

To do this at all efficiently (for reasons of data transferability and reusage) it is necessary to make the data management system the highest in the hierarchy, as noted in Figure 5. Operating systems are subservient, and there may be different operating systems associated with a single data management system, each providing the ballroom for their programs to interact with the data.

If data dances in many ballrooms there is going to be a recognition problem. Thus data must be identified as to type — either by data descriptive language or by identification to allow one to look somewhere for the characteristics. Thus there is a need for levels of identification and familiarity, as well as for levels of privacy. There is a rather universal mechanism to accomplish these, known as "ESCape". ESCape usually indicates a registered sequence which gives the identification number of a different character set, or variations in media labels, data formats and data communications control procedures. It may extend infinitely, for one can escape to another escape domain.

If one accepts my argument of the separation of the data base management system from the operating system, even though the ultimate benefit is not so apparent now, then it will be seen that there are many things wrong with our existing standards. For example, the Data Division of COBOL is a part of the program, not of the data tape or other media. Destroy the program and what is on the tape? Furthermore, the data procedures are not common between COBOL, PL/I and FORTRAN. There is no reason why they shouldn't be common, and the users are paying for this in operating inefficiency and unnecessary software using up valuable storage.

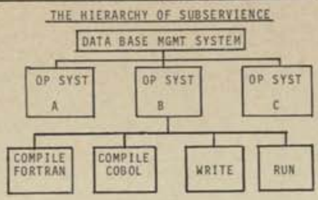


Figure Five

I do not wish to emphasize standards of compliance more than standards of performance. Both contribute heavily to the efficiency and cost-performance effectiveness of computer utilization. In both areas, however, I am at a great disadvantage to convince users of the relative value of standards, and to ask the users' support in their creation and adoption, because many users cannot relate to what I am saying, lacking quantitative tools to measure the cost to performance of lack or misuse or standards.

If some action takes 10 milliseconds that should take only one, the human cannot detect it in his software system, nor can he relate to it without measurement. When we instrumented the 600 software (a first in the industry) we found some serious system inefficiencies. Correction has enabled the improvement of performance by better than two-to-one. Some firms now supply instrumentation for customer programs, and have demonstrated 20 to 40 per cent performance improvement in a short test time. But these are primarily for user's programs, not the manufacturer- or software house-supplied basic software. The operation of this software is pretty much out of the user's control, and very likely he is paying heavily (and unwittingly) for processes which are either useless or inefficient.

Standards affect the inefficient processes, such as conversion to and from the ISO (ASCII) Code in communication-based systems. Standardization workers would find it easier to talk to users on an understanding basis if the users could only find out from their computer salesman which elements of the hardware and software system were there to get around non-standardization, and then add up the cost.

In closing there are two excellent sources of such information detailing the actual and diverse standardization activities:

(1) The series of notes on Federal Information Processing Standards, from the Center of Computer Sciences and Technology, the National Bureau of Standards. These are available in the NBS Technical News Bulletin from the Supt. of Documents, U.S. Government Printing Office, Washington, D.C. A yearly subscription costs $3.

(2) BEMA, the Business Equipment Manufacturers Association, puts out a quarterly progress report on national and international standardization for computers and information processing. Available upon request. ■

Standardization—What, Why and How?

by Milt Bryce
President
TekFax, Inc.

In discussing our attitudes toward standards, I suggest that the reason we, as a profession, have not developed a formalized body of standards is that we have emotional hang-ups on the subject. Some individuals have developed standards and some installations have standards, but why as a group have we resisted attacking this problem head-on? Why, 19 years after the first commercial computer was announced, are we still wrestling with standards?

One reason might be that such things as standards and standard operating procedures fail to fit the image some of us have of ourselves. We like impressing others with our computer gibberish. If we became business-like and used standards, we might lose this image; the mystique of the computer room might disappear.

Also, standards are, by definition, a measure or a base for comparison purposes. Are we afraid of having our performance measured? I have a feel-

1970 June 23

INFORMATION PROCESSING STANDARDS

for the 1970 International Data Processing Conference

Seattle, Washington

R. W. Bemer, the General Electric Co., Phoenix, Arizona

Even if one thinks that the topic of standardization is dull and useless, standards can be important, as the owners of a German ocean liner believe (from a news story in the New York Times, 1966 September 13).

"Inquiry Studies Hanseatic Fire -

The city's fireboats are not equipped with the so-called international hose connections, which the liner had, and therefore could not provide water to the liner's fire-fighting system, including both hoselines and sprinklers, a witness said..."

Perhaps the New York City Fire Commissioners had taken the commonplace attitude described in the 1968 August 26 issue of the American Machinist Magazine, asking if the reader's definition of a standard was:

"A dull document produced by a committee of dull people who argue interminably and consume reams of paper in letter ballots before they produce a consensus on a position that is already obsolete when it is adopted."

SHOWING PARTS EDITED OUT OF DPMA PUBLICATION

The preferred definition is that of Dr. A. V. Astin, former Director of the National Bureau of Standards:

"A standard is an arbitrary solution to a recurring problem."

Standardization is not really a dull topic. It just seems that way from the dull people explaining it, without an awareness of the need for public relations. Someone should try to make it interesting, for we are all concerned with standards more than we realize. They are all around us, serving quietly and for the most part unnoticeably, except when one gets in trouble for lack of them. The Swedish Standards Commission gives out matchbooks with a cartoon of a partly dressed lady covering herself in panic because her window shade is too small for the window.

Let's look at a few examples. Perhaps you have had correspondence from Europe, and have noted the odd size of the paper. I get quite a lot of it in my job and have to keep a cutting board in my office to trim it to fit our ring binders, or to reproduce it to send around the company. Since it is 7/10 of an inch longer than U.S. paper, and the European secretaries type to as close to the bottom of the page as do our own, it is often quite difficult not to trim off some copy. So our secretaries complain about this paper, which is called ISO A4 (ISO is the International Standardization Organization, based in Geneva, Switzerland). Why don't the Europeans use the standard size, they ask?

printer for computer output very nearly in production. Unlike the present impact printers with the wide sheets, this device produced normal page sizes, cut from a continuous roll of paper. I asked what the maximum length of cut was, and the reply was 11 inches. I then asked if they planned to market it in Europe? Oh, absolutely! I am afraid that my explanation at that time was not gentle, for the maximum length was built into the physical frame and was not possible to increase!

Of course, European designers of printers have much the same type of problem to supply the U.S. market, just because we do not have sufficient international standards for the paper used in line printers. I once noticed a footnote in an engineering development report, which said that the paper feed worked great except for a "nonstandard" American paper type called Crimplok. That started my investigation. I walked casually into a computer room at Phoenix and asked if there was any Crimplok paper there that I could look at. There was plenty available. In fact, there wasn't much of anything else. So much for the nonstandard type. I then noted that the top and bottom pinfeed holes on each sheet were a little bigger, to accommodate the plastic spindles of a common type of U.S. binder. Since the bottom hole of one page was followed immediately by the top hole of the next, the two oversized holes in succession allowed a jiggle in the registration. I called Moore Business Forms, and found that their subsidiary made the Kidder tractor, used upon almost all U.S. printers. The chain engaged at least eight and as many as twelve pins at one time. Result--no jiggle in registration. Without this knowledge, the European designer was going to make a cheaper paper drive.

One international standardization topic should be of considerable interest to the DPMA, for it has partial impetus from computer usage. That is the way one writes the date. Europe (and formerly the U.S. Armed Forces) writes it as day-month-year. Much of the U.S. public uses month-day-comma-year. Perhaps this doesn't seem earthshaking, but I was once almost unable to attend an important conference in Europe because I could not get into the country with a smallpox vaccination certificate that expired on 9/3/59, and it was already June!

The ISO has agreed, after eight years, on the Swedish proposal for an ordering of year-month-day. The U.S. Department of Defense has adopted this method effective the first of 1970. The American Bankers Association has made no move as yet to make the forms of checks for this ordering, but that could have a tremendous influence on adoption by the public. Perhaps they remember the public outcries about MICR digits, and the vocal rebellion when all-digit numbers were introduced by the telephone companies. To convert the general public to writing the date in this form will take considerable public relations work.

As an example of reaction, some people complain that it is too difficult to relearn, and what about all those date stamps in offices? Well, I have used this ordering for six years now; I have the change time down to five minutes for two well-known models of date stamps, and secretaries can convert overnight, once I run through a simple test. I ask for the time on my watch, and to not use any prepositions in the reply. Then I ask, "Oh, you mean you mention the larger unit first?"

the same result. Then IBM came out with the Selectric, which has (as you know) a concave keyboard and no keytops as such.

2. Don't believe things too abjectly, or accept them as obvious. I once gave a paper on program transferability, wherein I said that on the whole it was a healthy phenomenon to get different answers from the same program running on a different computer. One of my co-workers objected to this statement, so I found him some examples:

"The U.S. Army had run a FORTRAN object program on a 7090 for three years. UNIVAC was attempting to sell an 1107. In compiling the source program, a diagnostic message said that there was an entry to the middle of a DO loop, which had not been recognized for those three years of wrong answers."

"A large matrix was being inverted in short (32-bit word) precision. The program was then moved to a 48-bit word machine. The user thought he had 5-decimal accuracy in the answers, was making decisions based upon 3 decimal digits, and now found out that they weren't any better than one digit."

3. Don't think that some things are too simple and trivial to be bothered with. Take the example of the COBOL statement:

IF CHARACTER EXCEEDS 'S' THEN NEXT STATEMENT OTHERWISE STOP

Unfortunately the IBM 360 COBOL will give the opposite action from that of the NCR Century COBOL. For this reason, and also because the U.S. Government has made such a directive for file representations, we have now persuaded CODASYL to adopt the ASCII collating sequence for COBOL. But watch out, as this will give spurious solutions for two-case usage. If the straight collating sequence is used for telephone books, there will be some anguished subscribers, including:

De Carlo
De La Rue
De Long
DeLair
DeLancey
DeLaRue
Delancey
de Carlo
de la Rue
deLancey

Going from specifics to the general, there are many reasons for standardization in data and information processing. Some of these are:

- Data interchange and movement
- Multiple use of data (banks)
- Transfer of data, problem solutions (programs) and documentation to:

Additional equipment		
Multiple	"	
Backup	"	and for brokerage
Linked	"	
New	"	
Different	"	

- Economy of competitive acquisition (interfaces, mixed systems)
- Capture of other work, avoidance of reinvention
- Flexibility in response to changing requirements
- Personnel turnover and training

We can give many more, but they all come down to one thing--money! We all like it because Westinghouse, GE, and Sylvania light bulbs fit the same socket and give us a cheaper price via competition. But we are playing in a bigger game than light bulbs. Perhaps some may not realize how big:

(Figure 1 - Data processing inventory)

Accompanying over $5 billion in hardware in 1969 was about $7 billion in software and mechanically recorded data. Our business is extrapolated to be the largest in the country some time around the end of this new decade. A major redundancy factor exists, however. The U.S. Government gets from 30 to 50% utilization from their equipment, other users not much more, and they worry about it. But how about that $7 billion in software? No more than one billion dollars worth is reusable on other equipment and other people's problems, due to transferability problems. This is an even lower utilization figure.

One of my friends at IBM tried this in the Spring of 1969, except that he put the 702 inside the 705. He reported that the program ran slightly faster on the 360 than it did on the 702, vintage 1954.

It is shocking how many people are fooling themselves and running like this. Many do not even use their files in EBCDIC, but rather the old 6-bit code of the 705! It was said that 80% of the 7080s themselves were run with the switch at the 705 MOD I position.

It's not a laughing matter, as Howard Smith and I once thought when we thought about hoaxing the industry by pretending to find an old manuscript by Countess Lovelace, entitled "Simulation of Ye Difference Engine Upon Ye Analytic Engine".

Why can't we move to use new equipment at its best? Is it the program or the data that causes the difficulties? I have a little saying that "If the data are not transferable--the program cannot be transferable".

Already we see signs of services arriving in response to the problems of program (and more basically data) transferability. Computerworld had an article (1970 February) on the formation of a new firm.

> "Computer Conversions, Inc., intends to specialize in helping firms surmount conversion problems. Believing that hundreds, even thousands, of computer installations are not able to get the best out of new technologies simply because they don't have adequate in-house conversion capabilities.

"Computer Conversions intends to help its clients not only in the selection of equipment and negotiation of contracts but also in the specific development of systems and procedures for the efficient conversion from the old equipment to the new. This includes, where appropriate, training of programming and operating staffs, conversion of files, testing, and documentation of operational programs."

One of the present difficulties in data processing standardization is that we are still working on standards in the areas indicated by the past decade, not in the area of greatest opportunity and payoff in the next decade. The difference may be illustrated by starting with the following definitions:

Data	-	A representation of facts or ideas in a formalized manner capable of being communicated or manipulated by some process.
Information	-	The meaning that a human assigns to data by means of the known conventions used in its representation.

The distinction can also be made on the basis that if you can move it, put it away, find it again, transform it and untransform it--without knowing what it meant--it's data!

I find it interesting that the "D" in "DPMA" is becoming more pertinent for the next decade. In the sixties we processed more information than data; in the seventies the processing of data will outweigh by far the processing of information (when the content is changed in any way). The reason for this is of

We did not used to have to worry too much about how to dance with strangers. In the nineteenth century we did not travel enough to know many strangers. Similarly, data and programs have been very familar to each other. In fact, the structure of the data has commonly been buried implicitly in the program. But now communications and data banks make it possible for the same data to dance in many ballrooms, even simultaneously, and with different program partners. See [1] for a discussion of the standards required to make this feasible.

To do this at all efficiently (for reasons of data transferability and reusage) it is necessary to make the data management system the <u>highest</u> in the hierarchy:

(Figure 5 - The hierarchy of subservience)

Operating systems are subservient, and there may be different operating systems associated with a single data management system, each providing the ballroom for <u>their</u> programs to interact with the data.

If data dances in many ballrooms there is going to be a recognition problem. (Do you dance Swahili or Nebraska cornhusker style?) Thus data must be identified as to type--either by data descriptive language or by identification to allow one to look somewhere for the characteristics. It is just like the recognition process between humans, which flowcharts as: "I'm so-and-so. If you know me, proceed; if not, check the rules for getting acquainted".

1. The series of notes on Federal Information Processing Standards, from the Center for Computer Sciences and Technology, the National Bureau of Standards. These are available in the NBS Technical News Bulletin from the Supt. of Documents, U.S. Government Printing Office, Washington, D.C. A yearly subscription costs $3, and every computing installation will find it well worth while to have these documents.

2. BEMA, the Business Equipment Manufacturers Association, puts out a quarterly progress Report on national and international standardization for computers and information processing. Available upon request from BEMA, 1828 L Street NW, Washington, D.C. 20036.

It takes some sacrifice to follow standards, and more to participate in their development. Presently the user finds it difficult to spend the effort and money to do so. Nevertheless, these sacrifices will have to be made to achieve better results. Imagine the effect upon the French, with their justifiable national and linguistic pride, to write and document software in English. We are fortunate not to have that problem, so let's do our part in other ways. It pays off.

A Swedish friend says there is a standard answer to the fear that a standardized world might be awfully dull. It is that "a standard-sized brick doesn't make for dull architecture, and don't forget what Mozart did with all those standardized little notes". We're going to be in an awful muddle as the largest business in the post-industrial world if we can't bring some order into it through standards. We are overdue in starting an effort of the required magnitude.

References

1. Bonn, Theodore H., "Standards and Interconnection", Interdisciplinary Conference on Multiple Access Computer Networks, 1970 April 20-22, University of Texas, Austin.

2. Bemer, R. W., "Escape to Reality", Forum Editorial, Datamation Magazine, 1969 August, 239-240.

3. Bemer, R. W., "Straightening Out Programming Languages", A Talk to the 10th Anniversary Meeting of CODASYL, 1969 May.

SCIENCE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE
1515 MASSACHUSETTS AVENUE, NW, WASHINGTON, D.C. 20005 • 387-7171

September 11, 1970

Dr. R. W. Bemer
General Electric Company
13430 North Black Canyon Highway
Phoenix, Arizona 85029

Dear Dr. Bemer:

Thank you for your comments on the dating system used at Science. We have used day-month-year since 1954 July 2 or, as we express it, 2 July 1954.

I think the system was adopted because of Science's extensive international circulation, and because it saved keystrokes in typesetting. I am pretty certain that no thought was given to the advantages of a logical sequence ordered in the same way as hours, minutes, and seconds are usually ordered. I do not think much thought was given to the legal status, or lack thereof, of any of the various ways of expressing dates.

Your proposal makes good sense, and we shall consider adopting it. Adoption probably depends on our willingness to depart from convention and answer letters of criticism.

Sincerely,

Robert V. Ormes
Robert V. Ormes
Managing Editor

RVO/pu

USED WITH DoD ONLY

Honeywell

1971 January 18

To: Members of X3

Why the confusion on Document X3L8/139? Let us summarize the options and conditions of possible existence:

	Form	Data Length	Written Length
Cardinal -	YYYYMMDD	8	10
	YYMMDD	6	8
	YMMDD	5	7
Ordinal -	YYYYNNN	7	9
	YYNNN	5	7
	YNNN	4	6

Obviously there is no conflict in the written form. Y-MM-DD is distinguishable from YY-NNN.

The apparent conflict in the data form between YMMDD and YYNNN is resolvable by considering that:

1) The standard makes no provision for automatic delimiting on media. Therefore, the field must be located by convention (either by the program that operates on the data, or the label* for that medium, or documentation for the file).

2) Because the convention must include one purpose, it can be used for another.

3) It wouldn't even be difficult to make the distinction by program, because only 183 combinations are common to MMDD (ex 366) and YNNN (ex 3660).

<u>ON THE OTHER HAND</u>, Mr. Frey's Point #1 has merit, for:

1) The ANStandard would be consistent with the ISO recommendation.

2) The possible savings in storage and file media by eliminating a single character are zilch compared with the possible expense of confusion.

R Bemer

R. W. Bemer

/eh

*Registry is possible.

COMPUTER OPERATIONS – PHOENIX, HONEYWELL INFORMATION SYSTEMS INC.
13430 NORTH BLACK CANYON HIGHWAY, PHOENIX, ARIZONA 85029, TELEPHONE 602/263-2141

September 2, 1971

Dan McBride

Eric Clamons

EMI

cc: M. Kirschner

I have attached a copy of ISO Recommendation 2015: "Numbering of Weeks." As you can see, it conflicts with the calendar schedule you proposed in GAPP-1000. I understand that Honeywell also adopted the procedure.

The fiscal calendar is also used for other purposes including the scheduling of meetings, some of which could be with people outside our corporation. Since other HIS departments are affected by Accounting's fiscal calendar closing dates, we face the unpleasant prospect of having the HIS Fiscal Calendar and the standard out of phase by one week in two out of any six years.

I am sure that something can be worked out to avoid this conflict preferably for 1972. In 1973 the two calendars coincide. You will notice that the conflict existed in 1971, but the standard was not approved in time for adoption. During the merger, it did not appear urgent enough to mention so we slipped and did not get the word to you.

I would be happy to discuss this further with you. L. E. Hepfner was very helpful in bringing me up to date.

Eric H. Clamons

EHC/ms
Attachment

blind copies to:

R. W. Bemer
T. J. McNamara

P. S. The attached fiscal calendar is marked up.

Honeywell

1971 July 7

Mr. Olle Sturen
Secretary General
International Standards Organization
1, rue de Varembe
1211 Geneva 20
SWITZERLAND

Dear Olle:

I'm writing to you wearing a different hat this time. It's the hat of Editor of the Honeywell Computer Journal, and I get it by virtue of last year's formation of HIS from the computer components of Honeywell and General Electric.

The publication is in Vol. 5 this year, but has not been what I (and my manager, Dr. John Weil) think that it is capable of being. However, it is easier to modify an existing publication in stages than to start anew, and I am very glad of this opportunity.

There are some aspects that will interest you. This new company is not only second in size to IBM, but a slight preponderance of the employees are non-U.S. This gives official blessing and urging to my natural inclination to take a very international viewpoint. I have just changed the size to A4, and SI units are used throughout. It goes without saying how the dates will be written!

In addition, I am authorized and even encouraged to have the publication reflect a personal imprimatur. I shall give a framing for each article to indicate significance, relevance, relationship to other social and technical aspects, and generally set an ambiance. I do believe that I can give the readability of, say, the Scientific American, and satisfy the interests of a broad audience. I want it to be an exciting magazine, which is a goal that neither of the IBM Journals have either attempted or achieved. It will certainly become a prestige publication.

This new look starts with the 3rd issue of this year. Among the authors I have Congressman Brooks (the real father of information processing standards in the U.S.); Col. Aines (of the President's Office of Science and Technology, who will discuss microfiche, for I am introducing the practice of inserting a microfiche copy with each printed copy, but don't let the secret out yet); my own history of COBOL; a story on the Gamma 60 (of Compagnie Bull), the computer that was "ahead of its time"; etc.

Honeywell

Surely the detail I have given so far has indicated my motive: to have a contribution from the Secretary General of ISO, perhaps for the 4th issue of this year. The topic is unrestricted except that it should have relevance to computers and their uses. The SI system comes to mind, and so does a subset dealing with the reasons for the A series of paper sizes. The contribution could be small or large. It could be a modification or reprint of existing work. It should bring the importance of ISO in information processing standards strongly to the attention of an international readership.

I hope you can accept. I give a personal guarantee that you will be well pleased by the treatment we should give such a contribution and by the quality of the publication in which it will appear. Another small item: I assume that it is permissible to reprint (in some issue) the ISO News Service announcement on Recommendations 2014 and 2015.

Cordially

Bob

R. W. Bemer

HONEYWELL INTEROFFICE CORRESPONDENCE

PHOENIX OPERATIONS – HONEYWELL INFORMATION SYSTEMS

DATE 1971 September 09 PHONE 3000 MAIL ZONE C88 COPIES RL Steele
RW Bemer

TO DJ West

FROM PG Skelly

COMPONENT Standards and Manufacturing Support

SUBJECT Writing of Calendar Dates in All-numeric Form

REFERENCE Management Newsletter 71-40

I have noted your use of the sequence month-day-year for the representation of dates in an all-numeric form.

I am enclosing for your information a copy of the International Standards Organization Recommendation 2014; this document specifies the sequence year-month-day for the several reasons spelled out in its introduction.

This same topic is expected to be the subject of a related American National Standard in the near future.

Honeywell, through its membership on American National Standards Committee X3, has supported, both nationally and internationally, the descending sequence.

Patrick G. Skelly

Patrick G Skelly
Senior Systems Engineer

HONEYWELL INTEROFFICE CORRESPONDENCE

ENTER MAIL STATION NUMBER AFTER EACH NAME

DATE September 14, 1971

TO Patrick G. Skelly, C88

FROM D. J. West, B41

DIVISION E&CR

cc: R. W. Bemer, B106
D. E. Callanan, Wellesley 172
W. D. Conley, Waltham 457
R. G. Lahm, B92
R. L. Steele, C88
J. B. Stroup, Waltham 413

SUBJECT Writing of Calendar Dates

Reference your letter dated 1971 September 09 concerning writing of calendar dates.

The forms are provided to us by the Honeywell Corporate office and not designed at the local level.

To my knowledge we have had no prior correspondence in this office which required the standard suggested in your correspondence.

As you can see, I have referred your letter to additional sources to acquire an official HIS position.

Thanks for the suggestion. I'll let you know when I get the "word."

Del

DJW:vp

CF 28

1971 October 13

D.J. West, B-41

R.W. Bemer 993-2569

Advanced Systems & Technology B-106

Writing (Representation) of
Calendar Dates

E.H. Clamons
D.E. Callanan
W.D. Conley
R.G. Lahm
T.W. Shidler
P.G. Skelly
R.L. Steele
J.B. Stroup

Re your memo of 1971 September 14 seeking an official HIS position on writing of the date, this should not be too difficult to obtain, becauuse:

- Listed in the Table of Contents of the HIS Standards Book is A00.03, Method of Representing the Date (not issued yet - responsibility of E.H. Clamons).
- In addition to ISO Standard 2014, see also American National Standard X3.30-1971 (approved 1971 July 01).
- See also Department of Defense Directive of 1966 Oct 27, specifying implementation of the year-month-day ordering no later than the first day of 1970.

As an unofficial straw in the wind, please note conformity to this ordering in the Honeywell Computer Journal.

R. W. Bemer

RWB:eh

ISO

our date
1971-12-16

our reference
ISO/DATCO

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION • МЕЖДУНАРОДНАЯ ОРГАНИЗАЦИЯ ПО СТАНДАРТИЗАЦИИ • ORGANISATION INTERNATIONALE DE NORMALISATION

Olle Sturen
Secretary-General of ISO
1, rue de Varembé
1211 Genève 20
Switzerland

Mr. R.W. Bemer
Honeywell Information Systems, Inc.
Deer Valley Park
P.O. Box 6000
Phoenix, Arizona

your reference

RWB: eh

Dear Bob,

I have received,and we have reviewed for verification, the article "What is the date?" which you intended to publish in your Journal. Enclosed we are returning the article with our suggestions.

We are pleased, indeed, that you give our work some extended coverage, but I believe that you would also be glad if I fulfilled soon my promise to contribute to your Journal. I have a piece intended for such publication in my drawer, but extensive trips have delayed not only this item, but a number of others as well on my work programme. If it can be a consolation to you, however : it is not forgotten.

Merry Christmas and a Happy New Year !

Yours sincerely,

Olle Sturen

1 enclosure : article

OS/ak

Telephone
(022) 34 12 40

Telex
23 887 ISO CH

Telegrams
ISORGANIZ

ISO

our date
1972-01-13

our reference
ISO/TG 3

INT[...]ONAL ORGANIZATION FOR STANDARDIZATION • МЕЖДУНАРОДНАЯ ОРГАНИЗАЦИЯ ПО СТАНДАРТИЗАЦИИ • ORGANISATION INTERNATIONALE DE NORMALISATION

Olle Sturen
Secretary-General of ISO
1, rue de Varembé
1211 Genève 20
Switzerland

Mr. R.W. Bemer
Honeywell
P.O. Box 6 000
Deer Valley Park
Phoenix, Arizona 85005

your reference

RWB:eh

Dear Bob,

Your letter of 7 January 1972 about the "ISO Fiscal Calendar 1972" was duly received. The numbering of weeks is in accordance with the rules stated in ISO/R 2015 and seems therefore acceptable.

Yours sincerely,

Olle Sturen

4,4,5

LOWELL
FOSTER

5 YEARS
OTHER TYPE
STAGE

WR/ak

Telephone Telex Telegrams

Honeywell

1973 August 21

Dr. Burgess Gordon
American Medical Association
535 North Dearborn
Chicago, IL 60610

Dear Dr. Gordon:

I hope that you can remember me from ACM 70 and my work toward a National Computer Year. I have a specific point to raise with you with respect to medical records.

Yesterday I picked up some X-rays to take to another physician. The time sequence being important, I looked at the date. It appeared in the form

MM DD YY (M for month, D-day, Y-year)

Having been an active participant in the adoption of International Standard 2014, for the numeric representation of date, it immediately struck me that serious consequences could have ensued had I taken these plates to a doctor in Europe. I know that I was once refused admittance into Switzerland (for an important standards meeting) because the official assumed that my passport had expired because the date was in the form

DD MM YY

until I explained that the American way differed.

It was for just this reason that the new international standard way of representing the date numerically is

YY MM DD

Having just come from Sweden last week, I can vouch for the fact that the whole country has converted, as I found on the hotel reservation form. Assuming the possibility of international exchange of medical records, I would hope that you could bring this standard to the attention of practicing physicians for their use. Observe that for today (73-08-21) it is quite obvious that 73 could be neither month nor day-of-the-month, and that the remainder is in the form that Americans are used to. Thus there should be less difficulties for us than for the rest of the world.

Sincerely,

Bob

R. W. Bemer

n

cc: O.Sturen

HONEYWELL INFORMATION SYSTEMS INC ADVANCED SYSTEMS & TECHNOLOGY
DEER VALLEY PARK P O BOX 6000 PHOENIX ARIZONA 85005 TELEPHONE 602 993 6000

1973 August 21 993-2569 B106 J.W. Weil
T. McNamara

C. W. DIX

R. W. Bemer

ASTO - Phoenix

INTERNATIONAL STANDARD FOR NUMERIC
REPRESENTATION OF DATE

I have written you previously on this subject, which is covered in International Standard 2014. With time, the matter has gotten more serious, as I discovered in my recent lecture tour in Scandinavia.

Attached is a hotel registration form that demonstrates that this standard (yr-mo-da) is not theoretical, but in fact has been adopted nationally for use by everyone.

Consequently, the software supplied with systems furnished in countries where the standard has been put into practice should provide at least the option to use the date in this form rather than the provincial form of the United States. This was expressed to me by data processing people of Cie. Honeywell Bull.

R. W. Bemer

n

Attachment

COMPUTERS and our Society*

Computer usage is classified as either 1) advisory, 2) leading to decisions by humans, or 3) with decisions being taken by a preprogrammed computer unless countermanded in time. Some examples of difficulties even in the first two categories imply that caution in the third is imperative. The computer technology learned from the space effort is not yet transferred to the bulk of computer usage.

Both legal and voluntary (professional) measures against misuse are discussed.

R. W. Bemer
Honeywell Information Systems
Phoenix, AZ, US

INTRODUCTION

In 1950, after my "graveyard shift" at the RAND Corporation, I was still working at 0830 on a 604 board to take an 8-digit square root of an 8-digit number (until then not accomplished mechanically for that equipment). A round little man approached and asked what I was doing. I told him. He then asked about the calculator, and as I answered each question the next one got more difficult and penetrating, until I was really straining every faculty to answer correspondingly. He did not introduce himself, but I found out later that day that it was John von Neumann.

Naturally the incident remains very clear in my mind. I recall that he did *not* leave me saying "Use the tool well for the social benefit of mankind", or anything else in this vein. There were very few men in the computer world or business then that were considering social ramifications of this sort. Ed Berkeley was, and remains, an exception. To most of us it was just a time of freeing the mind to do far beyond our previous capabilities, at a fantastic rate. We were lured and beguiled; the newness and vast potential drew us, with so much waiting to be done. We took little time for speculation about the eventual effect of computers upon our society, or the extent and scope of the usage to come.

This insensitivity may also have been due to the fact that the first work was almost exclusively concerned with processes upon numbers. Even when I started in 1949, ten years after the first program-controlled calculator was designed, the manipulation of symbols was considered by only a few, and did not even become recognized as a proper computer function until 1956.

I intend to show that there has been a significant change in the type of applications made possible by computers, a change we are ill-prepared for. Any tool that provides leverage or amplification can be misused. I shall give some case histories to demonstrate some ways of misuse and why they continue to be effective. Then I shall outline some measures to reverse the trend and stop much of the misusage.

A CLASSIFICATION OF COMPUTER APPLICATIONS

For purposes of this talk, I propose a simple and perhaps novel classification of computer usage:

- *Applications that do not lead to decisions affecting humans directly.*

Examples come largely from the field of numerical computation, the earliest category of usage. Computational results that might tend to prove or lead to a theory; calculations for spaceship or missile design (they don't have to be built or launched); programs for playing games, or associating payoffs with strategies, etc. We may term such computation *advisory*.

- *Applications with computational results that lead to decisions by humans.*

Some of these can get very close to integration into human affairs. For example, someone may be denied credit or refused an employment opportunity. It has turned out, in much practice, that the human decision to be taken may be perfunctory or mindless. Nevertheless there is recourse, no matter how time-consuming and difficult it may be, and regardless of what body of law may need to be enacted to protect people in such circumstances.

- *Applications where the computer has been previously programmed to take a decision and action, and will in fact act unless countermanded in time.*

Examples are online patient monitoring, control of nuclear power plants, air traffic control and collision avoidance systems, automatic transportation systems (i. e., BART, in San Francisco), and automobile braking and antiskid systems.

* A slightly abridged version of a presentation to the NordData Conference in Copenhagen, Denmark, 1973 August 15-17. It was not submitted in time to be included in the published proceedings, and is presented here to rectify that omission.

The hardware developments of about the last three years, leading to microprocessors on chips, portend a tremendous increase in the third class of application. And this is why we must be on guard as to the propriety and systems aspects of such applications. Applied to digital wristwatches, this does not seem critical. Applied to automobiles, such applications could be extremely critical. One is reminded of power-steering, a boon when it operates, perhaps, but a definite danger when power fails or is turned off.

A pair of questions indicates a possible dilemma:

Q: Does technology exist to integrate computer components very closely into human affairs?

A: Yes. For an example, see the 1974 US automobiles, which will not operate unless seat belts are fastened.

Q: Are system design and good practice manuals available for such a level of technology, and/or is suitable indoctrination and education available in our educational institutions?

A: Emphatically NO! And this is frightening enough to suggest a moratorium on such developments until we understand the tool better.

Consider the announcement of an experimental device which requires matching a certain procedure before you can start your automobile. The intent, and certainly an obvious usage, is to preclude drunken drivers from operating vehicles. But suppose that you are extremely shaken because your wife has just been killed, and your child needs to be taken to the hospital. Could you start the car then?

Or consider the case of online patient-monitoring reported in Datamation magazine of 1972 October. The programming was correct but the computer was not 100% reliable. This, as we know, is taken care of by having a customer engineer to fix it. But nobody remembered to find out whether the customer engineers would always be available over the weekend, and speedily. As reported, a patient died because confusion in the human system caused the computer to remain inoperable.

Certainly the US space effort has gathered ample experience in the matter of letting computers decide, when they are capable of it, and of overriding them sensibly when it is shown that they were programmed incorrectly or without consideration for all eventualities and malfunctions. We see many spin-offs from the space effort with respect to products, but very little in methodology which could be so very applicable to computer usage.

A CAVEAT

I now wish to make it quite clear that I like computers. I believe that they are presently more beneficial than harmful to society, and that this ratio can be increased if we take careful consideration and plan for their best and proper usage. If I were fatalistic, I should feel that they have arrived just in time to save us from our enemies, who are ourselves. In 25 years as a programmer I have never faced a day of working with computers without pleasant anticipation.

I also like a fire in the fireplace, but not arson. Both fire and computers are tools accessible to all of society in some form, and society uses such basic tools in many ways, some deemed good and some bad.

Fire was an early tool, useful for hollowing out logs to make vessels, to make transformations in food, and to heat enclosed air. It was also used to burn vegetation and trees, sometimes accidentally (which was thought bad) and sometimes deliberately, to clear for planting (which was thought good).

A major difficulty in analyzing the contribution of a tool is the inability to categorize, in an absolute way, its uses as being good or bad. This is not philosophical, but only to remind us that we make these judgments of good and bad in the narrow context of our mores and morals, which are in turn conditioned by our accumulated knowledge and analysis of the workings of our world. We have learned a little more of those workings lately, not because we sought the knowledge so much as because it has been made painfully evident to us that there is more or less coupling between all the elements of our world.

I quote from an interview with Dr. Carl Hammer of Univac, regarding a conversation with V. A. Trapeznikov, acting Co-Chairman of the United States and Russian Joint Commission on Scientific and Technical Cooperation: "He told me, as he told President Nixon one day earlier, that 'we all must cease to make wrong decisions on a large scale because mankind can no longer afford it. Mankind's resources are highly limited, and we can no longer squander them' ... we must develop not only national but international models for improving our decisionmaking processes. Decisions which at this time are made on a political or emotional base, neither way will produce optimal results".

So I touch on some bad uses of computers only to illustrate the problems to overcome by legislation, education, and professionalism to make computers serve us better.

THE POWER OF THE COMPUTER

Carl Hammer says "We have already built into our society a mind-amplifying factor of 2000 to one. Behind every man, woman, and child in this country (the US), there stands the power of 2000 human beings. The responsibility of any data processing manager of today, of the computer scientists ... is so enormous that even I cannot envision it. It is the greatest challenge that has ever faced mankind".

Power it is, in elemental form. IBM's recent advertising stresses "think of the computer as energy". Theoretically, the computer is vast power at the service of people, to be used as the imagination of the people leads it, subject of course to limiting legislation. But let us not be lulled by any advertising into thinking that the energy is just like electricity. Computer power is work power, but it is also knowledge power, of the kind that has been used throughout history for aggrandisement as well as the good of the people. In a time when technology stands at bay, it will be well to consider the dangers of computer misuse in prejudicing the population against a valuable tool, and of misuse by corrupt or ignorant officials.

There are no known instances of computers voluntarily stopping normal work to perform illegal acts without direction by humans. Consider the science fiction capability of walking through matter; we have seen it in the cinema, usually used to get into the bank vault or perform some other evil deed. But in the cinema it was a power accorded only to a few, being so technically difficult. Computer power is available widely, and we must not be surprised that some people should turn it to their own ends in disregard of the general benefit of society.

Consider the case of Jerry Schneider. There is no problem with mentioning his activities. He sent an abstract of a paper that he wanted to present at the 1973 National Computer Conference, telling about how he tapped into a computerized ordering system and stole something like $1 million of telephone equipment by having it delivered to a telephone company van bought at auction. The computer program, not knowing how to bill and get payment, ignored it as being within loss limits. When turned in by an employee, Schneider spent two months in jail and was back in business as a computer security consultant!

There is no question but that computer power may be abused by individuals. It may be so used by larger entities, such as corporations, to fool or defraud. It may be so used even by governments, however wittingly.

Dr. Henry Bruck of M.I.T. spoke of this at ACM 70, in a talk entitled "To Redress the Balance". His thesis was that computers, because of cost and training investment, were more likely to become the tools of government and big business than the general public. Countering the argument that minicomputers, microcomputers, and hand calculators are available to individuals at low cost, he said that it was a fallacy to assume that this meant that computer power was available to the general public for this reason. Shovels for a penny are useless unless one knows how to dig, and has arms. It is the usage skill that is important.

He thought that modifying education so that imparting basic computer skills (and problem-solving techniques) would be given as much emphasis as learning one's own language would be unnecessary overspecialization. Nor would the answer be to reduce usage by government and business, for we have ever more need for decisionmaking information that is more likely to be accurate and complete, taking into account the overall advantage to people. However, he saw no reason why computer services could not be provided to the citizenry through public institutions.

I agree. There are many opportunities for computer services to be provided by municipalities and/or private ventures. One can imagine data banks that could serve as advisories for human action and choices. There is an experiment in Los Angeles where the computer serves as a general counselor for a multitude of services. Consumerism could be served in a great many ways -- product safety and efficiency, comparative shopping, financing aid for major purchases, reminders for preventive maintenance, etc.

Thus there are many ways to redress the balance by making computer power really available to everyone in a direct manner and without having to learn how to program. There is a need, however, for a certain amount of "computer literacy" in order to feel comfortable with such usage.

A PANORAMA OF EVILS ARISING FROM THE "AUTHORITY" OF THE COMPUTER

As a tool, the computer has become commonplace with a rapidity exceeded by no other, even the automobile. This has caused some disallocation and unease, which the practitioners have not been able to avoid. Most major tools, when introduced, have had their custodians, and then their guilds or professions that, from gradual experience, added to the body of law and practice those safeguards for usage that appeared necessary from gradual occurrences of misuse.

This did not occur with computers, and perhaps we did not even use the time that was available to us, so caught up were we with the mystique and power. Certainly we did not familiarize people generally with computers; instead, they were publicized as "giant brains", and the mystique grew into *authoritativeness.* One of the main problems with authority is that it can be blamed. Surely you all know many examples, but I shall add a few to your knowledge:

The Authority of the Computer as a Scapegoat and Excuse

Perhaps it is a worldwide phenomenon. One calls the store that has made a mistake in the bill, the bank that has not returned the cancelled checks, the association that has blacklisted your credit -- and the voice replies "I'm sorry, sir, but we have a computer now ...".

- The Allen Piano and Organ Company of Phoenix advertised by radio that its computer had made a mistake in ordering inventory; they were now overstocked and were therefore holding a sale. I wrote the company a letter, on behalf of the Association for Computing Machinery, offering to fix the computer or program so it would not make such a mistake anymore, on condition that *if it developed that a human was at fault,* and not a computer, they would so acknowledge this in their subsequent broadcast advertising. Datamation magazine followed the story -- it turned out that the Allen Piano and Organ Company *did not have* a computer, nor did they use any computer facilities.

  Note the convictions of the advertisers that a computer would give authority to their spurious claim of overstocking.
- One Mr. D'Unger, not of the computer community, wrote to several companies maintaining mailing lists containing his name, either for billing or solicitation, asking them to please spell it correctly. Not DUNGER, and not D UNGER, and not Dunger (for those with lower case capability). He received several replies, all saying that it was unfortunately impossible with their computer equipment. Learning of this from his letter to Computerworld, I called several of these data processing departments, to find in each case that the print chain was in fact an IBM chain that did have the apostrophe on it, but that they had not bothered to use it! It seems to me that a man's name is a dear possession, and not one to be treated cavalierly under cloak of computer authority.

- I once visited a home where four elderly women were playing bridge. When they found out that I was in the computer profession there was a chorus of horror stories. Then one brought out a letter from her bank, with a handwritten apology from the teller for the shortcomings of the computer. I was on the spot. To save face I called the bank vice president to see what could be done. They didn't have a computer either!

The Authority of the Computer as an Accomplice

The computer is a convenient means of implicitly or explicitly covering activities that run from illegal to self-serving, intentional or unintentional:

- The notorious Equity Funding scandal will certainly become a classic, even though the exact ways that it was perpetrated will take some time to discover. We know, even now, that it was a pyramiding operation, and that computers were used to give authority and extra layers of protection from discovery. Many corrective actions could arise from the case, such as new emphasis on EDP auditing. It appears that perhaps as many as 200 people were involved in collusion.
- The University of Michigan has a research service that projects the effect of various decisions and actions upon the GNP (Gross National Product) and its growth, with respect to the State of Michigan. The results could easily be given in regular typewritten (or typeset) reports, but they are not! A computer printout accompanies the report to give it *authority*. The set of results that I saw seemed both spurious and misleading, and perhaps others could have detected this had they been as unawed by computers as I am.

Perhaps there may come a day when the US augments its Environmental Protection Agency with a Human Protection Agency. Then, taking the lead from the present requirement to make notification on cigarette packages that "cigarette smoking is dangerous to your health", it could order that each computer-printed page be preceded by:

> "WARNING -- these answers were produced by a computer, and could be hazardous to your health!"

Of course I am being facetious about the overkill which does not seem to diminish smoking anyway, but I do recall a case when:

- Univac was attempting to sell the US Army an 1107. The benchmark process included a compilation and run of a certain FORTRAN program. The 1107 compiler printed a diagnostic indicating an entry into the middle of a DO loop. The General in charge indicated that this was impossible, as they had been running that same program for three years, and asked a programmer to examine the situation. He returned in a short while and said "Sorry, General. Three years of wrong answers".

The Computer as a Sewage System

A well-known truism of computer usage is "Garbage In, Garbage Out". But what happens when we put perfectly valid data in? Can we get it out again? Can someone else do so? If it does come out, is it legible?

We still live in the computer era where 90% or more of the data depends entirely upon the associated program to be turned into information. The data description of COBOL is a start to improve this, but why should the description be appended to the program rather than to the data itself?

Do you need a program to read a book in the library? At ACM 70, Dr. John Richardson of the US Dept. of Commerce said "Information Conserves Resources Through Better Decisions", but some of the valuable data that we need to make those better decisions is not, in fact, retrievable, exchangeable, or digestible. It cannot be turned into information. Indeed, one of the major findings in the various studies of data banks is that the sum of many small data banks is *not* a large data bank, at least not yet, contrary to the fears of many. And yet there are good as well as harmful reasons to consolidate data. If, for example, the US Congress had two reliable pieces of information -- 1) how much it was costing to not grow cotton, and 2) how much it was costing to promote the use of cotton -- the very juxtaposition might give rise to some better decisions. The organizing power of the computer depends completely upon legibility and interchangeability of data.

A classic example is the situation that arose when the EPA (US Environmental Protection Agency) was formed by consolidation of several diverse groups, each with its own information systems. When they tried to consolidate the data as well, surely one of the main reasons for the coalescence, they found out that data could not only not be exchanged between various components, but not even between the several computer systems in the subdivisions of the agencies! And, of course, the air masses travel over many states, each with its own computers and monitoring systems, and each incapable of making decisions that would optimize for the entire country, much less the world -- if that possibility were permitted.

Examples of the illegibility of computer data without the program are countless. Dr. Fred Whipple, the astronomer, once mentioned that only 1% of his information from satellite and probe vehicles was being processed. I corrected him slightly to say "data", and he reiterated "information". I asked if anyone could process the tapes if the program were destroyed? He admitted that it would be impossible. "Data" it was.

The Las Vegas city police and county sheriff's department recently consolidated to form a "Metropolitan" Force. It will be many years before their computerized data files can also be consolidated to be of efficient use.

Of course this particular manifestation of swallowing of data and not giving it back to anyone else could be largely solved by using labels and data description on data media, so that the data can be self-descriptive. Congressman Brooks of the US has called for a "declaration of independence for data". Another way of not being able to get data out is to have the computer system fail.

PROTECTIVE MEASURES AGAINST MISUSE

Legal Measures

There are many examples of laws for involuntary personal protection. Construction workers must wear hard hats; cyclists must wear leather and helmets. These are occupational protections enforced upon the individual presumably because he represents an investment by society.

The US Government has imposed certain requirements upon the manufacture of automobiles, i.e., to be constructed so as to withstand collision of X km/h without sustaining more than $Y in damage, or the like. The Government has stated that requiring such action is within its right to protect the safety of its citizens. It seems certain that the computer has a direct effect upon not only the safety of our citizens, but also upon other rights. It might thus be reasonable to demand that software and hardware should also be built to certain standards to protect these rights.

We are certainly going to have to build computer systems with facilities for confidentiality and security. Although there is no law on this, there is little doubt that US Government users will be demanding these features.

I shall not mention more, because this area is covered comprehensively in "Legal Aspects of Computerized Information Systems", a US Govt. Report that the Honeywell Computer Journal was privileged to present in **7**, No. 1.

Voluntary Measures

Dr. Harold Sackman, Chairman of the AFIPS Committee on Social Implications of Computers, called recently for a "computer user society of America". This was to be a computer citizen's group active in social reliability, for the reason that the computer community really gets to see the problems first, and has the responsibility to expose the problems to those who can treat them. The ACM owes much to be Scandinavian creation of the ombudsman; its ombudsman program has solved many problems of bad computer usage.

There is a growing class of auditors versed in data processing, but we may have to take drastic measures to aid them. There are many current efforts for better methods for software construction. One hopes that increased simplicity will lead to more direct legibility and auditability of computer programs. Most programs are documented poorly, and I see only one hope of solution -- the program specifications, narrative documentation, and operating instructions must be integral! Using a block-structured language is vital to constructing auditable software. It also enables programmed devices to detect tampering with the running programs.

Handbooks of design and practice are required to be available before computing can truly be a profession. Many computer societies are in various stages of using codes of practice and certification of practitioners. One hopes that they will not stop short of general certification but will also adopt application-oriented certification in joint action with the professions of those applications.

We will have to equip our systems with performance measuring and evaluation capabilities. Wastage of resources has been considered an evil in other fields before this.

CONCLUSION

As custodians of the power source we have many responsibilities. When I planned the ACM 70 Conference it was as a model for a National Computer Year, which could possibly be followed by an International Computer Year. A possible list of goals for such a Year could be:

- To consciously put computers in service to international goals, to increase public understanding of the role and potential of computer usage, and to accent the role of the computer as servant by more humanization of applications and usage.
- To develop strategies for the best future use of computer systems (technological, social, educational, political, and legislative).
- To conserve, and maximize utility of, those existing and future intellectual resources known as data and programs, by finding how to utilize them on multiple equipment and in multiple applications.
- To aid government, business, and private decisionmaking by opening up new and more complete data for those decisions, and to facilitate the making of those decisions by reducing the information volume required (as opposed to data volume).
- To plan a closed cycle for redistributing work assignments between people and computers, for re-education prior to change of assignment, so that people can best fulfill their potential.
- To ensure that public safety and welfare are considered adequately when computers are integrated directly into human activity.
- To set up new and broad interdisciplinary paths for exchange of information among hitherto segregated organizations, and to foster their maximum involvement on an international scale.
- To plan the most economical and effective interaction between computing systems and other systems such as communications.

It is not too soon for a comprehensive examination of the interaction between computers and our society. Two papers from the 1973 National Computer Conference support this view -- "The Social Implications of the Use of Computers Across National Boundaries" and "A New NSF Thrust -- Computer Impact on Society". NSF is the National Science Foundation of the US, and this paper demonstrates concern on at least a national level.

I have the feeling that it won't be so difficult for computers and society to adjust to each other if we really put our minds to making it happen. In 1970 an Assistant Postmaster General of the US observed that a third of all first class mail is machine-addressed, but only 6% arrives on the post office docks in Zipcode order. He asked why the computerized address files could not be ordered by Zipcode as well as any other way? So I asked many data processing departments the same question. The answer was that they had not thought about it, and would just as soon do it that way.

It's as simple as that. ■

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cc: O.Sturen

HONEYWELL INFORMATION SYSTEMS INC ADVANCED SYSTEMS & TECHNOLOGY
DEER VALLEY PARK P.O. BOX 6000 PHOENIX ARIZONA 85005 TELEPHONE 602 993 6000

1133 AVENUE OF THE AMERICAS
NEW YORK, N.Y. 10036
(212) 265-6300

acm Association for Computing Machinery

JOSEPH F. CUNNINGHAM, *Executive Director*

January 29, 1974

Mr. Robert W. Bemer
B-106, Honeywell Info. Systems Inc.
Advanced Systems & Technology
Deer Valley Park, P.O. Box 6000
Phoenix, Arizona 85005

Dear Bob,

Attached is a copy of the letter to the Director of Administration of the IEEE, who provides computer support for the ACM. I appreciate your bringing this to our attention and we will pursue it in spite of your final paragraph.

Just received copies #3 and #4, Volume 7, and it looks like the high quality of your journal is being maintained. Congratulations.

Sincerely,

Joe

Joseph F. Cunningham

JFC/clf

1974 FEB 4

1133 AVENUE OF THE AMERICAS
NEW YORK, N.Y. 10036
(212) 265-6300

ACM Association for Computing Machinery

January 29, 1974

COPY

Mr. Bill Keyes
IEEE
345 East 47th Street
New York, New York 10017

Dear Bill,

Attached is a copy of a renewal notice received in this office on January 24 from one of our members. Note that he is objecting to the computer based information system not conforming with the national standard which is year, month and day. Also attached is a copy of the national standard.

Obviously, I am in favor of using it for ACM's system if I have the flexibility so to do within the service you provide. I suggest this is a matter you may wish to review from the standpoint of the IEEE policy and I will include it on the agenda for our February 14 meeting.

Sincerely,

Joseph F. Cunningham

JFC/clf
cc: B. Bemer
J. Fraum

THE INSTITUTE OF
ELECTRICAL AND
ELECTRONICS
ENGINEERS, INC.

345 EAST 47TH STREET, NEW YORK, N.Y. 10017 AREA CODE 212 752-6800

FEB 12 1974

February 8, 1974

Mr. Joseph F. Cunningham
The Association for Computing
Machinery
1133 Avenue of the Americas
New York, New York 10036

Dear Mr. Cunningham:

With reference to your letter of January 29th, addressed to Mr. Bill Keyes, Mr. R. W. Bemer had complained that the dates on his Renewal Notice did not conform to the international standard. After reviewing the National Standard, enclosed in your letter, I have come to the following conclusions:

1. The scope of the standard is limited to the interchange of data among data systems. The standard was <u>not</u> designed for usage by humans as input or output from data systems.

2. The standard would require a date of 11/30/74 to be written as 741130 which could lead to confusion.

3. Most of your members have their bills paid by their companies. Accounts receivable clerks are probably more apt to be familiar with 11/30/74 as compared to 741130.

4. In the past, we, at the IEEE, were using a year month date format which caused much more than one complaint.

If you desire to make this change in your bills, please inform us of the exact format you wish.

Sincerely yours,

Walt Last

Walter Last
Programmer, EDP Systems

WL:mm
cc: W. J. Keyes
J. Fraum

1133 AVENUE OF THE AMERICAS
NEW YORK, N.Y. 10036
(212) 265-6300

acm Association for Computing Machinery

JOSEPH F. CUNNINGHAM, *Executive Director*

February 13, 1974

Mr. Robert W. Bemer
B-106, Honeywell Info. Systems Inc.
Advanced Systems & Technology
Deer Valley Park, P.O. Box 6000
Phoenix, Arizona 85005

Dear Bob,

Please see the attached reply. We are going to modify our renewal notices, membership cards, etc. and I will not lose sight of this in the revision.

What was it Max Planck said, something like "a bold new idea does not achieve acceptance on its brilliance; the old generation must pass away and a new generation born to and accepting the idea gives it life" -- or something like that.

Sincerely,

Joe

Joseph F. Cunningham

JFC/clf

1974 March 01

Mr. Joseph F. Cunningham
Association for Computing Machinery
1133 Avenue of the Americas
New York, NY 10036

Dear Joe:

My note said that your date method did not correspond to the "international" standard 2014, which is for "Writing of Calendar Dates in All-Numeric Form". I did not suggest at all to override this by American Standard X3.30, which is admittedly only for internal computer representation for information interchange.

I wrote the note on the assumption that ACM was an international organization, and would presume to serve the characteristics of an international membership. If you were to visit your ACM constituency in Sweden, for example, the hotel reservation form you would fill out would be preprinted for the year-month-date order.

So that you can see the inapplicability of Mr. Last's conclusions, I am enclosing a copy of the Honeywell Computer Journal giving this information. Note that the international form uses hyphens for spacers rather than the stroke. Moreover, although we do not have a 74th month or a 74th day, the ISO recommends using the full 4-digit form for the year. This will certainly bring a flash of comprehension to most ACM members, unless they are of the most moronic caliber, don't you think?

Cordially,

R. W. Bemer

n

Encl. 5 #4

1975-79

1975 February 13   2569   C61

JR Searles

RW Bemer

REPRESENTATION OF THE DATE

American National Standard X3.30 specifies that the numeric representation of the date shall be in year-month-day order, separated by hyphens. The International Standard 2014 does the same, the only difference being that the ISO prefers the 4-digit year to be better understood by humans, not computers. Thus today is:

ANSI 75-02-13   ISO 1975-02-13

HIS has adopted this practice in particular for fiscal weeks, as prescribed in ISO 2015, companion to 2014.

The purpose of this memo is to ask whether now is not the time to establish the general practice throughout HIS. Affected would be checks, memos, business data processing, scheduling, timesharing programs, etc.

Both the standard and the old forms are now used, and the duality is bothering others besides myself. Further, the practice is gaining outside the company. Yesterday, I received a check from Arizona Public Service, preprinted for the year-month-day sequence.

One of the reasons for adoption of this standard was to make computer processing of date material simpler, as well as more logical. Thus a speedup of those portions of our business programs may be expected, and may well pay for the conversion.

RW Bemer

pak

1975 February 13 2569 C61

JR Searles

RW Bemer

REPRESENTATION OF THE DATE

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One of the reasons for adoption of this standard was to make computer processing of date material simpler, as well as more logical. Thus a speedup of those portions of our business programs may be expected, and may well pay for the conversion.

RW Bemer

pak

MANAGEMENT NEWSLETTER

HONEYWELL INFORMATION SYSTEMS LARGE INFORMATION SYSTEMS DIVISION

Date: 1977 December 21 77-41

To: LISD Management

From: D. J. West

Subject: DATE STANDARDIZATION

From time to time we get questions about the "right way" to write the date. In the past it has mattered little and so individual preference has prevailed. More and more, however, documents are being automated and being exchanged internationally.

In the interests of consistency, it is recommended that the sequence of year, month, and day of month be used throughout LISD in preference to other styles. For example:

77-12-04
77/12/04
77 December 04
1977 December 04

Please communicate this preference to your people.

Del

D. J. West

/lin

2587

MANAGEMENT NEWSLETTER

HONEYWELL INFORMATION SYSTEMS LARGE INFORMATION SYSTEMS DIVISION

Date: August 8, 1978 78-48

To: LISD Management

From: D. J. West

Subject: DATE STANDARDIZATION -- CORRESPONDENCE ONLY

Inconsistencies continue to appear in our style of writing dates on correspondence.

In the interest of consistency, we should use the common sequence of month, day of month and year on all LISD correspondence.

Please communicate this approach to your people.

Del

D. J. West

ECMA

EUROPEAN COMPUTER MANUFACTURERS ASSOCIATION

1204 GENEVA RUE DU RHÔNE 114
CABLE ADDRESS: EUCOMANUFAS GENÈVE
PHONE: (22) 35 36 34
TELEX: 22288

Mr. R.W. BEMER
Honeywell Inc.
Deer Valley Park
Box 6000
PHOENIX, Arizona 85029
U S A

OUR REF. He/mb YOUR REF. DATE Dec. 12, 1978

Dear Bob,

Thank you for your sending of Dec. 5, 1978. A very interesting paper as usual. Enclosed I am sending you copies of pages 12, 13 with corrections to the orthography of French and German.

I wish you and your family all the best for the coming year.

Sincerely yours,

D. Hekimi
Secretary General

Olle Sturen, *Secretary-General of ISO*

our date
1978-12-08

our reference
ISO/EDP

your date

your reference

Mr. R.W. Bemer
Honeywell Information Systems Inc.
Deer Valley Park
P.O. Box 6 000
Phoenix / Arizona 85005
U.S.A.

Dear Bob,

It was very nice to hear from you again.

I appreciated very much your kindness in sending me a copy of the article on "Time and the Computer" to be printed in Interface Age Magazine next year.

I have noted with great satisfaction that in the article you promote the standards ISO has published, but I am more impressed in the additions you have made.

The article needs more careful study. As yet, however, I have had no time to do so, but shall certainly do it, as you have kindly allowed me to use it in whatever manner I would like to.

With my very best wishes for Christmas and the New Year,

Yours sincerely,

Olle

Olle Sturen

OS/ak

MB

Honeywell

1979 January 25

Olle Sturen
Secretary General
International Standards Organization
1 rue de Varembe
1211 Geneva 20,
SWITZERLAND

Dear Olle:

I'm pleased that you found my article about time to have some new values. Indeed, the discovery (more or less) of the Fiscal Constant led me to experiment with perpetual calendars. The results are enclosed. In several copies, in case you wish to circulate to your associates. You may have more if you need them.

It occurred to me that ISO might wish to print this as one page of the standard ISO 2015. Note on the small sheets that one type is plain vanilla (an Americanism!), and the other is screened for 1979 and ensuing years. Either could be used.

If you do, the calendars could be typeset. Or I could send you our mats. Perhaps I should have added the 3-letter French equivalents for the months. In any case, there is no copyright, and ISO is free to use whatever it might wish of this idea.

Bob

RW Bemer

pak

cc: Harry White
Chairman TC97/SC8

1982

Fiscal Year 1

FW	M	T	W	T	F	S	S	
1	4	5	6	7	8	9	10	
2	11	12	13	14	15	16	17	JAN
3	18	19	20	21	22	23	24	
4	25	26	27	28	29	30	31	
5	1	2	3	4	5	6	7	
6	8	9	10	11	12	13	14	FEB
7	15	16	17	18	19	20	21	
8	22	23	24	25	26	27	28	
9 8							29	
10 9	1	2	3	4	5	6	7	
11 10	8	9	10	11	12	13	14	MAR
12 11	15	16	17	18	19	20	21	
13 12	22	23	24	25	26	27	28	
14 13	29	30	31	1	2	3	4	
15 14	5	6	7	8	9	10	11	APR
16 15	12	13	14	15	16	17	18	
17 16	19	20	21	22	23	24	25	
18 17	26	27	28	29	30	1	2	
19 18	3	4	5	6	7	8	9	MAY
20 19	10	11	12	13	14	15	16	
21 20	17	18	19	20	21	22	23	
22 21	24	25	26	27	28	29	30	
23 22	31	1	2	3	4	5	6	
24 23	7	8	9	10	11	12	13	JUN
25 24	14	15	16	17	18	19	20	
26 25	21	22	23	24	25	26	27	
27 26	28	29	30	1	2	3	4	
28 27	5	6	7	8	9	10	11	JUL
29 28	12	13	14	15	16	17	18	
30 29	19	20	21	22	23	24	25	
31 30	26	27	28	29	30	31	1	
32 31	2	3	4	5	6	7	8	AUG
33 32	9	10	11	12	13	14	15	
34 33	16	17	18	19	20	21	22	
35 34	23	24	25	26	27	28	29	
36 35	30	31	1	2	3	4	5	
37 36	6	7	8	9	10	11	12	SEP
38 37	13	14	15	16	17	18	19	
39 38	20	21	22	23	24	25	26	
40 39	27	28	29	30	1	2	3	
41 40	4	5	6	7	8	9	10	OCT
42 41	11	12	13	14	15	16	17	
43 42	18	19	20	21	22	23	24	
44 43	25	26	27	28	29	30	31	
45 44	1	2	3	4	5	6	7	
46 45	8	9	10	11	12	13	14	NOV
47 46	15	16	17	18	19	20	21	
48 47	22	23	24	25	26	27	28	
49 48	29	30	1	2	3	4	5	
50 49	6	7	8	9	10	11	12	DEC
51 50	13	14	15	16	17	18	19	
52 51	20	21	22	23	24	25	26	
53 52	27	28	29	30	31	1	2	

1983

Fiscal Year 2

FW	M	T	W	T	F	S	S	
1	3	4	5	6	7	8	9	
2	10	11	12	13	14	15	16	JAN
3	17	18	19	20	21	22	23	
4	24	25	26	27	28	29	30	
5	31	1	2	3	4	5	6	
6	7	8	9	10	11	12	13	FEB
7	14	15	16	17	18	19	20	
8	21	22	23	24	25	26	27	
9	28							
9	29	1	2	3	4	5	6	
10	7	8	9	10	11	12	13	MAR
11	14	15	16	17	18	19	20	
12	21	22	23	24	25	26	27	
13	28	29	30	31	1	2	3	
14	4	5	6	7	8	9	10	APR
15	11	12	13	14	15	16	17	
16	18	19	20	21	22	23	24	
17	25	26	27	28	29	30	1	
18	2	3	4	5	6	7	8	MAY
19	9	10	11	12	13	14	15	
20	16	17	18	19	20	21	22	
21	23	24	25	26	27	28	29	
22	30	31	1	2	3	4	5	
23	6	7	8	9	10	11	12	JUN
24	13	14	15	16	17	18	19	
25	20	21	22	23	24	25	26	
26	27	28	29	30	1	2	3	
27	4	5	6	7	8	9	10	JUL
28	11	12	13	14	15	16	17	
29	18	19	20	21	22	23	24	
30	25	26	27	28	29	30	31	
31	1	2	3	4	5	6	7	
32	8	9	10	11	12	13	14	AUG
33	15	16	17	18	19	20	21	
34	22	23	24	25	26	27	28	
35	29	30	31	1	2	3	4	
36	5	6	7	8	9	10	11	SEP
37	12	13	14	15	16	17	18	
38	19	20	21	22	23	24	25	
39	26	27	28	29	30	1	2	
40	3	4	5	6	7	8	9	OCT
41	10	11	12	13	14	15	16	
42	17	18	19	20	21	22	23	
43	24	25	26	27	28	29	30	
44	31	1	2	3	4	5	6	
45	7	8	9	10	11	12	13	NOV
46	14	15	16	17	18	19	20	
47	21	22	23	24	25	26	27	
48	28	29	30	1	2	3	4	
49	5	6	7	8	9	10	11	DEC
50	12	13	14	15	16	17	18	
51	19	20	21	22	23	24	25	
52	26	27	28	29	30	31	1	

Fiscal Year 3

FW	M	T	W	T	F	S	S	
1	2	3	4	5	6	7	8	
2	9	10	11	12	13	14	15	JAN
3	16	17	18	19	20	21	22	
4	23	24	25	26	27	28	29	
5	30	31	1	2	3	4	5	
6	6	7	8	9	10	11	12	FEB
7	13	14	15	16	17	18	19	
8	20	21	22	23	24	25	26	
9	27	28						
9		29	1	2	3	4	5	
10	6	7	8	9	10	11	12	MAR
11	13	14	15	16	17	18	19	
12	20	21	22	23	24	25	26	
13	27	28	29	30	31	1	2	
14	3	4	5	6	7	8	9	APR
15	10	11	12	13	14	15	16	
16	17	18	19	20	21	22	23	
17	24	25	26	27	28	29	30	
18	1	2	3	4	5	6	7	
19	8	9	10	11	12	13	14	MAY
20	15	16	17	18	19	20	21	
21	22	23	24	25	26	27	28	
22	29	30	31	1	2	3	4	
23	5	6	7	8	9	10	11	JUN
24	12	13	14	15	16	17	18	
25	19	20	21	22	23	24	25	
26	26	27	28	29	30	1	2	
27	3	4	5	6	7	8	9	JUL
28	10	11	12	13	14	15	16	
29	17	18	19	20	21	22	23	
30	24	25	26	27	28	29	30	
31	31	1	2	3	4	5	6	
32	7	8	9	10	11	12	13	AUG
33	14	15	16	17	18	19	20	
34	21	22	23	24	25	26	27	
35	28	29	30	31	1	2	3	
36	4	5	6	7	8	9	10	SEP
37	11	12	13	14	15	16	17	
38	18	19	20	21	22	23	24	
39	25	26	27	28	29	30	1	
40	2	3	4	5	6	7	8	OCT
41	9	10	11	12	13	14	15	
42	16	17	18	19	20	21	22	
43	23	24	25	26	27	28	29	
44	30	31	1	2	3	4	5	
45	6	7	8	9	10	11	12	NOV
46	13	14	15	16	17	18	19	
47	20	21	22	23	24	25	26	
48	27	28	29	30	1	2	3	
49	4	5	6	7	8	9	10	DEC
50	11	12	13	14	15	16	17	
51	18	19	20	21	22	23	24	
52	25	26	27	28	29	30	31	

1979

Fiscal Year 4

FW	M	T	W	T	F	S	S	
1	1	2	3	4	5	6	7	
2	8	9	10	11	12	13	14	JAN
3	15	16	17	18	19	20	21	
4	22	23	24	25	26	27	28	
5	29	30	31	1	2	3	4	
6	5	6	7	8	9	10	11	FEB
7	12	13	14	15	16	17	18	
8	19	20	21	22	23	24	25	
9	26	27	28					
9			29	1	2	3	4	
10	5	6	7	8	9	10	11	MAR
11	12	13	14	15	16	17	18	
12	19	20	21	22	23	24	25	
13	26	27	28	29	30	31	1	
14	2	3	4	5	6	7	8	APR
15	9	10	11	12	13	14	15	
16	16	17	18	19	20	21	22	
17	23	24	25	26	27	28	29	
18	30	1	2	3	4	5	6	
19	7	8	9	10	11	12	13	MAY
20	14	15	16	17	18	19	20	
21	21	22	23	24	25	26	27	
22	28	29	30	31	1	2	3	
23	4	5	6	7	8	9	10	JUN
24	11	12	13	14	15	16	17	
25	18	19	20	21	22	23	24	
26	25	26	27	28	29	30	1	
27	2	3	4	5	6	7	8	JUL
28	9	10	11	12	13	14	15	
29	16	17	18	19	20	21	22	
30	23	24	25	26	27	28	29	
31	30	31	1	2	3	4	5	
32	6	7	8	9	10	11	12	AUG
33	13	14	15	16	17	18	19	
34	20	21	22	23	24	25	26	
35	27	28	29	30	31	1	2	
36	3	4	5	6	7	8	9	SEP
37	10	11	12	13	14	15	16	
38	17	18	19	20	21	22	23	
39	24	25	26	27	28	29	30	
40	1	2	3	4	5	6	7	
41	8	9	10	11	12	13	14	OCT
42	15	16	17	18	19	20	21	
43	22	23	24	25	26	27	28	
44	29	30	31	1	2	3	4	
45	5	6	7	8	9	10	11	NOV
46	12	13	14	15	16	17	18	
47	19	20	21	22	23	24	25	
48	26	27	28	29	30	1	2	
49	3	4	5	6	7	8	9	DEC
50	10	11	12	13	14	15	16	
51	17	18	19	20	21	22	23	
52	24	25	26	27	28	29	30	

1980

Fiscal Year 5

FW	M	T	W	T	F	S	S	
1	31	1	2	3	4	5	6	
2	7	8	9	10	11	12	13	JAN
3	14	15	16	17	18	19	20	
4	21	22	23	24	25	26	27	
5	28	29	30	31	1	2	3	
6	4	5	6	7	8	9	10	FEB
7	11	12	13	14	15	16	17	
8	18	19	20	21	22	23	24	
9	25	26	27	28				
9				29	1	2	3	
10	4	5	6	7	8	9	10	MAR
11	11	12	13	14	15	16	17	
12	18	19	20	21	22	23	24	
13	25	26	27	28	29	30	31	
14	1	2	3	4	5	6	7	
15	8	9	10	11	12	13	14	APR
16	15	16	17	18	19	20	21	
17	22	23	24	25	26	27	28	
18	29	30	1	2	3	4	5	
19	6	7	8	9	10	11	12	MAY
20	13	14	15	16	17	18	19	
21	20	21	22	23	24	25	26	
22	27	28	29	30	31	1	2	
23	3	4	5	6	7	8	9	JUN
24	10	11	12	13	14	15	16	
25	17	18	19	20	21	22	23	
26	24	25	26	27	28	29	30	
27	1	2	3	4	5	6	7	
28	8	9	10	11	12	13	14	JUL
29	15	16	17	18	19	20	21	
30	22	23	24	25	26	27	28	
31	29	30	31	1	2	3	4	
32	5	6	7	8	9	10	11	AUG
33	12	13	14	15	16	17	18	
34	19	20	21	22	23	24	25	
35	26	27	28	29	30	31	1	
36	2	3	4	5	6	7	8	SEP
37	9	10	11	12	13	14	15	
38	16	17	18	19	20	21	22	
39	23	24	25	26	27	28	29	
40	30	1	2	3	4	5	6	
41	7	8	9	10	11	12	13	OCT
42	14	15	16	17	18	19	20	
43	21	22	23	24	25	26	27	
44	28	29	30	31	1	2	3	
45	4	5	6	7	8	9	10	NOV
46	11	12	13	14	15	16	17	
47	18	19	20	21	22	23	24	
48	25	26	27	28	29	30	1	
49	2	3	4	5	6	7	8	DEC
50	9	10	11	12	13	14	15	
51	16	17	18	19	20	21	22	
52	23	24	25	26	27	28	29	

Fiscal Year 6

FW	M	T	W	T	F	S	S	
1	30	31	1	2	3	4	5	
2	6	7	8	9	10	11	12	JAN
3	13	14	15	16	17	18	19	
4	20	21	22	23	24	25	26	
5	27	28	29	30	31	1	2	
6	3	4	5	6	7	8	9	FEB
7	10	11	12	13	14	15	16	
8	17	18	19	20	21	22	23	
9	24	25	26	27	28			
9					29	1	2	
10	3	4	5	6	7	8	9	MAR
11	10	11	12	13	14	15	16	
12	17	18	19	20	21	22	23	
13	24	25	26	27	28	29	30	
14	31	1	2	3	4	5	6	
15	7	8	9	10	11	12	13	APR
16	14	15	16	17	18	19	20	
17	21	22	23	24	25	26	27	
18	28	29	30	1	2	3	4	
19	5	6	7	8	9	10	11	MAY
20	12	13	14	15	16	17	18	
21	19	20	21	22	23	24	25	
22	26	27	28	29	30	31	1	
23	2	3	4	5	6	7	8	JUN
24	9	10	11	12	13	14	15	
25	16	17	18	19	20	21	22	
26	23	24	25	26	27	28	29	
27	30	1	2	3	4	5	6	
28	7	8	9	10	11	12	13	JUL
29	14	15	16	17	18	19	20	
30	21	22	23	24	25	26	27	
31	28	29	30	31	1	2	3	
32	4	5	6	7	8	9	10	AUG
33	11	12	13	14	15	16	17	
34	18	19	20	21	22	23	24	
35	25	26	27	28	29	30	31	
36	1	2	3	4	5	6	7	
37	8	9	10	11	12	13	14	SEP
38	15	16	17	18	19	20	21	
39	22	23	24	25	26	27	28	
40	29	30	1	2	3	4	5	
41	6	7	8	9	10	11	12	OCT
42	13	14	15	16	17	18	19	
43	20	21	22	23	24	25	26	
44	27	28	29	30	31	1	2	
45	3	4	5	6	7	8	9	NOV
46	10	11	12	13	14	15	16	
47	17	18	19	20	21	22	23	
48	24	25	26	27	28	29	30	
49	1	2	3	4	5	6	7	
50	8	9	10	11	12	13	14	DEC
51	15	16	17	18	19	20	21	
52	22	23	24	25	26	27	28	

1981

Fiscal Year 7

FW	M	T	W	T	F	S	S	
1	29	30	31	1	2	3	4	
2	5	6	7	8	9	10	11	JAN
3	12	13	14	15	16	17	18	
4	19	20	21	22	23	24	25	
5	26	27	28	29	30	31	1	
6	2	3	4	5	6	7	8	FEB
7	9	10	11	12	13	14	15	
8	16	17	18	19	20	21	22	
9	23	24	25	26	27	28		
9						29	1	
10	2	3	4	5	6	7	8	MAR
11	9	10	11	12	13	14	15	
12	16	17	18	19	20	21	22	
13	23	24	25	26	27	28	29	
14	30	31	1	2	3	4	5	
15	6	7	8	9	10	11	12	APR
16	13	14	15	16	17	18	19	
17	20	21	22	23	24	25	26	
18	27	28	29	30	1	2	3	
19	4	5	6	7	8	9	10	MAY
20	11	12	13	14	15	16	17	
21	18	19	20	21	22	23	24	
22	25	26	27	28	29	30	31	
23	1	2	3	4	5	6	7	
24	8	9	10	11	12	13	14	JUN
25	15	16	17	18	19	20	21	
26	22	23	24	25	26	27	28	
27	29	30	1	2	3	4	5	
28	6	7	8	9	10	11	12	JUL
29	13	14	15	16	17	18	19	
30	20	21	22	23	24	25	26	
31	27	28	29	30	31	1	2	
32	3	4	5	6	7	8	9	AUG
33	10	11	12	13	14	15	16	
34	17	18	19	20	21	22	23	
35	24	25	26	27	28	29	30	
36	31	1	2	3	4	5	6	
37	7	8	9	10	11	12	13	SEP
38	14	15	16	17	18	19	20	
39	21	22	23	24	25	26	27	
40	28	29	30	1	2	3	4	
41	5	6	7	8	9	10	11	OCT
42	12	13	14	15	16	17	18	
43	19	20	21	22	23	24	25	
44	26	27	28	29	30	31	1	
45	2	3	4	5	6	7	8	NOV
46	9	10	11	12	13	14	15	
47	16	17	18	19	20	21	22	
48	23	24	25	26	27	28	29	
49	30	1	2	3	4	5	6	
50	7	8	9	10	11	12	13	DEC
51	14	15	16	17	18	19	20	
52	21	22	23	24	25	26	27	
53	28	29	30	31	1	2	3	

Year of Decade

Decade	0	1	2	3	4	5	6	7	8	9
190	4	5	6	7	1,2	3	4	5	6,7	1
191	2	3	4,5	6	7	1	2,3	4	5	6
192	7,1	2	3	4	5,6	7	1	2	3,4	5
193	6	7	1,2	3	4	5	6,7	1	2	3
194	4,5	6	7	1	2,3	4	5	6	7,1	2
195	3	4	5,6	7	1	2	3,4	5	6	7
196	1,2	3	4	5	6,7	1	2	3	4,5	6
197	7	1	2,3	4	5	6	7,1	2	3	4
198	5,6	7	1	2	3,4	5	6	7	1,2	3
199	4	5	6,7	1	2	3	4,5	6	7	1
200	2,3	4	5	6	7,1	2	3	4	5,6	7
201	1	2	3,4	5	6	7	1,2	3	4	5
202	6,7	1	2	3	4,5	6	7	1	2,3	4
203	5	6	7,1	2	3	4	5,6	7	1	2
204	3,4	5	6	7	1,2	3	4	5	6,7	1
205	2	3	4,5	6	7	1	2,3	4	5	6
206	7,1	2	3	4	5,6	7	1	2	3,4	5
207	6	7	1,2	3	4	5	6,7	1	2	3
208	4,5	6	7	1	2,3	4	5	6	7,1	2
209	3	4	5,6	7	1	2	3,4	5	6	7
210	1	2	3	4	5,6	7	1	2	3,4	5

PERPETUAL FISCAL CALENDAR
(design by RWBemer)

To Use

Find calendar number in table at left. Single digits mean not a leap year; use the FY calendar of that digit. Close the gap to remove February 29. Two digits signify a leap year. Use the FY calendar of the first digit through February 28; then the FY calendar of the second digit for the balance of the year. Use the lefthand Fiscal Week number for FY calendar 1 only for case 7,1.

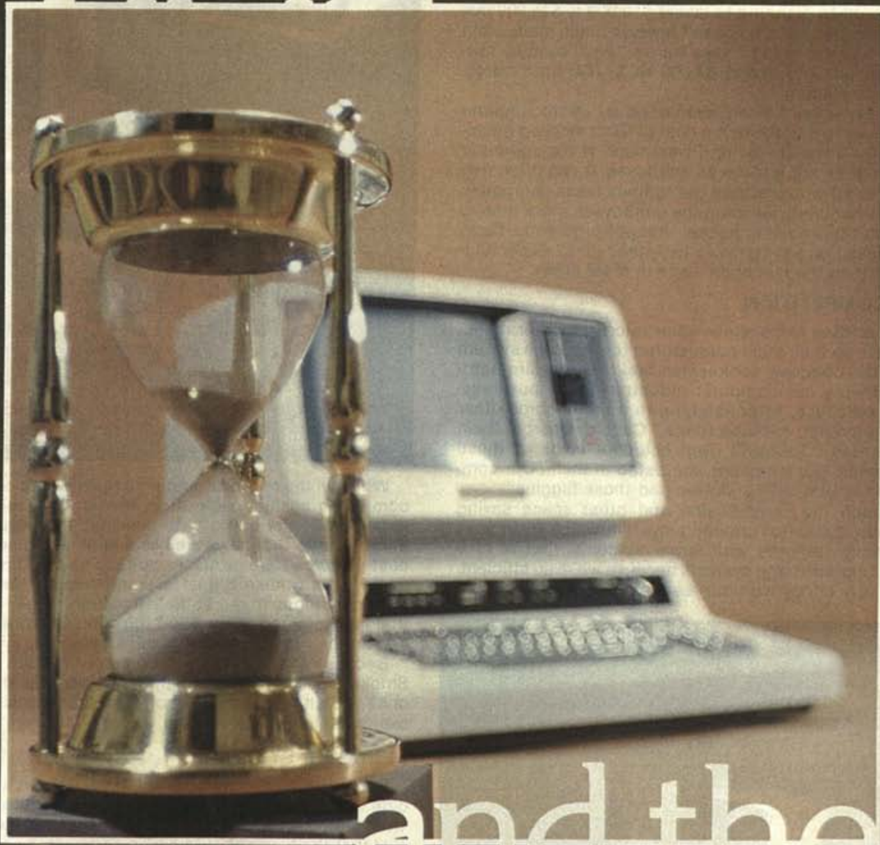
Mode d'emploi

Chercher le numéro du calendrier dans la table de gauche. Un chiffre simple indique une année non bissextile. Utiliser le calendrier AF (année fiscale) correspondant à ce chiffre. Refermer l'espace pour supprimer la 29 Février. 2 chiffres indiquent une année bissextile. Utiliser le calendrier AF correspondant au premier chiffre jusqu'au 28 Février; puis le calendrier du deuxième chiffre pour la reste de l'année. Utiliser le chiffre de gauche de la semaine fiscale du calendrier de l'AF 1 pour le cas 7,1 seulement.

Honeywell

LARGE INFORMATION SYSTEMS DIVISION

TIME and the COMPUTER



PHOTOGRAPH BY SHELLEY WRIGHT

By R.W. Bemer, Contributing Editor

Knowledge and use of time is an essential part of computer usage. In payroll programs, for example, so we can get paid periodically. In control programs, as for rockets. And not least in measuring efficiency of the programs themselves.

I'm going to give here all time standards and other aspects that I'm aware of. But first a few warnings:

- Don't embed time characteristics in program workings. There are many horror stories about programs, working for years, that died on some significant change in the date. The original programmer had moved on, of course, and left little documentation. For example, suppose in the 1970s the tens position of the year (i.e., 7) was used for the number of days in the week. Works OK then, but not in the 1980's. And year 2000 isn't far away.
- Don't write programs with provincial time elements. Use international standards, and make them useful for many languages. References and tables for these matters are at the end of this article.
- If from lack of knowledge you cannot program for all conditions, at least put in a stop and display wherever you are unsure.

BASICS OF TIME

The second is one of the seven basic units of the SI (International Systems of Units — the metric system). It may be abbreviated to "sec.", but never use the abbreviation as a symbol. The symbol is "s". E.g.:

```
3 Gs  (3 gigaseconds, or 3 000 000 000 seconds)
```

It's perfectly possible to do all time calculations with the second only, but it doesn't serve people very well. So we go to calendar time, for which a brief resume is given here:

	second	minute	hour	day	week
second	1				
minute	60	1			
hour	3600	60	1		
day	86400	1440	24	1	
week	604800	10080	168	7	1

After this every relationship is arbitrary. The fortnight might appear logical to the U.S., but to the Spanish it's 15 days, not 14. Perhaps to halve the month more closely.

FORMATS FOR DATE

When asked the time, do you reply 4:30 (four thirty) or 30:4 (thirty four)? 4:30, of course. The larger unit (hour) precedes the smaller (minute). That's the rationale for International Standard 2014[1] and American National Standard X3.30[3].

The American way has been "month day, year", while the American military and most of the rest of the world used "day month year", not needing a comma. Spelled out, confusion between the two forms was minimal. In digits only, as for a postmark or inside a computer, the confusion was intense, and costly for international trade. Fortunately for compromise, neither form had logic on its side. The international and American standards give time in a sequence that descends to the right:

calendar year - month - day - hour - minute - second

business year - fiscal week - day - hour - minute - second

ISO (International Standards Organization) had these reasons for the descending sequence:

- Ease with which the whole date may be used as a single numeral for the purpose of filing and classification (e.g., for insurance or social security systems);
- Arithmetical calculation, particularly in some computer applications;
- The capability of continuing the order by adding digits for hour-minute-second (subject to the differences in world time zones).

If it is required to separate the date elements for display, the separator is preferably a hyphen (or a space, for second choice), but not the slash (stroke) or point. E.g.:

1979-01-24, *not* 1971/01/24 or 1971.01.24

In particular, don't drop the first two digits for computer processing, unless you take extreme care, remembering that it's only the "year of the century". Otherwise the program may fail from ambiguity in the year 2000.

COMPARING TWO DATES

The American Standard recommends representing the date in computer store without separators, e.g. 19790124. This makes it easier to compare two dates (which is earlier/later). A simple subtraction does it. Finding the difference between two dates in (elapsed or working) days is more complicated, due to variations in both years and months.

LEAP YEARS

The leap year device is used periodically to adjust the synthetic calendar year to the real astronomical year. Every year divisible by 4 is a leap year, except if it's divisible by 100 but not 400. So 1800 and 1900 were not leap years, but 2000 is. Finer adjustment is coming. Years divisible by 4000 won't be leap years (may your programs run that long). You won't have trouble unless you are computing backward in time, in which case pay particular attention to 1582, which is when the Gregorian calendar superseded the Julian, with a resultant loss of 10 days from October 5 to 15.

Vector strings for the individual and cumulative days in the months (12 per year, of course) are:

031028031030031030031031030031030031
029

031059090120151181212243273304334365
060091121152182213244274305335366

A simple method of calculating whether a year is/isn't a leap year is embedded in Robertson's algorithm[18]. It uses the integer arithmetic found in FORTRAN, TEX, and some other programming languages. The entry variable "i" is the 4-digit year:

```
a=(i-i/4*4+3)/4           (0 if divisible by   4, else 1)
b= (i-i/100*100+99)/100   (0 if divisible by 100, else 1)
c=(i-i/400*400+399)/400   (0 if divisible by 400, else 1)
leap=1-a+b-c              (1 if "i" is leap year, else 0)  (1)
```

Thus (1-a + b-c) has a value 1 (1-0 + 1-1) for regular leap years, and for 1600, 2000, 2400, etc. (1-0 + 0-0). But it's 0 (1-0 + 0-1) for 1700, 1800, 1900, etc., and all other years (1-1 + 1-1). I have a feeling this one can be bettered.

It's easier in TEX, remainder being an active function. Here the variable "a" contains "if *rmdr:eq:0 leap", and "|" is the substitute character:

```
leap=0 q=i/4 |a|=1 q=q/25 |a|=0 q=q/4 |a|=1 q=q/10 |a|=0    (2)
```

This one handles the year 4000 case, falling through to the next statement 3 out of 4 times without further computation!

ORDINAL DATES

American Standard X3.30 allows replacement of month and day by a 3-digit ordinal day of the year. So does ISO 2711[2], a separate standard. The date shown before would be:

1979-024 (1979024 internally)

```
l=jd+68569
n=4*l/146097
l=l-(146097*n+3)/4
i=4000*(l+1)/1461001
l=l-1461*i/4+31
j=80*l/2447
k=l-2447*j/80
l=j/11
j=j+2-12*l
i=100*(n-49)+i+l                                    (19)
```

RECAPITULATION

Now our four representations for date are compared:

Unit	Abbr.	Type	Representation
Day of time	DOT	Julian	XXXXXXX
Day of week	DOW	Fiscal	FFFFWWD
Day of month	DOM	Calendar	YYYYMMDD
Day of year	DOY	Ordinal	YYYY000 (or III or ORD)

Fiscal year is represented by FFFF because it's not always equal to YYYY, calendar year. Internal format problems are possible. Three of the representations have 7 characters. For some time the Julian day number will begin with 24..... (If you wish, Smithsonian Day brings it to 6 characters by subtracting 2000001.) But is 1979011 day 1 of fiscal week 1, or ordinal day 11? We could embed separators, as 1979.01.1. I like prefacing date fields with a letter. A same date is:

```
J2444239      F1980011      C19791231      01979365
```

Harry White of the National Bureau of Standards (chairman of both American and International committees on standards for data representation) suggests omitting the "C" prefix in the calendar date. It is thus a default case, being a calendar date when the first character is a digit, not a letter. This permits a common field size of 8 characters. I like it.

Now the sequences of numbered formulas for conversion are summarized. For example, "F-J" means the conversion from fiscal to Julian. When no direct conversions are given, the intermediate conversions are indicated:

```
C-O   (1)(3)                       F-C    f-o,o-c
C-F    c-o,o-f                     F-O   (8)(11)(16)(17)(18)
C-J   (7)                          F-J    f-o,o-j
O-C   (1)(4)(5)(6)                 J-C   (19)
O-F   (8)(11)(12)(13)(14)(15)      J-O    j-c,c-o
O-J   (8)(9a)                      J-F    j-c,c-f
```

THE YEAR AND SHORTER PERIODS

Pay rate is an interesting topic. As rigor stops with the week, salary or other stipend based upon a week, day, or hour gives no problem. Monthly salaries would be rather unfair, due to the variation of up to 3 days, but yearly salaries are common. The question is how often a portion of the salary is paid. There is no problem with calculating a monthly portion — just divide by 12, even though the recipient has to adjust a little. But paying every week or two weeks gives a rate problem.

One solution is to have regular years have 52 1/7 (52.143) weeks or 26 1/14 (26.0714) 2-week periods, and leap years to have 52 2/7 (52.286) weeks or 26 1/7 (26.143) 2-week periods. Or if the employee is expected to stay a long time, constant values of 52.1786 or 26.0893 may be used.

LOCAL TIME OF DAY

Except for the military again (and some airlines), the United States has used 12-hour time (clocks) much more than 24-hour time. Digital clocks will help the trend to 24-hour time. Any problems?

Yes. 12:59 is less than the 24 hours in a day. We've had no problem referring to 12:59 AM and 12:59 PM, followed by 01:00 AM and PM respectively. When we add 12 hours to all those after noon, 12:59 is followed by 13:00, but is 23:59 followed by 24:00 and then 24:01 when there are only 24 hours in a day? It seems logical that one minute after midnight should be 00:01, but is midnight 00:00 or 24:00?

This was one of the major difficulties in trying to settle on standards for time[10,11,14]. The result is that there are six permissible ways to express time of day numerically:

```
1. HH
2. HH.hhh--h
3. HHMM              (optionally HH:MM)
4. HHMM.mmm--m       (optionally HH:MM.mmm--m)
5. HHMMSS            (optionally HH:MM:SS)
6. HHMMSS.sss--s     (optionally HH:MM:SS.sss--s)
```

The optional colon spacer gives no logical problem. If not encountered in the third position from the left, it has not been used. If a decimal point is encountered there, the field is decimal hours only. If a decimal appears in the 5th position from the left, the field is hours and decimal minutes. If in the 7th, it is hours, minutes, and decimal seconds. In all three cases, the decimal part is of variable length.

MM and SS have values from 00 to 59, HH from 00 to 23, except that midnight may be 24 in Form 1 only. All 12-hour time forms are followed (no space between) by a meridiem designator, "A" or "P". Some examples in both 12-hour and 24-hour forms are:

Form	12-hour	24-hour	
1	02P	14	
3	12:00P	12:00	noon
5	120000	120000	noon
3	12:21P	14:21	
1	12A	00	midnight
1	12A	24	"
3	12:00A	00:00	"

Date and local time of day may be stored in a single field. Examples:

```
19791231-235958   (2 seconds to midnight)
19791231-235959   (1 second  to midnight)

19800101-000000   (Auld Lang Syne)
19800101000000    ( " )
```

Although the example just shown was from the standard, I think it better to actually store the colon(s) and decimal point in the time format. Otherwise one must program their insertion for display. Two times can't be compared by subtraction, as two dates can be, so there's no point to it.

Note:

Midnight is always 00 .. in the ISO Standard. The American Standard permitted "24" to accommodate certain applications of the Department of Defense, but don't you use it! It works only for time accurate to one hour, and it violates other computer standards. It's like having digits 0-1-2-3-4-5-6-7-8-9-X, and you could use either X or 10 at your option.

UNIVERSAL TIME

American National Standard X3.51[13] relates U.S. time zones to universal time (Greenwich Meridian) and specifies the representations to do so. Time may be specified as universal, in which case 12-hour clock time is followed by A or P (for A.M. or P.M.), a space, and "GMT"; while 24-hour clock time is followed directly by "Z", for Zero time. E.g.:

```
07:09:23P GMT      190923Z
```

Or it may be specified as local, with either a time differential factor (TDF), or a time zone reference. E.g.:

```
140923-0500      140923 EST      02:09:23P EST
```

This form is easier to difference, particularly within the same year. Only the leap year factor remains. To compute ordinal day we use the rest of Robertson's algorithm, with two more inputs — month "j" and day "k", 2 digits each. (j + 10)/13 has a value 0 for January and February, else 1.

```
iday=3055*(j+2)/100-(j+10)/13*2-91+(1-a+b-c)*(j+10)/13+k    (3)
```

CONVERTING ORDINAL TO CALENDAR DAY

Here we use my modification of an algorithm by Stone[17]. The original has a note that a patent was applied for, but the odds are it didn't make it.

The value of "leap" is computed as shown previously, with inputs ordinal day "iday" of year "i" (4 digits). Outputs are month "j" and day "k":

```
id=iday+((405+iday-leap)/365)*(2-leap)          (4)
j=((id+91)*100)/3055-2                          (5)
k=id+30-(j*3056)/100                            (6)
```

JULIAN DAYS AND DIFFERENCING

There are many methods of computing the number of days between two days, but the simplest and most reliable is to express any date in the Julian form. No relation to the Julian Calendar, this form has but one unit — the day (just as the metric system has the second as a linear unit).

The best algorithm is the classic of Fliegel and Van Flandern[16]. It also uses integer arithmetic without logic. The leap year algorithm is built in; the constant 1461 is the number of days in a 4-year cycle. Inputs "i", "j", and "k" are YYYY, MM, and DD respectively:

```
jd=k-32075+1461*(i+4800+(j-14)/12)/4
jd=jd+367*(j-2-(j-14)/12*12)/12
jd=jd-3*((i+4900+(j-14)/12)/100)/4              (7)
```

E.g., 1979-01-01 is Julian Day number 2443875. To difference two dates, compute and difference their Julian Day values.

An optional method, if ordinal day is needed anyway, is to compute the Julian day for the first day of the year. Substituting values of 1 for both j and k in the general expression, we get:

```
jd1=1461*(i+4799)/4-31738-3*((i+4899)/100)/4          (8)
jd=jd1+ord-1                                          (9a)
ord=jd-jd1+1                                          (9b)
jdord=1461*(i+4799)/4+ord-31739-3*((i+4899)/100)/4    (10)
```

As a curiosity, Julian Day 0 is found for Nov 24 of the year -4713 (yes, minus!), but that's not what the calendar said then. And if you go into more detail with Julian days, remember that they start at noon Greenwich Time.

FISCAL WEEKS

A companion standard, ISO 2015[8], recognizes the calendar week as an important unit for purposes of planning and accounting, as for delivery dates. So the numbering of weeks has increasing use in international trade and industrial planning. Monday is specified as the first day of the week for business and commercial (not religious) purposes.

Hebdomadal, or septenary, years have an integral number of fiscal weeks. For these, a week divided by the turn of the year belongs to the year having the larger number of days that week. Equivalently, the year of that week's Thursday. Thus some hebdomadal years have 53 fiscal weeks. If based on calendar year, they can start anywhere from December 29 to January 4. Some people try to form fiscal months, of 4 or 5 weeks each, by the same dividing rule. Don't believe it!

Fiscal years are arbitrary, but hebdomadal calendar year is often chosen. In the remainder of the article it's called an "F-year". Figure 1 shows all possible F-year patterns. They're the same 14 of the perpetual calendar business, only the F-years are shown boxed. They're renumbered so that the fiscal constant "fc", which we must calculate, is the number plus 3. Note the 53 weeks in years 7N, 6L, and 7L.

```
              Non-Leap Years                Leap Years

          M  T  W  T  F  S  S          M  T  W  T  F  S  S
No. fc
                      01 02 03                     01 02 03
          04 05 06 07 08 09 10         04 05 06 07 08 09 10
1)   4    .  .  .  .                   .  .  .  .
          27 28 29 30 31 01 02         26 27 28 29 30 31 01

                         01 02                        01 02
          03 04 05 06 07 08 09         03 04 05 06 07 08 09
2)   5    .  .  .  .                   .  .  .  .
          26 27 28 29 30 31 01         25 26 27 28 29 30 31

                            01                           01
          02 03 04 05 06 07 08         02 03 04 05 06 07 08
3)   6    .  .  .  .                   .  .  .  .
          25 26 27 28 29 30 31         24 25 26 27 28 29 30
                                       31

          01 02 03 04 05 06 07         01 02 03 04 05 06 07
4)   7    .  .  .  .                   .  .  .  .
          24 25 26 27 28 29 30         23 24 25 26 27 28 29
          31                           30 31

          31 01 02 03 04 05 06         31 01 02 03 04 05 06
5)   8    .  .  .  .                   .  .  .  .
          23 24 25 26 27 28 29         22 23 24 25 26 27 28
          30 31                        29 30 31

          30 31 01 02 03 04 05         30 31 01 02 03 04 05
6)   9    .  .  .  .                   .  .  .  .
          22 23 24 25 26 27 28         21 22 23 24 25 26 27
          29 30 31                     28 29 30 31 01 02 03

          29 30 31 01 02 03 04         29 30 31 01 02 03 04
7)  10    .  .  .  .                   .  .  .  .
          21 22 23 24 25 26 27         20 21 22 23 24 25 26
          28 29 30 31 01 02 03         27 28 29 30 31 01 02
```

Figure 1. Possible F-Year Patterns

CONVERTING ORDINAL TO FISCAL

Because some days of the calendar year may lie in either the previous or the following F-year, we need first an algorithm to determine which of the 14 types the year is. It's convenient to determine a constant "fc", such that:

Fiscal Day of Jan 01	1	2	3	4	5	6	7
fc	7	8	9	10	4	5	6

First Julian Day for Jan 01 is derived from (8), and then:

```
t=jd1-jd1/7*7
fc=t+7-(t+3)/7*7                                (11)
```

Now the fiscal date is computable:

```
fw=(iday+fc-1)/7                                (12)
fd=(iday+fc-1)-7*fw+1    (=*rmdr+1 in TEX)      (13)
```

F-year "fy" is first assumed to be the same as calendar year "i". But:

```
if fw:eq:53 if (fc+leap):lt:10 fy=i+1 fw=1          (14)
if fw:eq:0 fy=i-1 i=fy (1) fw=53-(fc+1-leap)/6      (15)
```

In (15), F-year is 1 less than the calendar year, so formula (1) must be used to see if *it* is a leap year.

CONVERTING FISCAL TO ORDINAL

Assuming calendar year "i" to be the same as fiscal, formulas (8) and (11) give its fiscal constant. Then:

```
iday=7*fw+fd-fc                                 (16)
```

"leap" is found from (1), and:

```
if iday:gt:(365+leap) i=i+1 iday=iday-365-leap      (17)
if iday:lt:1 i=i-1 (1) iday=365+leap+iday           (18)
```

CONVERTING FROM JULIAN DAY

Fliegel and Van Flandern[16] found going from Julian to calendar a bit complicated. Here it is. Going from Julian to ordinal should be much simpler:

U.S. Standard Time Zones and properties are:

```
Newfoundland (Standard) NST  -0330                          Time
Atlantic         "      AST  -0400   -0300  ADT  (Daylight) "
Eastern          "      EST  -0500   -0400  EDT      "      "
Central          "      CST  -0600   -0500  CDT      "      "
Mountain         "      MST  -0700   -0600  MDT      "      "
Pacific          "      PST  -0800   -0700  PDT      "      "
Yukon            "      YST  -0900   -0800  YDT      "      "
Alaska-Hawaii    "      HST  -1000   -0900  HDT      "      "
Bering           "      BST  -1100   -1000  BDT      "      "
```

The Newfoundland Zone doesn't use Daylight Time, nor do Arizona and parts of Indiana. Moreover, it's not unique in being on the half hour from Greenwich. There are 16 other cases, as listed in the International Standard Time Chart of the Official Airline Guide, Worldwide Edition. That's really the authoritative list. Oddly, only a few countries have to use Daylight Time to delude themselves — including the United States, Cuba, Chile, France, and parts of the British Commonwealth. And to most of these it's called Summer Time, not Daylight (Saving) Time.

Halfhour time zones deny extension of the alphabetic zone designations, like EST, because there are more different zones than letters. They're supposed to be mnemonic anyway.

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Standards — Fiscal Calendar

8. ISO 2015-1976, Numbering of Weeks.
9. British Standard 4760:1971, Specification for the Numbering of Weeks.

Standards — Local Time of Day

10. ISO 3307, Information Interchange — Representation of Time of the Day.
11. ANSI X3.43-1977, Representation of Local Time of the Day for Information Interchange ($3.00).

Standards — Universal Time

12. ISO Draft Standard 4031, Information Processing — Representation of Local Time Differentials.
13. ANSI X3.51-1975, Representation of Universal Time, Local Time Differentials, and United States Time Zone References for Information Interchange ($1.50).

Composite Standards

14. British Standard 5249:1976, Representation of Elements of Data in Interchange Using Data Processing Systems, Part I: Representations of Dates and Times.

Methods

15. R.G. Tanzen, "Conversions between calendar date and Julian day number", Commun. ACM 6, No. 8, 1963 Aug, 444
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18. J.D. Robertson, "Remark on Algorithm 398", Commun. ACM 15, No. 10, 1972 Oct, 918
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    Describes usage of qualifiers (IN, BEFORE, AFTER, EVER) for all dates within a period, and qualifiers (DURING, UNTIL, SINCE, ALWAYS) true for at least one day in a period.

TIME ELEMENTS IN OTHER LANGUAGES

The computer business is aware that survival lies in software. So why shouldn't software be built to be salable internationally? With the help of Tables I and II, and some programmed switching, this should be easy.

Notice that some words are spelled with characters other than letters. This is to remind you that these characters of ASCII are replaced, in the other languages, with the following graphics:

```
] Å    } å          (Swedish circle a)
] Ü    } ü          (German umlaut u)
] Ñ    } ñ          (Spanish tilde n)
       ] ç          (Portuguese cedilla c)
```

All other accented letters are formable with the backspace and diacritical marks, e.g., ô

For Table II, the first entry is an adjective (semiannual notice), the second an adverb (do it semiannually).□

English	German	Swedish
yearly	jährlich	}rs
yearly	"	}rligen
semiannual	halbjährlich	halv}rs
semiannually	"	halv}rsvis
quarterly	vierteljährlich	kvartals
quarterly	"	kvartalsvis
bimonthly	zweimonatlich	-
bimonthly	"	varannan m}nad
monthly	monatlich	m}nads
monthly	"	varje m}nad
weekly	wöchenlich	vecko
weekly	"	varje vecka
daily	täglich	dags
daily	"	dagligen
hourly	st}ndlich	tim
hourly	"	varje timme

Table IIa. Time Modifiers

English	French	Italian	Spanish	Portuguese
yearly	annuel	annuale	anual	anual
yearly	annuellement	annualmente	anualmente	anualmente
semiannual	semestriel	semestrale	semestral	semestral
semiannually	semestrielment	semestralmente	semestralmente	semestralmente
quarterly	trimestriel	trimestrale	trimestral	trimestral
quarterly	trimestrielment	trimestralmente	trimestralmente	trimestralmente
bimonthly	bimestriel	bimestrale	bimestral	bimestral
bimonthly	bimestrielment	ogni due mesi	bimestralmente	bimestralmente
monthly	mensuel	mensile	mensual	mensal
monthly	mensuellement	mensilmente	mensualmente	mensalmente
weekly	hebdomadaire	settimanale	semanal	semanal
weekly	toutes les semaines	settimanalmente	semanalmente	semanalmente
daily	quotidien	quotidiano	cotidiano	cotidiano
daily	quotidiennement	giornalmente	diariamente	todos os dias
hourly	a chaque heure	-	por horas	horårio
hourly	d'heure en heure	ogni ora	a cada ora	a cada hora

Table IIb. Time Modifiers

English	German	Swedish	French	Italian	Spanish	Portuguese
Monday	Montag	m}ndag	lundi	lunedī	lunes	segunda-feira
Tuesday	Dienstag	tisdag	mardi	martedi	martes	ter]a-feira
Wednesday	Mittwoch	onsdag	mercredi	mercoledi	miércoles	quarta-feira
Thursday	Donnerstag	torsdag	jeudi	giovedi	jueves	quinta-feira
Friday	Freitag	fredag	vendredi	venerdi	viernes	sexta-feira
Saturday	Samstag	lördag	samedi	sabato	såbado	såbado
Sunday	Sonntag	söndag	dimanche	domenica	domingo	domingo
January	Januar	januari	janvier	gennaio	enero	janeiro
JAN	JAN	JAN	JAN	GEN	ENE	JAN
February	Februar	februari	fevrier	febbraio	febrero	fevereiro
FEB	FEB	FEB	FEV	FEB	FEB	FEV
March	März	mars	mars	marzo	marzo	mar]o
MAR	MRZ	MAR	MAR	MAR	MAR	MAR
April	April	april	avril	aprile	abril	abril
APR	APR	APR	AVR	APR	ABR	ABR
May	Mai	maj	mai	maggio	mayo	maio
MAY	MAI	MAJ	MAI	MAG	MAY	MAI
June	Juni	juni	juin	giugno	junio	junho
JUN	JUN	JUN	JUN	GIU	JUN	JUN
July	Juli	juli	juillet	luglio	julio	julho
JUL	JUL	JUL	JLT	LUG	JUL	JUL
August	August	augusti	août	agosto	agosto	agôsto
AUG	AUG	AUG	AOU	AGO	AGO	AGO
September	September	september	septembre	settembre	septiembre	setembro
SEP	SEP	SEP	SEP	SET	SEP	SET
October	Oktober	oktober	octobre	ottobre	octubre	outubro
OCT	OKT	OKT	OCT	OTT	OCT	OUT
November	November	november	novembre	novembre	noviembre	novembro
NOV	NOV	NOV	NOV	NOV	NOV	NOV
December	Dezember	december	dècembre	dicembre	diciembre	dezembro
DEC	DEZ	DEC	DEC	DIC	DIC	DEZ
spring	Fr}hling	v}r	printemps	primavera	primavera	primavera
summer	Sommer	sommar	été	estate	verano	verão
fall	Herbst	höst	automne	autunno	oto}o	outuno
winter	Winter	vinter	hiver	inverno	invierno	inverno
A.D.	P. Chr.	e. Kr.	apr. J.-C.	d.C.	A.C.	D.C.
B.C.	A. Ch.	f. Kr.	av. J.-C.	a.C.	?	A.C.
period	periode	period	pèriode	periodo	perīodo	perīodo
century	Jahrhundert	sekel	siècle	secolo	siglo	centenårio
decade	Jahrzehnt	dekad	dècade	decade	decenio	decênio
year	Jahr	}r	année	anno	a}o	ano
6 months	halbjahr	halv}r	semestre	semestre	semestre	semestre
3 months	vierteljahr	kvartal	trimestre	trimestre	trimestre	trimestre
2 months	sechsteljahr	tv} m}nader	bimestre	bimestre	bimestre	bimestre
month	Monat	m}nad	mois	mese	mes	mês
week	Woche	vecka	semaine	settimana	semana	semana
day	Tag	dag	jour	giorno	dia	dia
hour	Uhr	timme	heure	ora	hora	hora
minute	Minute	minut	minute	minuto	minuto	minuto
second	Sekunde	sekund	seconde	secondo	segundo	segundo
date	Datum	datum	date	data	data	data
time	Zeit	tid	temps	tempo	tiempo	tempo
calendar	Kalender	kalender	calendrier	calendario	calendario	calendårio
Julian	Julianische	juliansk	julien	Giuliano	juliano	Juliano
fiscal	finanz-	räkenskaps	fiscale	fiscale	fiscal	fiscal
ordinal	Ordnungs-	ordnings-	ordinal	ordinale	ordinal	ordinal
clock	Uhr	klocka	horloge	orologio	reloj	relógio
yesterday	Gestern	ig}r	hier	ieri	ayer	ontem
today	Heute	idag	aujourd'hui	oggi	hoy	hoje
morning	Morgen	morgon	matin	mattino	ma}ana	manhã
noon	Mittag	middag	midi	mezzogiorno	mediodīa	meio-dia
afternoon	Nachmittag	eftermiddag	après-midi	pomeriggio	tarde	tarde
evening	Abend	afton	soir	sera	tarde	noite
night	Nacht	natt	nuit	notte	noche	noite
midnight	Mitternacht	midnatt	minuit	mezzanotte	medianoche	meia-noite
tomorrow	Morgen	imorgon	demain	domani	ma}ana	àmanhã

Table I. Time Elements

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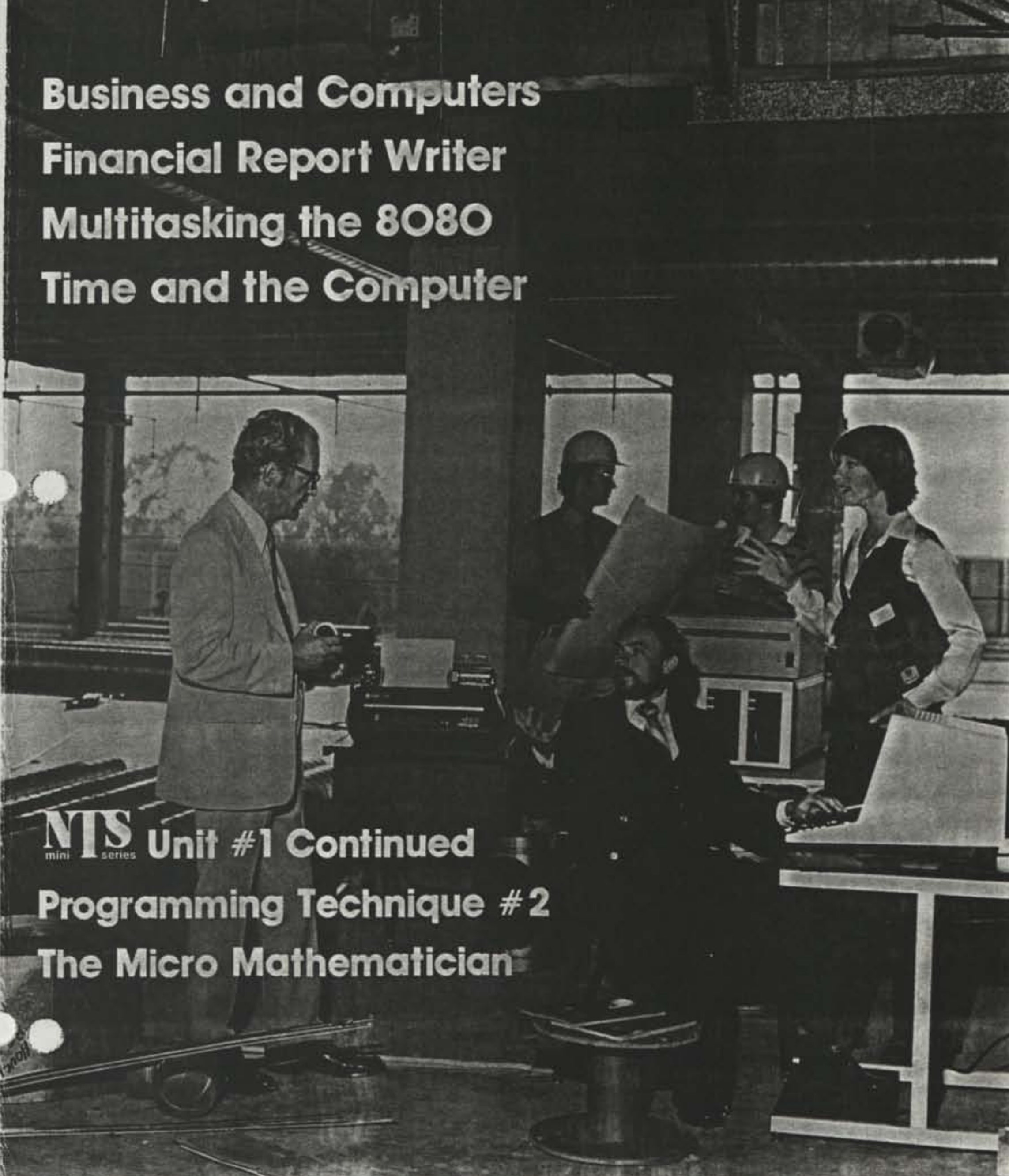

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Honeywell

1979 Sep 11

Dear Heinz:

What a number of subjects you covered in your letter! I shall have to enumerate the answers and comments, and key them to the enclosures.

1. I have found a whole copy of the Interface Age magazine containing the article, which should be better than a tear sheet. Enclosed.

2. On the matter of being cryptic in algorithms, I of course agree with you. But they are basically not mine. I collected them from the sources referenced. I believe that I mentioned more than once that the main principle for their operation was "integer arithmetic", where any fractional part of the quotient was lost.
   Yes, perhaps "blindly". Was that not the original intent of the "Taschenbuch" for ALGOL?

3. To shed further light, I enclose a draft paper on "Structured Dialog and Access", which again features the program "DATE". Note the individual explanations that may be requested, which sometimes include the references.

4. You are very kind to correct the terms that are not English. Some had been caught, but not in time for publication. Fortunately the paper is in my computer database, and I shall make the corrections there for future reference.

5. You may like to see the language tables in use. I enclose a test of the program TEXLIB/L/TODAY, with many possible outputs, together with a source program to show how easy it is to do this with the TEX language.

6. And in case you are not yet familiar with TEX, a small black reference manual to decode some of the more abstruse statements. This is presently under standardization in ANSI X3J6, with the same status as PL/I, etc.!

Honeywell

7. You are painfully correct about the accented letters. Using the substitute characters was an afterthought, poorly executed. They should all be replaced according to the registered variants of the ISO Code given on page 82, 1978 July issue of Interface Age (enclosed, see point 9). I have encircled the positions affected. My intent was to use the ASCII characters directly in the programs; when printed on devices conforming to the national variants (ISO 646-021 in the German case) they would come out automatically as the proper accented letters. I have enclosed part of a terminal log showing that I have accomplished part of the corrections needed. Thank you.

8. You need not look it up. Both Austria and Germany are signatories to ISO 2015, Numbering of Weeks. I enclose some exemplars of a perpetual Fiscal Week calendar of my design. Some are shaded for the near future to show specific years, and also how the calendar works in general principle. Feel free to use the calendar in any way you choose. It has already been submitted to ISO for their usage.

9. I enclose a curriculum vitae listing my papers, for any which could be of use to you. Reprints of the TEX and ASCII articles are enclosed, plus a shortened summary which references them. Request any others that you would like.

10. About your work, my German is terrible. But luckily I work closely with Eric Clamons, a "landsman" of yours (Vienna) who designed the TEX language. He will do the necessary work with pleasure, so send all you can.

11. This reminds me that I have not yet received any exemplar of the paper of mine that you translated, although it has been some time now. Could you please recheck?

12. Can't find my original data on Smithsonian day? I'll have to continue looking.

By all means come to Phoenix in late November. It will our pleasure to extend a big welcome.

Bob

Bob Bemer

1980-84

#2 (122 lines) 09/30/80 14:27 Mailed by: Lamson.Multics
Date: 30 September 1980 17:27 edt
From: Lamson.Multics
Subject: time standards document
To: Schauble.G4ARCH
Message-ID: <800930212721.241082>

I found your time standards document very good except for a few points. I thought you'd like to hear about them.

The last time I heard anything about these things, ISO standard dates were to look like 1971.01.24, a format you specifically warn against. This is confusing, to say the least -- I have been using that format for dates in program journalization comments for several years now.

The vector stirng for individual dats in the months has the 029 for leap-year February out of alignment.

Everywhere you have calcualated date-related numbers, you have used extremely non-mnemonic names for the variables. This has the property of making the algorithms harder (for me, anyway) to follow. I suggest either making the names mnemonic (harder, but prettier), or at least adding a glossary of variable names to the text before the first time any of them are used.

The algorithm for leap-year calculation would be easier to understand if the representation were changed to the opposite of the one you have used. I.e. I would have all the divisibility checks return 1 if divisible, rather than zero. This would not make the last equation any less efficient, but would make the algorithm easier to understand for poor minds like mine who only understand positive logic (I spent about ten minutes on those four lines).

TEX is an obscure text-processing language; references to it, while cute, are not useful and should be elided. Nearly everybody reading this document will know FORTRAN, though, and since integer arithmetic is subject to misinterpretation across languages, I would leave the FORTRAN examples in the document.

The Gregorian calendar superseeded the Julian one on different dates in different parts of the world. For example, in the British colonies in North America, people were still using the Julian calendar until after the American revolution. Thus, George Washington was actually born on February 11, although when the Gregorian calendar went into effect, the date was changed to Feb 22 (note the difference of eleven days, rather than the ten in 1582).

As a matter of curiosity, where do Julain dates actually come from? In particular, where does the -4713 year come from (4712 BC, I guess -- or is it 4714??) Also, why do they start at noon Z, rather than midnight? Do they really date from the time of Julius Caesar?

Fiscal week calculations are hopeless. I hope you've included the calculations about them so that people will be discouraged from using them. Although maybe not.

You should mention that there are at least three different fiscal calendars that are in common use. Most individuals and some companies have fiscal years that coincide with the "standard" calendar, i.e. starting on approximately Jan 1. Many state governments and companies start on July 1, however, and the Federal (US) government starts on about October 1. I don't know for sure whether any of these other entities uses fiscal weeks, but I am pretty sure that Uncle Sam does.

I also like prefacing date formats with a letter, although I think the letter "O" has ambiguity problems with the digit zero (see the front of any phone book for warnings about such things). Making the "C" be droppable because dates only need to be eight columns wide may be making trouble when the year 10000 comes around (may anybody's programs be running so long) (may there be any people to care whether there are any running programs by then).

There were a lot of discussions about 24-hour time and 12-hour time representation when people were trying to decide on the format for mail headers for the ARPA network. I don't have the text of these discussions, although you might try sending a request to the mailing list HEADER-PEOPLE at MIT-MC to see if anybody can give you a pointer to it. (use the send_mail command at MIT Multics thusly: send_mail HEADER-PEOPLE -at mc to do this.) One item I particularly remember from the discussions was the definition of 12pm. Some people thought this should be midnight, while others thought it should be noon. I believe that the NBS standard for this is that 12pm is midnight, while 12m (i.e. neither am nor pm, but just meridiem) is correct for noon. Of course, this is confusing to people who think that the "m" stands for "midnight", but this is an education problem. I think that if you're going to educate people anyway, you should go to 24-hour time, or do something similar to julian dates, making times be seconds since midnight.

The real question left unanswered by the whole document is whether dates are to be human-readable, machine-readable, or both. If they are to be human-readable, then clearly the "seconds since midnight" idea is a bad one. However, so are julian dates, ordinal dates, etc. So are dates and times without punctuation (which, by the way, are a source of ambiguity for machines, too -- this was also discussed in header-people, and is a source of a completely wedged feature of convert_date_to_binary_, whereby it doesn't know about times unless they have a decimal point in them, or a colon, or something similar).

You should include a time zone designation table in the text, rather than referring to the one in the OAG (you can give credit -- I thought it would appear in the bibliography, by the way). This would be more usefule than just referring to the one there.

One set of abbreviations you omitted for AD and BC is the ones used by (at least) Jews -- CE (common era) and BCE (before the common era). These, of course, are used so as not to speak of "the year of (our/their) Lord," tend to offend fewer people (although not everybody knows what they mean).

Also, in that table, the Russian column looks terrible. Or is that supposed to be the column after the Russian one? It's hard to tell.

Finally, there is no such word as semiannual. If something happens twice a year, it is biannual (every two years is biennial). I lost a bet on this one about eight years ago, so I am sure you don't want to promulgate a flagrant error.

On the whole, however, the document is very good. I would like to see something come out of it in the form of recommendations for convert_date_to_binary_, at least. Please let me know when you have a revised edition of this document, and I will review it for you, if you wish. I am more reachable at MIT than at Phoenix, as Lamson.SysMaint at MIT or Lamson.Multics at PHX.

-- Richard

PS If you are at HLSUA, I will see you there.

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COMPUTERWORLD

THE NEWSWEEKLY FOR THE COMPUTER COM

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Happy New Year?

By Brad Schultz
CW Staff

Software that runs under the rubric of IBM's Virtual Telecommunications Access Method (Vtam) solves complicated problems in getting a lot of data through large user networks around the world.

But Vtam forgot that 1980 was a leap year, according to a user spokesman who requested anonymity, and that user's 400-terminal network based on a 6M-byte 370/168 and 8M-byte 3032 did not run for part of New Year's Eve as a result.

Since the network plays a vital role in supporting emergency assistance to many people, the crash of Vtam Level 1.0 in this instance was not a pleasant way to ring out the year. Finding its three 3705 communications controllers dead and an INVALID DATE error message flashing on a systems monitor, the user soon deduced the problem: The Vtam in question did not recognize a 366-day year.

The occurrence of a 29th day in February 1980 made the final day of December No. 80366 on the Julian Calendar featured by this user's installation (the first two digits, "80," indicate the year and the final three digits specify a day of that year).

According to the spokesman, the 3705s under Vtam 1.0 choked on 80366 and, for two hours, froze the processing of data and forms critical to treatment of people with problems that made their holiday season catastrophic. In the final hours of 1980, systems specialists at the facility determined that the source of trouble was a faulty "fix" among many fixes used in preventive maintenance for their particular Vtam implementation.

(Continued on Page 8)

IBM Hikes Lease, Rental To Stimulate User Buying

By Tom Henkel
CW Staff

ARMONK, N.Y. — IBM apparently plans to raise lease and rental prices on its major processors every six months in efforts to encourage users into buying hardware. The firm just announced another round of 7% to 8% lease and rental increases along with up to 15% increases in software and maintenance services. The late December increase follows similar price increases in June 1980 and December 1979.

The latest announcement hikes prices on Data Processing Division (DPD) products by 7%, General Systems Division (GSD) products by 8% and major Office Products Division hardware by 8%.

DPD and GSD also increased monthly maintenance prices up to 15% and hourly maintenance by 10%. DPD increased the cost of educational courses by 10% and GSD increased its courses by 15%, IBM said.

Industry analysts, while not surprised by the IBM announcement, predict the move will set off a rash of price increases throughout the industry. Some vendors, including Digital Equipment Corp. and Memorex Corp. (see related story on Page 2), have already announced price increases.

As in previous announcements, IBM exempted new products, those facing heavy competition and those not faring well from the increases. Ex-

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Three HP Softw Fit 3000s Into I

PALO ALTO, Calif. — Hewlett-Packard Co. has announced three software products that fit HP 3000 computer systems to networks hosted by IBM mainframes.

The packages employ HP's Intelligent Network Processor (INP) for re-

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Computer Staff Union OK's Boeing's 34% Pay Hike Plan

By Jeffry Beeler
CW West Coast Bureau

SEATTLE — A labor union representing much of the Boeing Co.'s computing staff last week OK'd a proposal for a new three-year employment contract and in so doing narrowly averted a threatened Jan. 7 strike.

By an undisclosed margin, the 14,000 members of the Seattle Professional Engineering Employees Association (Speea) voted to accept a Boeing-proposed pay hike totaling 34% during the next three years.

Last week's vote abruptly ended a potentially costly internal labor dispute that nearly forced an estimated half to two-thirds of Boeing's programmers and systems analysts here to walk off their jobs.

As is usually the case in labor-contract squabbles, the Boeing dispute's main point of contention was money. Management's original contract offer called for a salary hike totaling 34%, but Speea sought a 45% increase instead, ostensibly to maintain pay-scale parity with one of the firm's other unions.

The 11% gap between the two sides' bargaining positions proved a major

(Continued on Page 5)

No Way to Celebrate

Happy New Year? Lear Year Freezes Net

(Continued from Page 1)

These so-called fixes were software programs essentially identical to those already running in conjunction with or as part of the user's Vtam 1.0.

The idea behind them is similar to what often happens when a car mechanic tries to service a vehicle afflicted by unknown diseases with conspicuous symptoms. As the user spokesman put it, a mechanic in such a situation will systematically replace various components — spark plugs, the coil and other parts under the hood — with components known to be working well.

With each replacement in this sequence, the mechanic will reattempt starting the car and attaining an acceptable running condition. In the event a particular parts replacement leads to a satisfactory rumbling of the engine, the mechanic can conclude that the cause of complaint has been excised.

Similarly, users of IBM installations with data communications among mainframes have a practice of regularly running Vtam fixes. As each module of the long Vtam program is tried, certain network performance problems may be eliminated, the spokesman explained.

But what happens if one of the fixes is bad? Apparently that happened at this installation in a major metropolitan area, triggering an INVALID DATE error and the loss of approximately 800 man-hours in labor as employees of the company and its clients waited for resurrection of the 370/168 and 3032.

An IBM service representative was soon on the scene, the spokesman told *Computerworld*, and the byte on which the 3705s gagged — the final '6' in the Julian number 80366 — was changed to something palatable.

Hope for Rebate

Does the user plan any legal action against IBM, reflecting the dollars lost due to the Vtam foul-up? According to the spokesman, the company hopes to receive a rebate from its prime systems supplier, but — to help keep this alternative viable — a vice-president asked him to withhold the company from print.

Life with IBM can be diffic customers that publicize pr with the vendor's product spokesman said.

However, it will be interest said, to see whether other Vta had the same New Year's Eve p when personnel gather at thi professional conferences.

Kickbacks, Sex for Jobs

(Continued from Page 1)

Still another ploy purportedly used by some employment agencies is running advertisements for jobs at a specific company's installation. These ads carry a post office box number that seems to belong to the company, but turns out to belong to the employment agency.

People who do not want to deal with agencies are then harrassed by calls, all the time wondering how their names were obtained.

Going hand in hand with money and gifts is the practice of blatantly misrepresenting companies and their DP installations in an attempt to make them appear more desirable. A company's status both in the business community and in professional DP quality will be purposely fabricated by some agencies to hook an applicant into accepting a job, sources claimed.

"I was offered a job as a systems pro-

ment revealed that he was harshly and unfairly by one N agency that told him bluntly was not worth the salary he w ing because he lacked experie IBM equipment.

"They tried to convince me t job for less money to gain IBM ence, not even considering th that I currently possess. It though I had a plague," he sai

The programmer eventually good job on his own.

Personnel departments in u panies contribute to the pro selling copies of incoming re agencies, which then follov them, sources said.

Sex Ploys

Some recruiters will even of ranking personnel manager companies "good times" wi recruiters of their choice in leads on job openings.

'Father Time Software' Secrets Allow Updating Of Dates

By Joe Celko and Jackie McDonald

I have a plan to make a fortune in the year 2000. I will start a company named "Father Time Software" that does nothing but correct programs and data files that used only the last two digits of the year ("year of century" format) for keeping their records. The company will supply a utility package that re-formats files and searches through program text for such sloppy code. We will charge fantastic fees for our services, and clients will have no choice but to pay.

First of all, some programs will simply blow up when they try to compute the number of days between "99DEC31" and "00JAN01." Those that die will be the nicest programs in the systems. Some programs will run, but with negative days in the calculations so that the customer will be charged negative interest on his debts.

Then, just when my clients have relaxed a bit about changing all of their files and programs over to a full-year date, I can come back and correct the leap-year cycle code in their date procedures. How many systems that remembered leap-years are divisible by four also remembered that when the year is divisible by 100, it is not a leap-year, unless it is divisible by 400? Another fantastic profit for Father Time Software Services in February of 2000 A.D.! The operation can be financed until 2000 A.D. by programs and data files that used in their dates only the year within the decade.

All this may sound a bit fantastic, but consider the havoc that can be wrought by such simple things. An insurance company, which will remain nameless, bought a block of business from another firm in the early 1960s. The new policies had numbers that, in traditional insurance company fashion, began with the year of issue followed by five digits (i.e. 60-00001 is the first policy issued in 1960).

Unfortunately, these numbers were identical to the company's own policy numbers. To solve this problem and to avoid confusing the computer, which would not accept duplicate numbers, it was decided to substitute "80" for the year of issue on the new policies. "After all, 1980 is 20 years away, and we will be gone by then," said the programming staff. Guess what year it is now?

This problem was further complicated for the company because during the years since 1960 it had developed a standard numbering format that is consistent from year to year. A large percentage of the numbers which would ordinarily have been allocated for 1980 are active, 1960 policies. The still-available numbers are interspersed with active numbers. (Maybe they could give the 1980 policies 2000 numbers. After all, 2000 is 20 years away, and we'll be gone by then.)

In the United States, a date is commonly written with slashes in the format "<month>/<day>/<two digit year>". In England and parts of Europe, the date is written in the format "<day>/<Arabic numeral month>/<two digit year>". The United States military uses the format "<day> <three letter month> <four digit year>".

Another military format

Continued on Page 32

Joe Celko is a research scientist at the Engineering Experiment Station of the Computer Science and Technology Laboratory at Georgia Tech in Atlanta.

Jackie McDonald is supervisor for central files at United Family Life Insurance Co., Atlanta, Ga.

How To Plan Ahead For Computer Dates In A New Century

Continued from Page 28

that was proposed in Europe was "<day> <Roman numeral month> <two digit year>" to avoid language problems with three letter abbreviations. The only thing that everyone agrees upon is that the year and the day are to be written in Arabic numerals.

When they are writing input routines for dates, typists must be allowed as much latitude as possible in the formats. But as soon as the date is in the system, print it out in one and only one format. In the case of interactive screens, the input date can be written over with the system format as soon as it is entered. Pretty soon, people will start using the systems format and not even think about it.

Julian dates are not the same thing as a *Julianized* date. Computer people often are sloppy about this point. The Julian date is an astronomy term, which is represented by a very large number and provides a count of the Earth's revolutions since a fixed date. The Julianized date is the count of days within the current year.

The Julianized date is part of the ANSI standard, and should be written without separators in the format "<year><day of year>". The first version of a Julianizing algorithm that a programmer writes generally involves having a table with the number of days of the month, and hanging in a loop to add up the number of days to convert the month into days.

It looks like the Julianize One procedure shown below:

```
INTEGER FUNCTION Julianize One
(Year, Month, Day);

INTEGER Year, Month, Day;

BEGIN
  INTEGER ARRAY month-table
  [1:12]
    INIT (31, 28, 31, 30, 31, 30, 31, 31,
    30, 31, 30, 31);
    INTEGER i;

LeapYear:
  COMMENT years divisible by 4 and
  400 are leap years; those divisible by
  100 are not. The MOD operator is the
  remainder of integer division;
  IF ((Year MOD 4 = 0) OR (Year MOD
  100 = 0))
    AND (Year MOD 400 <> 0)
  THEN month-table [2]:= 29;
 COMMENT Validate date, and use
 zero as 'bad date' value;
```


```
Validate:
  IF ((Month < 1) OR (Month > 12))
    OR ((Day < 1) OR (Day > month-
    table [Month]))
    OR (Year < minimum-year-in-
    system)
  THEN Julianize One:= 0
  ELSE
 Work: BEGIN
        Julianize One:= 0;
        FOR i:= 1 TO month-table
        [Month-1]
 DO Julianize One:= Julianize One +
        month-table [i];
        Julianize One:= (Year * 1000)
        +(Julianize One + Day);
        END;
END.
```

There are some bad spots with the procedure. First, most people forget the statement labeled "LeapYear:" the first time they do one of these programs, and then they forget the 400-year-cycle rule if they did remember. The second bad spot is that they assume they are getting a valid date and leave off the code labeled "Validate:".

Another bad spot is the placement of the validation in the same module as the Julianization; these are separate functions and the validation could be used by many input procedures in the system. Let us split it off into an external library procedure.

The final bad spot is that the statement labeled "work:" is much too long;

Continued on Next Page

Leap Year Programs Keep Computer Calendars Accurate

Continued from Page 32

the loop can be replaced with a table of accumulated total days to give this algorithm:

```
INTEGER FUNCTION Julianize Two
(Year, Month, Day);
INTEGER Year, Month, Day;
BEGIN
  INTEGER ARRAY accum-month-
  table [1:12]
    INIT (0, 31, 59, 90, 120, 151, 181,
    212, 243, 273, 304, 334);
  EXTERNAL BOOLEAN FUNC-
  TION Valid-date;
  EXTERNAL BOOLEAN FUNC-
  TION LeapYear;
  INTEGER i;
COMMENT Validate date, and leap
year checking are functions now;
  IF Valid-date (Year, Month, Day)
  THEN
Work:BEGIN
    IF (LeapYear (Year) AND (Month
    > 1))
    THEN Julianize Two:= 1
    ELSE Julianize Two:= 0;
    Julianize Two:= (Year * 1000) +
    accum-month-table [Month] + Day;
    END
  ELSE Julianize Two:= 0;
END.
```

Many programmers think the constant use of the Century cycle in these algorithms is a bit picky. But the year 2000 will come and go within the lifetime of many of the systems that are now in operation or which will be written in the near future. You might want to wait a bit and comment off the code for it, or use "IF (year = 2000) THEN . . ." *instead of the MOD operator—but* you should consider it.

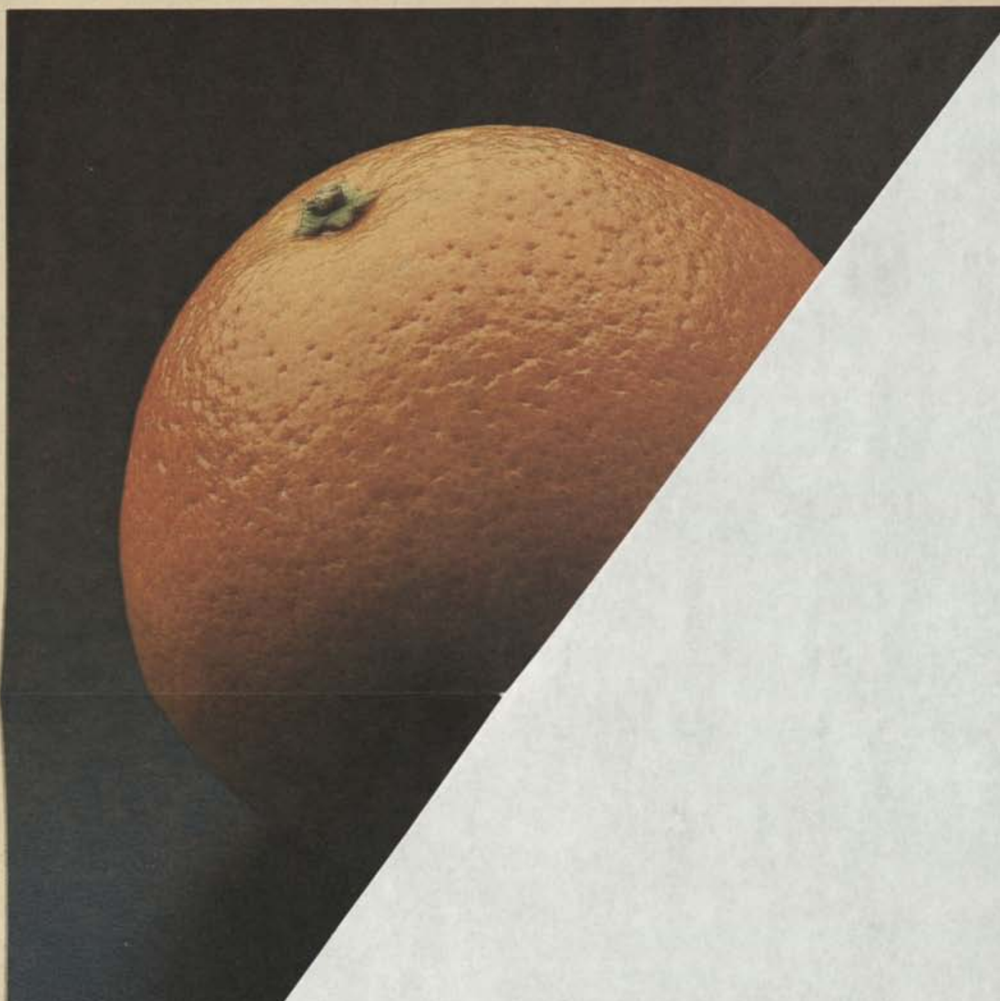
Robert Tantzen gave the following algorithms for calculation of the Julian date in the Collect Algorithms of the ACM. They will work for any date in the Gregorian calendar, and require integers that can hold up to seven digits.

```
INTEGER PROCEDURE Julian
(Year, Month, Day);
INTEGER Year, Month, Day;
BEGIN INTEGER Century, Year-in-
Century;
COMMENT The 'DIV' operator is
integer division;
  IF (Month > 2)
  THEN Month:= - 3
  ELSE BEGIN
    Month:= Month + 9;
    Year:= Year - 1;
    END;
  Century:= Year DIV 100;
  Year-in-Century:= y - 100 * Century;
  Julian:= (146097 * Century) DIV 4 +
  (1461 * Year-in-Century) + (153 *
  Month + 2) DIV 5 + Day + 1721119;
END.
```

Now that you have a Julian date, you will want to be able to get it back out, so a human being can read it. This procedure will perform that function:

```
PROCEDURE UnJulian (JulianDay,
Year, Month, Day);
COMMENT The input is the Julian
day and the output is the Gregorian
year, month and day;
INTEGER JulianDay, Year, Month,
Day;
BEGIN
  JulianDay:= JulianDay - 1721119;
  Year:= (4 * JulianDay - 1) DIV 146097;
  JulianDay:= 4 * JulianDay - 1 -
  146097 * Year;
  Day:= JulianDay DIV 4;
  JulianDay:= (4 * Day + 3) DIV 1461;
  Day:= 4 * Day + 3 - 1461 * JulianDay;
  Day:= (Day + 4) DIV 4;
  Month:= (5 * d - 3) DIV 153;
  Day:= 5 * Day - 3 - 153 * Month;
  Day:= (Day + 5) DIV 5;
  Year:= 100 * Year + JulianDay;
  IF (Month > 10)
  THEN Month:= Month + 3
  ELSE BEGIN
    Month:= Month - 9;
    Year:= Year + 1;
    END;
END.
```

The calculations are all in integers.



Honeywell Interoffice Correspondence

Bob: It now being nine months since I wrote this letter to you, are you about to give birth to an answer? Pete

Date: March 12, 1981

To: Bob Bemer

From: P. G. Smee

Location: EP&C

Subject:

I have some questions about TEXLIB/U/DATE.

If i set jd = 1, DATE tells me that the calendar date is -4713/11/25. Now that's not right, it should be -4713/1/1.

Examination of the algorithm leads me to believe that it assumes a "year zero" between years -1 and +1. That's not right either.

I attempted to create an algorithm which would give the "right" answer (whatever that is!). But for several dates for which I can obtain the julian day number from other references, my algorithm is "off" by 38 days. Now 10 of that results from the loss of 10 days when the Gregorian calendar was implemented, but where does the other 28 come from?

I note that your algorithm supplies the correct answer for these same dates, all of which are in the 20th century. But -4713/1/1 comes out as -327 (jd) which certainly isn't right. Somewhere between 190 and -4713 it gets off track, but where?

I also have a question about the LEAP algorithm. It says quadri-millesimal years are not leap years. I don't think Pope Gregory said that. Admittedly, it leads to an average year of 365.24225, which is closer to the actual 365.2422 than the Gregorian algorithm, which yields 365.2425 -- but is it "legal"?

I am hopeful that a "2-to-the-5th power" programmer can straighten out a mere novice like myself.

Pete

P. G. Smee

/gjb

Att: Sample programs

CF 25 (4-78)

1985-89

Standards

UDC 529.2 : 003.35

Ref. No. : ISO/R 2014-1971 (E)

ISO

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION

ISO RECOMMENDATION
R 2014

WRITING OF CALENDAR DATES IN ALL-NUMERIC FORM

1st EDITION

January 1971

Printed in Switzerland

Also issued in French and Russian. Copies to be obtained through the national standards organizations.

ISO Recommendation | R 2014 | January 1971

WRITING OF CALENDAR DATES IN ALL-NUMERIC FORM

INTRODUCTION

In all forms of international traffic and exchange, dates must be clearly designated and able to be compared without any ambiguity.

This ISO Recommendation for writing of calendar dates in all-numeric form has been prepared to obviate the confusion arising from misinterpretation of the significance of the numerals in a date written with numerals only; it is considered that similar confusion does not arise when the month is spelled out, either in full or in abbreviated form.

The occasions on which an all-numeric date might be used have been examined and the advantages for these occasions of the descending order year–month–day have been found to outweigh those for the ascending order day–month–year, established in many parts of the world.

The advantages of this descending order include the following in particular :

- the ease with which the whole date may be treated as a single numeral for the purpose of filing and classification (e.g. for insurance or social security systems);
- arithmetic calculation, particularly in some computer uses;
- the possibility of continuing the order by adding digits for hour–minute–second.

1. SCOPE

This ISO Recommendation specifies the writing of dates of the Gregorian calendar in all-numeric form, signified by the elements year, month, day.

2. FIELD OF APPLICATION

This ISO Recommendation should be applied whenever a calendar date containing the elements year, month, day is written in an all-numeric form.

UDC 529.2 : 003.35

Ref. No. : ISO/R 2015-1971 (E)

ISO

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION

ISO RECOMMENDATION

R 2015

NUMBERING OF WEEKS

1st EDITION

January 1971

For each individual country the only valid standard is the national standard of that country.

Printed in Switzerland

Also issued in French and Russian. Copies to be obtained through the national standards organizations.

BRIEF HISTORY

The ISO Recommendation R 2015, *Numbering of weeks,* was drawn up by the *Co-ordinating committee on the standardization of the writing of dates (DATCO)*, the Secretariat of which is held by the ISO Central Secretariat in Geneva.

Work on this question led to the adoption of Draft ISO Recommendation No. 2015, which was circulated to all the ISO Member Bodies for enquiry in January 1970. It was approved, subject to a few modifications of an editorial nature, by the following Member Bodies :

Austria	India	South Africa, Rep. of
Belgium	Iraq	Sweden
Canada	Ireland	Switzerland
Ceylon	Israel	Thailand
Czechoslovakia	Italy	U.A.R.
France	Korea, Dem. P. Rep. of	United Kingdom
Germany	Korea, Rep. of	U.S.A.
Greece	Netherlands	Yugoslavia
Hungary	Poland	

The following Member Bodies opposed the approval of the Draft :

Japan
Norway
Portugal

This Draft ISO Recommendation was then submitted by correspondence to the ISO Council, which decided to accept it as an ISO RECOMMENDATION.

ISO Recommendation | R 2015 | January 1971

NUMBERING OF WEEKS

INTRODUCTION

The calendar week is a convenient time period for certain commercial and planning purposes. Delivery dates in purchasing contracts, transport plans and similar documents are frequently designated by referring to a certain week number. Since methods of numbering the week of the year vary from country to country, it is very important to use a uniform numbering of weeks for international trade and the industrial planning of international companies.

Uniform numbering of weeks necessitates a unique designation of the day on which a week begins. For commercial, i.e. accounting, planning and similar purposes for which a week number might be used, Monday has been found the most appropriate as the first day of the week.

1. SCOPE

This ISO Recommendation specifies a system for the numbering of the weeks of a year of the Gregorian calendar. For this purpose it designates the day on which a week begins and defines week number one of a year.

2. FIELD OF APPLICATION

This ISO Recommendation should be applied in all cases where a definite week of the year is to be designated for commercial use.

3. RULES FOR NUMBERING

3.1 Definition

A week number should always stand for a time period of seven days.

3.2 Beginning of a week

For the purpose of week numbering, the first day of a week shall be Monday.

3.3 Designation of week number one of a year

Week number one of a year is the first week containing four days or more of the new year.

EXPLANATORY NOTE. – The first day of a week being Monday, week number one of a year is the week containing the first Thursday of January (see example in Appendix).

3.4 Writing of week number

This ISO Recommendation does not specify a unique form of writing the week number. The form of writing will depend on the context of its application :

- for the purpose of automatic data processing, the week numbers one to nine will be written with two digits (i.e. 01 to 09);
- diary and calendar publishers will not normally print a zero in front of the week numbers 1 to 9;
- to clearly indicate the reference to a week number, a symbol for "week" (in the relevant language) may be added to the number (e.g. W 01 or W 1 for week number one);
- in delivery contracts, etc. it may be preferable to write the week numbers one to nine with two digits, in order to reduce the possibility of falsification.

EXAMPLE OF NUMBERING OF WEEKS

Year	Day		No. of week
1968	Sunday	29 Dec.	52
1968	Monday	30 Dec.	01
1968	Tuesday	31 Dec.	01
1969	Wednesday	1 Jan.	01
1969	Thursday	2 Jan.	01
1969	Friday	3 Jan.	01
1969	Saturday	4 Jan.	01
1969	Sunday	5 Jan.	01
1969	Sunday	28 Dec.	52
1969	Monday	29 Dec.	01
1969	Tuesday	30 Dec.	01
1969	Wednesday	31 Dec.	01
1970	Thursday	1 Jan.	01
1970	Friday	2 Jan.	01
1970	Saturday	3 Jan.	01
1970	Sunday	4 Jan.	01
1970	Sunday	27 Dec.	52
1970	Monday	28 Dec.	53
1970	Tuesday	29 Dec.	53
1970	Wednesday	30 Dec.	53
1970	Thursday	31 Dec.	53
1971	Friday	1 Jan.	53
1971	Saturday	2 Jan.	53
1971	Sunday	3 Jan.	53
1971	Monday	4 Jan.	01
1971	Sunday	26 Dec.	51
1971	Monday	27 Dec.	52
1971	Tuesday	28 Dec.	52
1971	Wednesday	29 Dec.	52
1971	Thursday	30 Dec.	52
1971	Friday	31 Dec.	52
1972	Saturday	1 Jan.	52
1972	Sunday	2 Jan.	52
1972	Monday	3 Jan.	01
1972	Tuesday	4 Jan.	01
1972	Friday	29 Dec.	52
1972	Saturday	30 Dec.	52
1972	Sunday	31 Dec.	52
1973	Monday	1 Jan.	01
1973	Tuesday	2 Jan.	01
1973	Wednesday	3 Jan.	01
1973	Thursday	4 Jan.	01

ISO NEWS SERVICE

1971-02-03

Ref.: No. 107/02-71

How to avoid confusion when writing the date ....

The world-wide membership of ISO (the International Organization for Standardization) has agreed to standardize the manner of writing dates. Thus, the most junior typist has the opportunity of making her contribution to the removal of one unnecessary obstacle to international communication.

How?

By using the universally agreed system of descending order when writing the date on any letter or document. This rule applies only when an all-numeric form is used, which might lead to confusion.

Provided that the month is clearly spelled out (even in an abbreviated form) one can write the date however one wishes - 1 April 1971, April 1 1971, or 1971 April 1. There is no ambiguity, so no standard is required.

However, when an American writes the date 4 - 1 - 1971 to indicate April the first, an Englishman or a Norwegian, for example, would read the date as the fourth of January.

After studying all the implications of the question, an ISO committee of experts recommended the descending order and ISO Recommendation 2014 has now been approved by 25 countries *. Four countries only (Czechoslavakia, Ireland, Norway and Iraq) disapproved the proposal - they preferred the ascending order. Four more countries (Australia, Denmark New Zealand and Turkey) abstained.

* Austria, Belgium, Canada, Ceylon, France, Germany, Greece, Hungary, India, Italy, Japan, North Korea, South Korea, Netherlands, Poland, Portugal, South Africa, Spain, Sweden, Switzerland, Thailand, U.A.R., United Kingdom, U.S.A., Yugoslavia.

The ISO committee concluded that the advantages of the descending order clearly out-weighed any disadvantages. In particular, are cited:

- the ease with which the whole date may be treated as a single numeral for the purpose of filing and classification (e.g. for insurance or social security systems);
- arithmetical calculation, particularly in some computer applications;
- the possibility of continuing the order by adding digits for hour - minute - second.

To be precise, ISO recommends that if numbers only are used, the first day of April 1971 should be written: 1971 - 04 - 01.

For technical reasons, the hyphen is recommended as a separator rather than the point, the stroke or the space.

Of course, a standard is of little use unless it is widely known and understood. That is why ISO now seeks the cooperation of men and women all over the world who prefer order to chaos - and who would not wish to miss an important date because of a misunderstanding.

.......and when numbering the weeks

A second document, ISO/R 2015 lays down the agreed standard for the numbering of weeks. The calendar week is an important unit for planning and accounting purposes. Delivery dates in purchasing contracts, and similar documents are frequently designated by referring to a certain week number. Since methods of numbering the weeks of the year vary from country to country, a uniform system for the numbering of weeks has an increasing importance for international trade and industrial planning.

Briefly, ISO recommends that Monday (rather than Sunday) be regarded as the first day of the week for business and commercial purposes. ISO/R 2015 recommends, too, that the week should always be of seven days and that a week divided by the turn of the year should be attached to the year containing the higher number of days of that week. Thus, for practical purposes, the first week of the year could begin, at one extreme, on 29 December, and at the other extreme, on 4 January.

END

ANSI X3.30-1971

American National Standard

representation for calendar date and ordinal date for information interchange

X3.30-1971

american national standards institute, inc.
1430 broadway, new york, new york 10018

ANSI
X3.30-1971

American National Standard
Representation for Calendar Date and Ordinal Date for Information Interchange

Secretariat

Business Equipment Manufacturers Association

Approved July 1, 1971

American National Standards Institute, Inc

American National Standard

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Foreword

(This Foreword is not a part of American National Standard Representation for Calendar Date and Ordinal Date for Information Interchange, X3.30-1971.)

This American National Standard presents standard representations for calendar date and ordinal date for use in the interchange of data among data systems.

This standard was approved as an American National Standard by the American National Standards Institute (ANSI) on July 1, 1971.

Suggestions gained through the use of this standard will be welcome. They should be sent to the American National Standards Institute, Inc, 1430 Broadway, New York, N.Y. 10018.

The Standards Committee on Computers and Information Processing, X3, had the following personnel at the time of approval:

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Subcommittee X3L8 on Representations of Data Elements, which developed and processed this standard, had the following personnel:

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Contents

American National Standard Representation for Calendar Date and Ordinal Date for Information Interchange

1. Scope and Purpose

1.1 The scope of this standard is limited to the interchange of data among data systems. This standard was not designed for (nor does it preclude) usage by humans as input to or output from data systems.

1.2 The purpose of this standard is to provide standard means of representing calendar date and ordinal date to facilitate interchange of data among data systems.

2. Specifications

2.1 Calendar date is a representation composed of the time elements year, month of year, and day of month.

2.2 Ordinal date is a representation composed of the time elements year and day of year.

2.3 Year shall be represented as four digits with the option of omitting the two high order digits (commonly referred to as century) as required in applications where century is to be implied. In like manner, the four digit year may be truncated to the low order single digit in those applications where the century and decade are to be implied. When year is truncated to two digits, the term, "Year of Century" should be used to identify the representation; when truncated to one digit, the term "Year of Decade" should be used to identify the representation.

2.4 Month of year shall be represented by the ordinal numbers 01, 02, ... , 12, representing the first through the twelfth months.

2.5 Day of month shall be represented by the ordinal numbers 01, 02, ... , 31, representing the first through the thirty-first days.

2.6 Day of year shall be represented by the ordinal numbers ranging from 001 (January 1) through 365 or 366 (Leap Year) for December 31.

2.7 The sequence of the time elements shall be from high order to low order (left to right), year, month of year, and day of month of year, day of year.

2.8 No separators shall be used between the time elements.

3. Example

1967 July 1, 1 July 1967, and July 1, 1967 will be expressed as 19670701 in calendar date form and as 1967182 in ordinal date form. Alternatively, when the year is truncated to 2 or 1 digit(s), these would be represented as (670701 and 70701) and (67182 and 7182), respectively.

4. Qualifications

4.1 The ordinal date is commonly used in applications where frequent computation is employed to determine the number of elapsed days between two dates.

4.2 The time elements, year, month of year, day of month, and day of year may be represented and used independently or collectively as required. When used collectively, the high to low sequence must be maintained, that is, year-month of year, month of year-day of month, year-month of year-day of month, or year-day of year.

Appendix

(This Appendix is not a part of American National Standard Representation for Calendar Date and Ordinal Date for Information Interchange, X3.30-1971, but is included to facilitate its use.)

A1. Intended Use of the Standard Representations

The standard representations for calendar date and ordinal date are intended for use in the interchange of data among data systems. This interchange is the counterpart of the present interchange of conventional business transaction documents: bid requests, purchase orders, invoices, shipping notices, payments, etc, that are represented in machine sensible form.

A2. Projected Standard Representations for Time Elements

A2.1 The standard representations for calendar date and ordinal date are members of a family of representations for time elements to be developed for the full range of needs for representing time elements in the interchange of data.

A2.2 Additional members of the projected family of data codes for times include the following:

(1) Week of year.

(2) Julian day number.

(3) Quarter of year.

(4) Time of day carried to hours, minutes, seconds, and time zones.

(5) General time intervals. These are arbitrary intervals and intervals corresponding to established units of calendar and civil time.

(6) Period-to-date intervals. These are special cases of (5) above. The period for which the to-date interval is to be identified may be, for example, a year, half-year, quarter-year, month, or week.

INTERNATIONAL STANDARD ISO 2711

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION • МЕЖДУНАРОДНАЯ ОРГАНИЗАЦИЯ ПО СТАНДАРТИЗАЦИИ • ORGANISATION INTERNATIONALE DE NORMALISATION

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FOREWORD

ISO (the International Organization for Standardization) is a worldwide federation of national standards institutes (ISO Member Bodies). The work of developing International Standards is carried out through ISO Technical Committees. Every Member Body interested in a subject for which a Technical Committee has been set up has the right to be represented on that Committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work.

Draft International Standards adopted by the Technical Committees are circulated to the Member Bodies for approval before their acceptance as International Standards by the ISO Council.

International Standard ISO 2711 was drawn up by Technical Committee ISO/TC 97, *Computers and information processing.*

It was approved in July 1972 by the Member Bodies of the following countries :

Australia	Italy	Spain
Canada	Japan	Switzerland
Czechoslovakia	Netherlands	Thailand
Egypt, Arab Rep. of	New Zealand	United Kingdom
France	Poland	U.S.A.
Germany	Portugal	
Ireland	Romania	

The Member Bodies of the following countries expressed disapproval of the document on technical grounds :

Belgium
Sweden
Turkey

Printed in Switzerland.

Information processing interchange – Representation of ordinal dates

1 SCOPE

This International Standard establishes a system of representing ordinal dates to facilitate the interchange of data among data systems.

2 FIELD OF APPLICATION

This International Standard shall be applied whenever representations of ordinal dates are used in the interchange of data among data systems.

The ordinal date is commonly used in cases where machines are frequently utilized to carry out a systematic sorting in the order of succession of dates or to determine the number of days elapsed between two dates.

In other applications utilizing numeric representations of calendar date, the provisions of ISO/R 2014 shall apply.

3 REFERENCE

ISO/R 2014, *Writing of calendar dates in all-numeric form.*

4 RULES FOR REPRESENTING ORDINAL DATES

4.1 Composition

An ordinal date is composed of the time elements year and day of year.

4.2 Sequence

The sequence of the time elements shall be from high order to low order (left to right), year, day of year.

4.3 Representation of time elements

The year shall be represented as four digits with the option of omitting the two high order digits (commonly referred to as century) as required in applications where the century is to be implied. In a like manner, the four digit year may be truncated to the low order single digit in those applications where the century and decade are to be implied. When the year is truncated to two digits, the term "year of century" shall be used to identify the representation; when it is truncated to one digit, the term "year of decade" shall be used to identify the representation.

The day of year shall be represented by a three digit number from 001 (January 1) to 365 or 366 (leap year) for December 31 (see Table).

The time elements year and day of year may be represented and used independently or collectively as required. When used collectively the high to low sequence shall be maintained, i.e. year-day of year.

4.4 Separators

Separators are not required and consequently shall not be used when interchanging data among data processing systems. However, if required to facilitate human understanding, a hyphen (-) or a space shall be used between the year and day of year.

5 EXAMPLES

For the interchange of data among data systems, 1967 July 1, 1 July 1967, and July 1, 1967 will be represented in ordinal date form as 1967182. Alternatively, when the year is truncated to two or one digit(s), these will be represented as 67182 or 7182.

When separators are used to facilitate human understanding these will be represented as : 1967-182, 67-182, or 7-182 (with hyphens) or as 1967 182, 67 182, or 7 182 (with spaces).

TABLE – **Numerical calendar**

Day of month	Day of year											
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
01	001	032	060	091	121	152	182	213	244	274	305	335
02	002	033	061	092	122	153	183	214	245	275	306	336
03	003	034	062	093	123	154	184	215	246	276	307	337
04	004	035	063	094	124	155	185	216	247	277	308	338
05	005	036	064	095	125	156	186	217	248	278	309	339
06	006	037	065	096	126	157	187	218	249	279	310	340
07	007	038	066	097	127	158	188	219	250	280	311	341
08	008	039	067	098	128	159	189	220	251	281	312	342
09	009	040	068	099	129	160	190	221	252	282	313	343
10	010	041	069	100	130	161	191	222	253	283	314	344
11	011	042	070	101	131	162	192	223	254	284	315	345
12	012	043	071	102	132	163	193	224	255	285	316	346
13	013	044	072	103	133	164	194	225	256	286	317	347
14	014	045	073	104	134	165	195	226	257	287	318	348
15	015	046	074	105	135	166	196	227	258	288	319	349
16	016	047	075	106	136	167	197	228	259	289	320	350
17	017	048	076	107	137	168	198	229	260	290	321	351
18	018	049	077	108	138	169	199	230	261	291	322	352
19	019	050	078	109	139	170	200	231	262	292	323	353
20	020	051	079	110	140	171	201	232	263	293	324	354
21	021	052	080	111	141	172	202	233	264	294	325	355
22	022	053	081	112	142	173	203	234	265	295	326	356
23	023	054	082	113	143	174	204	235	266	296	327	357
24	024	055	083	114	144	175	205	236	267	297	328	358
25	025	056	084	115	145	176	206	237	268	298	329	359
26	026	057	085	116	146	177	207	238	269	299	330	360
27	027	058	086	117	147	178	208	239	270	300	331	361
28	028	059	087	118	148	179	209	240	271	301	332	362
29	029		088	119	149	180	210	241	272	302	333	363
30	030		089	120	150	181	211	242	273	303	334	364
31	031		090		151		212	243		304		365

NOTE – In the leap year "1" has to be added in each case after February 28.

American National Standard

representations of universal time, local time differentials, and United States time zone references for information interchange

Approved August 4, 1975 Secretariat: Computer and Business Equipment Manufacturers Association

1. General

1.1 Scope and Purpose

1.1.1 Scope. The scope of this standard is limited to the interchange of data among systems. This standard was not designed for (nor does it preclude) usage by humans as input to, or output from, data systems.

1.1.2 Purpose. The purpose of this standard is to provide standard means for representing Universal Time, Local Time Differentials, and United States Time Zone References to facilitate interchange of data among data systems. Specifically, it is intended to:

(1) Reduce the time required to record or format time expressions, or both, and transmit them

(2) Improve clarity and accuracy of interchange

(3) Minimize the amount of human intervention required for communicating time expressions

(4) Reduce costs

1.2 Qualifications. This standard does not prescribe file sequences, storage media, programming languages, or other features of information processing to be used in its implementation.

The use of this standard to represent Universal Time, Local Time Differentials, or U.S. Time Zone References does not ensure that the representation is accurate.

This standard provides more than one means whereby local time expressions can be related to Universal Time or a particular time zone. In applications using this standard, the particular form used should be defined in related record or file descriptions.

1.3 Related Standards. American National Standard Representation for Calendar Date and Ordinal Date for Information Interchange, X3.30-1971, can be used in combination with this standard for representing date-time groups.[1]

2. Specifications

2.1 Representation of Universal Time

2.1.1 Universal Time (Greenwich Mean Time) is represented by an uppercase letter "Z" directly following the low-order (or extreme right-hand) time element of the 24-hour clock time expression.

2.1.2 In 12-hour clock time expressions Universal Time is represented by a space followed by the uppercase letters "GMT," directly following the meridian designator (the low-order element). (Refer to Example 1 in Section 3.)

2.1.3 In systems limited to a lowercase character set, the lowercase "z" or "gmt" will be used to represent Universal Time in the same manner as indicated in 2.1.1 and 2.1.2, respectively.

2.2 Representation of a Local Time Differential Factor (TDF)

2.2.1 Many applications require that time be expressed as local civil clock time. A Time Differential Factor (TDF) is a means for facilitating information interchange by relating local time expressions to Universal Time (GMT). The TDF should not be used to imply or derive geographical references for the local time expression.

[1] In addition, a standard on representations for local time of the day for information interchange has been developed by the X3 Standards Committee and is being considered for adoption as an American National Standard.

ANSI1M1075/150

2.2.2 The TDF expresses the difference in hours and minutes between local time and Universal Time. It is represented by a four-digit number preceded by a plus (+) or minus (–) sign, indicating the hours and minutes the local time is ahead of or behind Universal Time, respectively.

2.2.3 The TDF for Universal Time is represented as +0000. Local times throughout the world vary from Universal Time by as much as 13 hours. When local times are behind (slower than) Universal Time, the TDF varies from –0001 to –1200. When local times are ahead of (faster than) Universal Time, the TDF varies from +0001 to +1300.

2.2.4 The TDF follows, without separators, the low-order (or extreme right-hand) time element of the 24-hour clock expression. (Refer to Example 2 in Section 3.) It is not to be used in expressions of 12-hour clock times.

2.3 Representation of Local Time Zones in General Use within the United States

2.3.1 Many applications within the United States require that local time be expressed referencing a particular time zone. Table 1 provides most of the time zone references that are used in these applications.

2.3.2 In accordance with the Uniform Time Act of 1966, "During the period commencing at 2 a.m. on the last Sunday in April of each year and ending at 2 a.m. on the last Sunday in October, the standard time is advanced one hour except in those states which have by law exempted themselves from observance of advanced time." This advanced time is commonly referred to as "Daylight" or "Daylight Saving" time. Table 2 provides codes for advanced time references.

Table 1
Time Zone References for U.S. Standard Time Zones

Time Zone Reference Code	Standard Time	TDF
NST	Newfoundland Standard Time	–0330
AST	Atlantic Standard Time	–0400
EST	Eastern Standard Time	–0500
CST	Central Standard Time	–0600
MST	Mountain Standard Time	–0700
PST	Pacific Standard Time	–0800
YST	Yukon Standard Time	–0900
HST	Alaska-Hawaii Standard Time	–1000
BST	Bering Standard Time	–1100

Table 2
Time Zone References for U.S. Advanced Time Zones

Advanced Time Reference Code	Advanced Time	TDF
ADT	Atlantic Daylight Time	–0300
EDT	Eastern Daylight Time	–0400
CDT	Central Daylight Time	–0500
MDT	Mountain Daylight Time	–0600
PDT	Pacific Daylight Time	–0700
YDT	Yukon Daylight Time	–0800
HDT	Alaska-Hawaii Daylight Time	–0900
BDT	Bering Daylight Time	–1000

2.3.3 A Time Zone Reference Code is represented by the uppercase three-letter code given in Tables 1 and 2. It is separated from the low-order time element of a local time expression by a space. (Refer to Example 3 in Section 3.) In systems having only a lowercase character set, the lowercase equivalents of the codes given in Tables 1 and 2 will be used as indicated.

3. Examples

The following examples represent a local time of 2 hours, 9 minutes, and 23 seconds past noon in the U.S. Eastern Standard Time Zone.

Example 1 (Universal Time)
Representation: 190923Z or 07:09:23P GMT

Example 2 (Local Time with a Time Differential Factor)
Representation: 140923-0500

Example 3 (Local Time with a Time Zone Reference)
Representation: 02:09:23P EST or 140923 EST

ANSI®
X3.43-1977

American National Standard Representations of Local Time of the Day for Information Interchange

Secretariat

Computer and Business Equipment Manufacturers Association

Approved November 29, 1976

American National Standards Institute, Inc

Foreword

(This Foreword is not a part of American National Standard Representations of Local Time of the Day for Information Interchange, X3.43-1977.)

Suggestions for improvement of this standard will be welcome. They should be sent to the American National Standards Institute, 1430 Broadway, New York, N.Y. 10018.

This standard was processed and approved for submittal to ANSI by American National Standards Committee on Computers and Information Processing, X3. Committee approval of the standard does not necessarily imply that all committee members voted for its approval. At the time it approved this standard, the X3 Committee had the following members:

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Univac	M. W. Bass C. D. Card (Alt)
U.S. Department of Defense	W. L. McGreer W. C. Rinehuls (Alt) W. B. Robertson (Alt)
Xerox Corporation	E. R. Vance

Technical Committee X3L8 on Representations of Data Elements, which developed this standard, had the following members:

H. S. White, Jr, Chairman
W. S. Haynie, Vice-Chairman

T. E. Anderson
M. F. Atkinson
J. E. Beltramea
C. Brosnan
L. B. Cheney
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N. Serrajian
D. L. Shoemaker
S. M. Smythe
C. E. Stevens
R. N. Tipton
C. R. Trueworthy
A. J. Wright

Contents

American National Standard Representations of Local Time of the Day for Information Interchange

1. General

1.1 Scope. This standard is designed to establish uniform time representations based upon both the 12- and 24-hour timekeeping systems. It provides a means for representing local time of the day in digital form for the purpose of interchanging information among data systems. Specifically, it is intended to:

(1) Reduce the time required to record or format the elements of local time of the day expressions and transmit them

(2) Improve clarity and accuracy of interchange

(3) Minimize the amount of human intervention required for communicating local time of the day expression

(4) Reduce costs

(5) Provide a convenient and efficient way for machines and humans to distinguish between time representations in the 12- and 24-hour timekeeping systems.

1.2 Qualifications. This standard does not prescribe file sequences, storage media, programming languages, or other features of information processing to be used in its implementation. The use of this standard to represent local time of the day expressions does not ensure that the time of the day represented is accurate.

1.3 Related Standard. American National Standard Representation for Calendar Date and Ordinal Date for Information Interchange, X3.30-1971, can be used in combination with this standard for representing date–time groups (see Section 4).

2. Specifications

2.1 Representations for Local Time of the Day. Local time of the day is defined as civil clock time at the point of origin. In both the 12- and 24-hour timekeeping systems, local time of the day may be expressed by the following combinations of the time elements hours, minutes, and seconds:

(1) Hours

(2) Hours and decimal fraction of an hour

(3) Hours and minutes

(4) Hours, minutes, and decimal fraction of a minute

(5) Hours, minutes, and seconds

(6) Hours, minutes, seconds, and decimal fraction of a second

Expressions for local time of the day in the 12-hour timekeeping system must additionally include a meridiem designator as defined in 2.7.

2.2 Sequencing of Time Elements. The sequencing of time elements shall be from high order to low order (left to right): hour, minute, second. When a decimal fraction of an element is specified, no lower-order element may be included in the expression. For example, an expression containing a decimal fraction of an hour cannot also include the element(s) minutes or seconds, or a combination thereof.

The meridiem designator required for expression in the 12-hour timekeeping system is always positioned as the extreme-lowest-order (rightmost) character in the representation.

2.3 Use of Separators. No separators are required in time representations other than the decimal point (period) used as described in 2.4 and 2.5. A colon may be used as a separator between the time elements of hours, minutes, and seconds to improve human visual understanding. No separator is permitted between the least-significant time element and the meridiem designator in representations of 12-hour clock times.

2.4 Representation of Hours. In the 24-hour timekeeping system, the hour shall be represented by a two-digit decimal number ranging from 00 through 23, beginning with 00 and continuing in series: 01, 02, . . . , 23.[1] In the 12-hour timekeeping system the hour shall be represented by a two-digit decimal number ranging from 01 through 12, beginning with 12 and continuing in series: 01, 02, . . . , 11. When a decimal fraction of an hour is specified, it shall be separated from the hour representation by a decimal point (period) and ex-

[1] When midnight is defined to be the end of a day, the hour may be represented as 24. See 2.8.

pressed numerically to the precision (number of decimal places) desired.

2.5 Representation of Minutes. In both the 12- and 24-hour timekeeping systems, the minute shall be represented by a two-digit decimal number ranging from 00 through 59. When a decimal fraction of a minute is specified, it shall be separated from the minute representation by a decimal point (period) and expressed numerically to the precision (number of decimal places) desired.

2.6 Representation of Seconds. In both the 12- and 24-hour timekeeping systems, the second shall be represented by a two-digit decimal number ranging from 00 through 59. When a decimal fraction of a second is specified, it shall be separated from the second representation by a decimal point (period) and expressed numerically to the precision (number of decimal places) desired.

2.7 Representation of Meridiem Designator. The meridiem designator, required in 12-hour clock expressions of time, shall be represented by a single uppercase alphabetic character in the low-order (right-hand) position of the expression: "A" shall represent ante meridiem (or a.m.) and is appended to all 12-hour clock times from and including midnight up to and excluding noon. "P" shall represent post meridiem (or p.m.) and is appended to all 12-hour clock times from and including noon up to and excluding midnight.

2.8 Representation of Midnight and Noon. Midnight in the 24-hour timekeeping system is represented in hours, minutes, and seconds as "000000" (the start of a day) or as "240000" (the end of a day). The 1-second time sequences shown in Table 1 are provided for purposes of illustration.

Table 1
Representation of Midnight and Noon in 24-Hour Timekeeping System

Date and Time	Representation
1975 December 31 (two seconds to midnight)	19751231-235958
1975 December 31 (one second to midnight)	19751231-235959
1976 January 1	(Start of new day and year) 19760101-000000
or	or
1975 December 31 (midnight)	(End of day and year) 19751231-240000
1976 January 1 (one second past midnight)	19760101-000001

Table 2
Representation of Time in 24- and 12-Hour Timekeeping Systems

Expression	Representation — Timekeeping System: 24-hour	12-hour
Hours	14	02P
Hours and decimal fraction of an hour	14.21	02.21P
Hours and minutes (with separators)	1412 14:12	0212P 02:12P
Hours, minutes, and decimal fraction of a minute (with separators)	1412.6 14:12.6	0212.6P 02:12.6P
Hours, minutes and seconds (with separators)	141236 14:12:36	021236P 02:12:36P
Hours, minutes, seconds and decimal fraction of a second (with separators)	141236.0 14:12:36.0	021236.0P 02:12:36.0P

Midnight in the 12-hour timekeeping system is represented in hours, minutes, seconds, and meridiem designation as "120000A."

Noon in the 24-hour timekeeping system is represented in hours, minutes, and seconds as "120000."

Noon in the 12-hour timekeeping system is represented in hours, minutes, seconds, and meridiem designation as "120000P."

3. Examples

The time of 12 minutes, 36 seconds past 2 o'clock p.m. locally is represented by examples shown in Table 2.

4. Combinations of Date and Time Representation

This standard is designed to be used in combination with American National Standard Representation for Calendar Date and Ordinal Date for Information Interchange, X3.30-1971. High-order to low-order sequence must be maintained, that is, year, month, day, hour, minute, second. Separators are not required and consequently should not be used to separate date and time for interchange among data processing systems; however, if separators are required to facilitate human understanding, a hyphen or a space may be used to separate the low-order element of the date and high-order element of the time. The time representation, "141236," combined with the calendar date, "1971-09-01," is represented as "19710901141236," or with a hyphen separating date and time as "19710901-141236."

5. Application

Depending upon the degree of specificity required by various applications in representing time, the number of time elements used may vary. For example, some applications need the hour only; others need the hour and minute; others the hour, minute, and second; and others the hour, minute, second, and decimal fraction of a second. In addition, the number of characters used to represent decimal fractions of time elements will vary depending on application requirements. Also, whether the 12- or 24-hour timekeeping system is used, the method for representing midnight will vary depending upon application requirements. Accordingly, there must be an understanding between the sender and recipient of time representations as to the specific structure used. This is generally accomplished by adequate definition in format or record descriptions.

When exchanging data on an international basis, it is recommended that only the 24-hour timekeeping system representations be used and that midnight be represented as "000000." This is in accordance with the provisions of ISO Standard 3307-1975, Information Interchange – Representations of Time of the Day.[2]

[2] Publications of the International Organization for Standardization are available from the American National Standards Institute, 1430 Broadway, New York, N.Y. 10018.

INTERNATIONAL STANDARD ISO 4031

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION•МЕЖДУНАРОДНАЯ ОРГАНИЗАЦИЯ ПО СТАНДАРТИЗАЦИИ•ORGANISATION INTERNATIONALE DE NORMALISATION

Information interchange — Representation of local time differentials

Échange d'information — Représentation des différences d'heure légale

First edition — 1978-12-15

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FOREWORD

ISO (the International Organization for Standardization) is a worldwide federation of national standards institutes (ISO member bodies). The work of developing International Standards is carried out through ISO technical committees. Every member body interested in a subject for which a technical committee has been set up has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work.

Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council.

International Standard ISO 4031 was developed by Technical Committee ISO/TC 97, *Computers and information processing*, and was circulated to the member bodies in May 1976.

It has been approved by the member bodies of the following countries :

Australia	Ireland	South Africa, Rep. of
Belgium	Italy	Sweden
Brazil	Japan	Switzerland
Canada	Mexico	Turkey
Czechoslovakia	New Zealand	U.S.A.
France	Philippines	
Hungary	Romania	

The member bodies of the following countries expressed disapproval of the document on technical grounds :

Germany, F.R.
United Kingdom

Printed in Switzerland

Information interchange — Representation of local time differentials

0 INTRODUCTION

Many applications require that clock time be expressed in a form that can be used to satisfy both local and international interchange requirements. A time differential factor (TDF) is a means of facilitating information interchange by relating local time expressions to the Co-ordinated Universal Time (UTC).

1 SCOPE AND FIELD OF APPLICATION

This International Standard specifies a standard means for representing local time differentials to facilitate interchange of data among data systems. Specifically, it is intended to :

a) reduce the time required to record and/or format local time expressions, relate them to the Co-ordinated Universal Time and transmit them;

b) improve clarity and accuracy of interchange;

c) minimize the amount of human intervention required for communicating time expressions;

d) reduce costs.

This International Standard does not prescribe file sequences, storage media, programming languages, or other features of information processing to be used in its implementation.

The use of this International Standard to represent local time differentials does not ensure that the representation is accurate.

2 REFERENCES

This International Standard is designed to be used in conjunction with the following International Standards when representing data-time groups :

a) ISO 2014, *Writing of calendar dates in all-numeric form;*

b) ISO 2711, *Information processing interchange — Representation of ordinal dates;*

c) ISO 3307, *Information interchange — Representations of time of the day.*

ISO 3307 provides for the representation of local time and Co-ordinated Universal Time, to which this International Standard directly relates. Accordingly, users of this International Standard should also apply the provisions of ISO 3307.

3 REPRESENTATION OF A LOCAL TIME DIFFERENTIAL FACTOR (TDF)

The TDF expresses the difference in hours and minutes between local time and the Co-ordinated Universal Time (UTC) as defined in ISO 3307. It is represented by a four-digit number preceded by a plus (+) or minus (−) sign, indicating the number of hours and minutes that local time differs from the Co-ordinated Universal Time.

The TDF for the Co-ordinated Universal Time (UTC) is represented as +0000. Local times throughout the world vary from the UTC by as much as −1200 hours (west of the Greenwich Meridian) and by as much as +1300 hours (east of the Greenwich Meridian).

The TDF immediately follows the low-order (extreme right-hand) time element of the 24-hour clock expression.

4 EXAMPLES

a) The following example represents a local time of 2 hours 9 minutes and 23 seconds past noon in the U.S. Eastern Standard Time Zone (five hours different from the UTC and west of the Greenwich Meridian).

	Representation	
	Without separators	With separators
Local time with the time differential factor	140923−0500	14:09:23−05:00

b) The following example represents a local time of 2 hours, 9 minutes and 23 seconds past noon in Calcutta, India (five and one-half hours different from the UTC and east of the Greenwich Meridian).

	Representation	
	Without separators	With separators
Local time with the time differential factor	140923+0530	14:09:23+05:30

The convention (i.e. algorithm) for using this data element in arithmetic conversions from and to Co-ordinated Universal Time is as follows :

- when converting from local time to Co-ordinated Universal Time, algebraically subtract the TDF from the local time;
- when converting from Co-ordinated Universal Time to local time, algebraically add the TDF to Co-ordinated Universal Time.

Adjust for a change in date, where applicable, using base 24 mathematical logic.

INTERNATIONAL STANDARD TIME CHART

STANDARD TIME: Legal time for each country fixed by law and based on the theoretical division of the world's surface into 24 zones each of 15° longitude with certain deviations due to frontiers or local option.
DAYLIGHT SAVING TIME (DST): Modified (advanced) legal time adopted by certain countries for part of year, especially during local summer.

COUNTRY	STANDARD TIME		DAYLIGHT SAVING TIME	
	Hours from GMT	Time at 1200 hours GMT	Hours from GMT	Effective Period (first and last day)
ADEN	+ 3	15 00		
AFGHANISTAN	+ 4 1/2	16 30		
ALBANIA	+ 1	13 00		
ALGERIA	+ 1	13 00		
ANGOLA	- 1	13 00		
ARGENTINA	- 3	09 00		
AUSTRALIA—Victoria, New South Wales, Tasmania	+10	22 00		
Queensland ►	+10	22 00		
South Australia	+ 9 1/2	21 30		
Northern Territory	+ 9 1/2	21 30		
Western Australia	+ 8	20 00		
AUSTRIA	+ 1	13 00		
AZORES	- 1	11 00		
BAHAMAS	- 5	07 00	- 4	Apr. 30—Oct. 28, 1978
BAHRAIN ISLAND	+ 3	15 00		
BANGLADESH	+ 6	18 00		
BARBADOS	- 4	08 00		
BELGIUM	+ 1	13 00		
BELIZE	- 6	06 00		
BENIN	+ 1	13 00		
BERMUDA	- 4	08 00	- 3	Apr. 30—Oct. 29, 1978
BOLIVIA	- 4	08 00		
BOTSWANA	+ 2	14 00		
BRAZIL — Eastern	- 3	09 00		
Espirito Santo, Guanabara, Minas Gerais, Rio de Janeiro, Sao Paulo	- 3	09 00		
Western Interior	- 4	08 00		
Territory of Acre	- 5	07 00		
BRITISH VIRGIN ISLANDS	- 4	08 00		
BRUNEI	+ 8	20 00		
BULGARIA	+ 2	14 00		
BURMA	+ 6 1/2	18 30		
BURUNDI	+ 2	14 00		
CAMBODIA (See Kampuchea, Dem.)				
CAMEROON	+ 1	13 00		
CANADA ‡ — Newfoundland	- 3 1/2	08 30	- 2 1/2	Apr. 30—Oct. 28, 1978
Atlantic Time	- 4	08 00	- 3	Apr. 30—Oct. 28, 1978
Eastern Time	- 5	07 00	- 4	Apr. 30—Oct. 28, 1978
Central Time	- 6	06 00	- 5	Apr. 30—Oct. 28, 1978
Mountain Time	- 7	05 00	- 6	Apr. 30—Oct. 28, 1978
Pacific Time	- 8	04 00	- 7	Apr. 30—Oct. 28, 1978
Yukon Time	- 8	04 00		
CANARY ISLANDS	GMT	12 00		
CAPE VERDE ISLANDS	- 1	11 00		
CAROLINE ISLANDS				
Palau Is.	+ 9	21 00		
Yap Is.	+10	22 00		
Ponape, Truk	+11	23 00		
CAYMAN ISLANDS	- 5	07 00		
CENTRAL AFRICAN EMPIRE	+ 1	13 00		
CEYLON (Republic of Sri Lanka)	+ 5 1/2	17 30		
CHAD	+ 1	13 00		
CHILE	- 4	08 00	3	Oct. 15, 1978—Mar. 10, 1979
CHINA				
Zone 1 (Tihwa)	+ 6	18 00		
Zone 2 (Chung-King, Lanchow)	+ 7	19 00		
Zone 3 (Peking, Shanghai)	+ 8	20 00		
Zone 4 (Harbin)	+ 8 1/2	20 30		
COCOS ISLANDS	+ 6 1/2	18 30		
COLOMBIA	- 5	07 00		
COMORO ISLANDS	+ 3	15 00		
CONGO REPUBLIC	+ 1	13 00		
COOK ISLANDS	10 1/2	01 30		
COSTA RICA	6	06 00		
CUBA	- 5	07 00	4	May 7—Oct. 7, 1978
CYPRUS	+ 2	14 00		
CZECHOSLOVAKIA	+ 1	13 00		
DENMARK	+ 1	13 00		
DJIBOUTI	+ 3	15 00		
DOHA	+ 3	15 00		
DOMINICAN REPUBLIC	- 4	08 00		
EASTER ISLANDS	7	05 00	6	Oct. 15, 1978—Mar. 10, 1979
ECUADOR	5	07 00		
EGYPT	+ 2	14 00		
EL SALVADOR	- 6	06 00		
EQUATORIAL GUINEA	+ 1	13 00		
ETHIOPIA	+ 3	15 00		
FAEROE ISLAND	GMT	12 00		
FALKLAND ISLANDS	- 3	09 00		
FIJI ISLANDS	+12	24 00		
FINLAND	+ 2	14 00		
FRANCE (incl. Corsica)	+ 1	13 00	+ 2	Apr. 2—Sep. 30, 1978
FRENCH GUIANA	- 3	09 00		
GABON	+ 1	13 00		
GAMBIA	GMT	12 00		
GERMAN DEMOCRATIC REP.	+ 1	13 00		
GERMANY, FEDERAL REP. OF	+ 1	13 00		
GHANA	GMT	12 00		
GIBRALTAR	+ 1	13 00		
GILBERT and ELLICE ISLANDS	+ 12	24 00		
GREECE (and Crete)	+ 2	14 00		
GREENLAND, Scoresby Sound	- 3	09 00		
Angmagssalik and W. Coast Thule	- 4	08 00		
GUAM	+10	22 00		
GUATEMALA	- 6	06 00		
GUINEA, Republic of	GMT	12 00		
GUINEA-BISSAU	GMT	12 00		
GUYANA	- 3	09 00		
HAITI	- 5	07 00		
HONDURAS	- 6	06 00		
HONG KONG (and MACAO)	+ 8	20 00		
HUNGARY	+ 1	13 00		
ICELAND	GMT	12 00		
INDIA	+ 5 1/2	17 30		
INDONESIA				
Western Time (Sumatra, Java, Madura, Bali, Bangka, Beliting, Lombok)	+ 7	19 00		
Central Time (Borneo, Celebes, Flores, Sumbawa, Sumba, Timor)	+ 8	20 00		
Eastern Time (Molucca Is., Tanimbar, Kai, West Irian)	+ 9	21 00		
IRAN	+ 4	16 00		
IRAQ	+ 3	15 00		
IRELAND	GMT	12 00	+ 1	Mar. 19—Oct. 28, 1978
ISRAEL	+ 2	14 00		
ITALY (incl. Sicily and Sardinia)	+ 1	13 00		
IVORY COAST	GMT	12 00		
JAMAICA	- 5	07 00	- 4	Apr. 30—Oct. 28, 1978
JAPAN	+ 9	21 00		
JORDAN	+ 2	14 00		
KAMARAN ISLAND	+ 3	15 00		

COUNTRY	STANDARD TIME		DAYLIGHT SAVING TIME	
	Hours from GMT	Time at 1200 hours GMT	Hours from GMT	Effective Period (first and last day)
KAMPUCHEA, DEM.	+ 7	19 00		
KENYA	+ 3	15 00		
KOREA, DEMOCRATIC PEOPLE'S REP. OF	+ 9	21 00		
KOREA, REPUBLIC OF	+ 9	21 00		
KUWAIT	+ 3	15 00		
LAOS	+ 7	19 00		
LEBANON	+ 2	14 00		
LESOTHO	+ 2	14 00		
LIBERIA	GMT	12 00		
LIBYA	+ 2	14 00		
LUXEMBOURG	+ 1	13 00		
MADAGASCAR	+ 3	15 00		
MADEIRA	GMT	12 00		
MALAWI	+ 2	14 00		
MALAYSIA (Kuala Lumpur, Penang)	+ 7 1/2	19 30		
East (Kota, Kinabalu, Kuching)	+ 8	20 00		
MALI	GMT	12 00		
MALTA	+ 1	13 00		
MARIANA ISLANDS	+10	22 00		
MARSHALL ISLANDS				
Majuro (same day as Guam)	+12	24 00		
Kwajalein (same day as Hawaii)	-12	24 00		
MAURITANIA	GMT	12 00		
MAURITIUS	+ 4	16 00		
MEXICO—Central Time	- 6	06 00		
Mountain Time	- 7	05 00		
Pacific Time #	- 8	04 00		
MIDWAY ISLAND	- 11	01 00		
MONACO	+ 1	13 00		
MONGOLIA	+ 8	20 00		
MOROCCO	+ 1	13 00		
MOZAMBIQUE	+ 2	14 00		
NAMIBIA	+ 2	14 00		
NAURU ISLAND	+11 1/2	23 30		
NEPAL	+ 5 1/2	17 30		
NETHERLANDS	+ 1	13 00		
NETHERLANDS ANTILLES	- 4	08 00		
NEW CALEDONIA	+11	23 00		
NEW HEBRIDES	+11	23 00		
NEW ZEALAND	+12	24 00		
NICARAGUA	- 6	06 00		
NIGER	+ 1	13 00		
NIGERIA	+ 1	13 00		
NIUE ISLAND	- 11	23 00		
NORFOLK ISLAND	+11 1/2	23 30		
NORWAY	+ 1	13 00		
OKINAWA (Ryukyu Islands)	+ 9	21 00		
OMAN (Muscat)	+ 4	16 00		
PAKISTAN	+ 5	17 00		
PANAMA	- 5	07 00		
PAPUA NEW GUINEA	+10	22 00		
PARAGUAY	- 4	08 00		
PERU	- 5	07 00		
PHILIPPINES	+ 8	20 00		
POLAND	+ 1	13 00		
PORTUGAL	GMT	12 00		
PUERTO RICO	- 4	08 00		
QATAR (DOHA)	+ 3	15 00		
REUNION	+ 4	16 00		
RHODESIA	+ 2	14 00		
ROMANIA	+ 2	14 00		
RWANDA	+ 2	14 00		
SAMOA	-11	01 00		
SAO TOME ISLAND	GMT	12 00		
SAUDI ARABIA	+ 3	15 00		
SENEGAL	GMT	12 00		
SEYCHELLES	+ 4	16 00		
SIERRA LEONE	GMT	12 00		
SINGAPORE	+ 7 1/2	19 30		
SOLOMON ISLANDS	+11	23 00		
SOMALIA	+ 3	15 00		
SOUTH AFRICA, Republic of	+ 2	14 00		
SOUTH WEST AFRICA	+ 2	14 00		
SPAIN	+ 1	13 00		
SRI LANKA, Republic of	+ 5 1/2	17 30		
SUDAN	+ 2	14 00		
SURINAM	- 3 1/2	08 30		
SWAZILAND	+ 2	14 00		
SWEDEN	+ 1	13 00		
SWITZERLAND	+ 1	13 00		
SYRIA	+ 2	14 00		
TAHITI	-10	02 00		
TAIWAN	+ 8	20 00		
TANZANIA	+ 3	15 00		
THAILAND	+ 7	19 00		
TOGO	GMT	12 00		
TONGA (Friendly Islands)	+13	01 00		
TUNISIA	+ 1	13 00		
TURKEY	+ 3	15 00		
UGANDA	+ 3	15 00		
UNITED ARAB EMIRATES	+ 4	16 00		
UNITED KINGDOM	GMT	12 00	+ 1	Mar. 19—Oct. 28, 1978
UPPER VOLTA	GMT	12 00		
URUGUAY	- 3	09 00		
U.S.A.—Eastern Time ∆	- 5	07 00	- 4	Apr. 30—Oct. 28, 1978
Central Time	- 6	06 00	- 5	Apr. 30—Oct. 28, 1978
Mountain Time ∆	- 7	05 00	- 6	Apr. 30—Oct. 28, 1978
Pacific Time	- 8	04 00	- 7	Apr. 30—Oct. 28, 1978
ALASKA—Ketchikan to Skagway	- 8	04 00	- 7	Apr. 30—Oct. 28, 1978
Skagway to 141° long. W. (Yakutat)	- 9	03 00	- 8	Apr. 30—Oct. 28, 1978
141° long. W. to 162° long. W.	-10	02 00	- 9	Apr. 30—Oct. 28, 1978
162° long. W. to Western tip	-11	01 00	-10	Apr. 30—Oct. 28, 1978
HAWAIIAN ISLANDS	-10	02 00		
U.S.S.R.—Moscow, Ukraine, West	+ 3	15 00		
Approximately every 15° from 30° 30' E.	+ 4	16 00		
to 172° 30' W., add 1 hr.	+12	24 00		
VENEZUELA	- 4	08 00		
VIETNAM, SOCIALIST REP. OF	+ 8	20 00		
WEST INDIES—Guadeloupe, Leeward Islands, Martinique, Tobago, Trinidad, Windward Islands	- 4	08 00		
Aruba, Bonaire, Curacao	- 4	08 00		
Turks and Caicos Islands	- 5	07 00		
YEMEN (Sanaa)	+ 3	15 00		
YEMEN DEMOCRATIC (ADEN)	+ 3	15 00		
YUGOSLAVIA	+ 1	13 00		
ZAIRE				
Kinshasa, Mbandaka	+ 1	13 00		
Orientale, Katanga, Kivu, Kasai, Lubumbashi	+ 2	14 00		
ZAMBIA	+ 2	14 00		

— Only Mexicali and Tijuana observe DST. ∆ — Arizona and parts of Indiana do not observe DST. ► — Queensland does not observe Daylight Saving Time. ‡ Certain Canadian cities remain on Standard Time all year. Mayo, Watson Lake and Whitehorse observe Daylight Time year round.

A Summary of the International Standard Date and Time Notation

by Markus Kuhn

International Standard ISO 8601 specifies numeric representations of date and time. This standard notation helps to avoid confusion in international communication caused by the many different national notations and increases the portability of computer user interfaces. In addition, these formats have several important advantages for computer usage compared to other traditional date and time notations. The time notation described here is already the de-facto standard in almost all countries and the date notation is becoming increasingly popular.

Especially authors of Web pages and software engineers who design user interfaces, file formats, and communication protocols should be familiar with ISO 8601.

Contents: Date, Time of Day, Time Zone.

Date

The international standard date notation is

YYYY-MM-DD

where YYYY is the year in the usual Gregorian calendar, MM is the month of the year between 01 (January) and 12 (December), and DD is the day of the month between 01 and 31.

For example, the fourth day of February in the year 1995 is written in the standard notation as

1995-02-04

Other commonly used notations are e.g. 2/4/95, 4/2/95, 95/2/4, 4.2.1995, 04-FEB-1995, 4-February-1995, and many more. Especially the first two examples are dangerous, because as both are used quite often in the U.S. and in Great Britain and both can not be distinguished, it is unclear whether 2/4/95 means 1995-04-02 or 1995-02-04. The date notation 2/4/5 has at least six reasonable interpretations (assuming that only the twentieth and twenty-first century are reasonable candidates in our life time).

Advantages of the ISO 8601 standard date notation compared to other commonly used variants:

- easily readable and writeable by software (no 'JAN', 'FEB', ... table necessary)
- easily comparable and sortable with a trivial string comparison
- language independent
- can not be confused with other popular date notations
- consistency with the common 24h time notation system, where the larger units (hours) are also written in front of the smaller ones (minutes and seconds)
- strings containing a date followed by a time are also easily comparable and sortable (e.g. write "1995-02-04 22:45:00")
- the notation is short and has constant length, which makes both keyboard data entry and table layout easier
- identical to the Chinese date notation, so the largest cultural group (>25%) on this planet is already familiar with it :-)
- date notations with the order "year, month, day" are in addition already widely used e.g. in Japan, Korea, Hungary, Sweden, Finland, Denmark, and a few other countries and people in

the U.S. are already used to at least the "month, day" order
- a 4-digit year representation avoids overflow problems after 1999-12-31

As dates will look a little bit strange anyway starting with 2000-01-01 (e.g. like 1/1/0), it has been suggested that the year 2000 is an excellent opportunity to change to the standard date notation.

Apart from the recommended primary standard notation **YYYY-MM-DD**, ISO 8601 also specifies a number of alternative formats for use in applications with special requirements. All of these alternatives can easily and automatically be distinguished from each other:

The hyphens can be omitted if compactness of the representation is more important than human readability, for example as in

19950204

For situations where information about the century is really not required, a 2-digit year representation is available:

95-02-04 or **950204**

If only the month or even only the year is of interest:

1995-02 or **1995**

In commercial and industrial applications (delivery times, production plans, etc.), especially in Europe, it is often required to refer to a week of a year. Week 01 of a year is per definition the first week that has the Thursday in this year, which is equivalent to the week that contains the fourth day of January. In other words, the first week of a new year is the week that has the majority of its days in the new year. Week 01 might also contain days from the previous year and the week before week 01 of a year is the last week (52 or 53) of the previous year even if it contains days from the new year. A week starts with Monday (day 1) and ends with Sunday (day 7). For example, the first week of the year 1997 lasts from 1996-12-30 to 1997-01-05 and can be written in standard notation as

1997-W01 or **1997W01**

The week notation can also be extended by a number indicating the day of the week. For example, the day 1996-12-31, which is the Tuesday (day 2) of the first week of 1997, can also be written as

1997-W01-2 or **1997W012**

for applications like industrial planning where many things like shift rotations are organized per week and knowing the week number and the day of the week is more handy than knowing the day of the month.

An abbreviated version of the year and week number like

95W05

is sometimes useful as a compact code printed on a product that indicates when it has been manufactured.

The ISO standard avoids explicitly stating the possible range of week numbers, but this can easily be deduced from the definition:

Theorem: Possible ISO week numbers are in the range 01 to 53. A year always has a week 52. (There is one historic exception: the year in which the Gregorian calendar was introduced had less than 365 days and less than 52 weeks.)

Proof: Per definition, the first week of a year is W01 and consequently days before week W01 belong to the previous year and so there is no week with lower numbers. Considering the highest possible week number, the worst case is a leap year like 1976 that starts with a Thursday, because this keeps the highest possible number of days of W01 in the previous year, i.e. 3 days. In this case, the Sunday of W52 of the worst case year is day number 4+51*7=361 and 361-366=5 days of W53 belong still to this year, which guarantees that in the worst case year day 4 (Thursday) of W53 is not yet in the next year, so a week number 53 is possible. For example, the 53 weeks of the worst case year 1976 started with 1975-12-29 = 1976-W01-1 and ended with 1977-01-02 = 1976-W53-7. On the other hand, considering the lowest number of the last week of a year, the worst case is a non-leap year like 1999 that starts with a Friday, which ensures that the first three days of the year belong to the last week of the previous year. In this case, the Sunday of week 52 would be day number 3+52*7=367, i.e. only the last 367-365=2 days of the W52 reach into the next year and consequently, even a worst case year like 1999 has a week W52 including the days 1999-12-27 to 2000-01-02. q.e.d.

[Unfortunately, the current version of the C programming language standard provides in the `strftime()` function no means to generate the ISO 8601 week notation. A required extension would be four new formatting codes: for the year of the week to which the specified day belongs (both 2-digit and 4-digit), for the number of the week between 01 and 53, and for the day of the week between 1 (Monday) and 7 (Sunday). Another trivial mistake in the description of `strftime()` in the C standard is that the range of seconds goes from 00 to 61, because at one time only one single leap second 60 can be inserted into UTC and consequently there will never be a leap second 61.]

Both day and year are useful units of structuring time, because the position of the sun on the sky, which influences our lives, is described by them. However the 12 months of a year are of some obscure mystic origin and have no real purpose today except that people are used to having them (they do not even describe the current position of the moon). In some applications, a date notation is preferred that uses only the year and the day of the year between 001 and 365 (366 in leap years). The standard notation for this variant representing the day 1995-02-04 (that is day 035 of the year 1995) is

1995-035 or **1995035**

Leap years are years with an additional day YYYY-02-29, where the year number is a multiple of four with the following exception: If a year is a multiple of 100, then it is only a leap year if it is also a multiple of 400. For example, 1900 was not a leap year, but 2000 is one.

Time of Day

The international standard notation for the time of day is

hh:mm:ss

where hh is the number of complete hours that have passed since midnight (00-24), mm is the number of complete minutes that have passed since the start of the hour (00-59), and ss is the number of complete seconds since the start of the minute (00-59). If the hour value is 24, then the minute and second values must be zero. [Although ISO 8601 does not mention this, the value 60 for ss might sometimes be needed during an inserted leap second in an atomic time scale like Coordinated Universal Time (UTC). A single leap second 23:59:60 is inserted into the UTC time scale every few years as announced by the International Earth Rotation Service in Paris to keep UTC from wandering away more than 0.9 s from the less constant astronomical time scale UT1 that is defined by the actual rotation of the earth.]

An example time is

23:59:59

which represents the time one second before midnight.

As with the date notation, the separating colons can also be omitted as in

235959

and the precision can be reduced by omitting the seconds or both the seconds and minutes as in

23:59, **2359**, or **23**

It is also possible to add fractions of a second after a decimal dot or comma, for instance the time 5.8 ms before midnight can be written as

23:59:59.9942 or **235959.9942**

As every day both starts and ends with midnight, the two notations **00:00** and **24:00** are available to distinguish the two midnights that can be associated with one date. This means that the following two notations refer to exactly the same point in time:

1995-02-04 24:00 = 1995-02-05 00:00

In case an unambiguous representation of time is required, 00:00 is usually the preferred notation for midnight and not 24:00. Digital clocks display 00:00 and not 24:00.

ISO 8601 does not specify, whether its notations specify a point in time or a time period. This means for example that ISO 8601 does not define whether 09:00 refers to the exact end of the ninth hour of the day or the period from 09:00 to 09:01 or anything else. The users of the standard must somehow agree on the exact interpretation of the time notation if this should be of any concern.

If a date and a time are displayed on the same line, then always write the date in front of the time. If a date and a time value are stored together in a single data field, then ISO 8601 suggests that they should be separated by a latin capital letter T, as in **19951231T235959**.

A remark for readers from the U.S.:

> The 24h time notation specified here has already been the de-facto standard all over the world in written language for decades. The only exception are some English speaking countries, where still notations with hours between 1 and 12 and additions like "a.m." and "p.m." are in wide use. The common 24h international standard notation starts to get widely used now even in England. Most other languages don't even have abbreviations like "a.m." and "p.m." and the 12h notation is certainly hardly ever used on Continental Europe to write or display a time. Even in the U.S., the military and computer programmers have been using the 24h notation for a long time.
>
> The old English 12h notation has many disadvantages like:
>
> - It is longer than the normal 24h notation.
> - It takes somewhat more time for humans to compare two times in 12h notation.
> - It is not clear, how 00:00, 12:00 and 24:00 are represented. Even encyclopedias and style manuals contain contradicting descriptions and a common quick fix seems to be to avoid "12:00 a.m./p.m." altogether and write "noon", "midnight", or "12:01 a.m./p.m." instead, although the word "midnight" still does not distinguish between 00:00 and 24:00.

- It makes people often believe that the next day starts at the overflow from "12:59 a.m." to "1:00 a.m.", which is a common problem not only when people try to program the timer of VCRs shortly after midnight.
- It is not easily comparable with a string compare operation.
- It is not immediately clear for the unaware, whether the time between "12:00 a.m./p.m." and "1:00 a.m./p.m." starts at 00:00 or at 12:00, i.e. the English 12h notation is more difficult to understand.

Please consider the 12h time to be a relic from the dark ages when Roman numerals were used, the number zero had not yet been invented and analog clocks where the only known form of displaying a time. Please avoid using it today, especially in technical applications! Even in the U.S., the widely respected *Chicago Manual of Style* recommends now to use the international standard time notation in publications.

A remark for readers from German speaking countries:

In May 1996, the German standard DIN 5008, which specifies typographical rules for German texts written on typewriters, has been updated. The old German numeric date notations DD.MM.YYYY and DD.MM.YY have been replaced by the ISO date notations YYYY-MM-DD and YY-MM-DD. Similarly, the old German time notations hh.mm and hh.mm.ss have been replaced by the ISO notations hh:mm and hh:mm:ss. Those new notations are now also mentioned in the latest edition of the *Duden*. The German alphanumeric date notation continues to be for example "3. August 1994" or "3. Aug. 1994". The corresponding Austrian standard has already used the ISO 8601 date and time notations before.

ISO 8601 has been adopted as European Standard EN 28601 and is therefore now a valid standard in all EU countries and all conflicting national standards have been changed accordingly.

Time Zone

Without any further additions, a date and time as written above is assumed to be in some local time zone. In order to indicate that a time is measured in Universal Time (UTC), you can append a capital letter **Z** to a time as in

23:59:59Z or **2359Z**

[The Z stands for the "zero meridian", which goes through Greenwich in London, and it is also commonly used in radio communication where it is pronounced "Zulu" (the word for Z in the international radio alphabet). Universal Time (sometimes also called "Zulu Time") was called Greenwich Mean Time (GMT) before 1972, however this term should no longer be used. Since the introduction of an international atomic time scale, almost all existing civil time zones are now related to UTC, which is slightly different from the old and now unused GMT.]

The strings

+hh:mm, **+hhmm**, or **+hh**

can be added to the time to indicate that the used local time zone is hh hours and mm minutes ahead of UTC. For time zones west of the zero meridian, which are behind UTC, the notation

-hh:mm, **-hhmm**, or **-hh**

is used instead. For example, Central European Time (CET) is +0100 and U.S./Canadian Eastern Standard Time (EST) is -0500. The following strings all indicate the same point of time:

12:00Z = 13:00+01:00 = 0700-0500

There exists no international standard that specifies abbreviations for civil time zones like CET, EST, etc. and sometimes the same abbreviation is even used for two very different time zones. In addition, politicians enjoy modifying the rules for civil time zones, especially for daylight saving times, every few years, so the only really reliable way of describing a local time zone is to specify numerically the difference of local time to UTC. Better use directly UTC as your only time zone where this is possible and then you do not have to worry about time zones and daylight saving time changes at all.

More Information about Time Zones

Arthur David Olson and others maintain a database of all current and many historic time zone changes and daylight saving time algorithms. It is available via ftp from elsie.nci.nih.gov in the `tzcode*` and `tzdata*` files. Most Unix time zone handling implementations are based on this package. If you want to join the `tz` mailing list, which is dedicated to discussions about time zones and this software, please send a request for subscription to tz-request@elsie.nci.nih.gov. You can read previous discussion there in the tz archive.

Other Links about Date, Time, and Calendars

Some other interesting sources of information about date and time on the Internet are for example the Glossary of Frequency and Timing Terms and the FAQ provided by NIST, the Yahoo Science:Weights and Measures:Measurements:Time link collection, the U.S. Naval Observatory Server, the International Earth Rotation Service (IERS) (for time gurus only!), the University of Delaware NTP Time Server, the time and calendar section of the USENET sci.astro FAQ, and the Calendar FAQ.

This was a brief overview of the ISO 8601 standard, which covers only the most useful notations and includes some additional related information. The full standard defines in addition a number of more exotic notations including some for periods of time. The ISO 8601:1988 document is unfortunately not available online and interested people will have to order a paper copy from

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Switzerland

phone: +41 22 749 01 11
fax: +41 22 733 34 30
email: sales@isocs.iso.ch

A more detailed online summary of ISO 8601 than this one is the text *ISO 8601:1988 Date/Time Representations* available from ftp.informatik.uni-erlangen.de/pub/doc/ISO/ISO8601.ps.Z (PostScript, 16 kb, 5 pages) written by Gary Houston, now also available in HTML. Ian Galpin (G1SMD) proposes to use ISO 8601 as a Common Date-Time Standard for Amateur Radio. Steve Adams has written another web page about the ISO date format that is partially based on this text.

ISO TC 154 decided in 1996 to revise ISO 8601. Louis Visser is coordinating this project. If you want to contribute to this work, you should contact your national ISO member organization.

I wish to thank Edward M. Reingold for developing the fine GNU Emacs calendar functions, as well as Rich Wales, Mark Brader, Paul Eggert, and others in the comp.std.internat,

comp.protocols.time.ntp, and sci.astro USENET discussion groups for valuable comments about this text. Further comments and hyperlinks to this page are very welcome.

You might also be interested in the International Standard Paper Sizes Web page.

Markus Kuhn <mskuhn@cip.informatik.uni-erlangen.de>

created 1995 -- last modified 1997-07-27 -- http://www.ft.uni-erlangen.de/~mskuhn/iso-time.html

BMR SOFTWARE

1997 August 19

International Organization for Standardization
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Subject: Time Standards

My name is Robert Bemer, and I was involved with computer standards for more than 25 years. I wrote the original scope and program of work for TC97, Computers and Information Processing, and chaired TC97/SC5 for 11 years. I was also involved in the first standards for time representation, and it was my co-worker and friend Eric Clamons and I that successfully argued for the Thursday split in the Fiscal Week. During all this I thus became a personal friend of Olle Sturen, your Secretary General of some years ago.

I now have a company building a solution to the Year 2000 problem for computers. I have moreover given a first draft of a White Paper, entitled "Use and Transport of Time Values", to the General Services Administration of the U. S. Government, and have expectations that they will put it on the Web under their auspices.

There are two reasons for this FAX:

1) My 1979 paper "Time and the Computer" referenced ISO 2014-1976, ISO 2015-1876, ISO 3307, and ISO 4031. I need to know if any of these are still in force, or if they have been superseded entirely by ISO 8601, for I had used these old references in the draft of my White Paper, which needs to be corrected.

2) The impetus of the Year 2000 emergency may well lead to a more comprehensive adoption of the ISO time standards. The need for interchangeability of time data between computers can be a most powerful force in this direction, and the U.S. Government, if influenced enough by the White Paper, may spread that influence throughout the general population.

A copy of ISO 8601 will of course be appreciated, by Fax (see below) or other method, and it should (in the historical part) give me the answers to my first question. Some bona fides are added in persuasion.

Thank you,

RBemer

R. W. Bemer

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NEW DIRECT TELEFAX NUMBER FOR INFOCENTRE: + 41 22 749 01 55

Dear Mr. Bemer,

International standard ISO 8601

Thank you for your interesting fax of August 19.

In reply to your question concerning ISO 8601:1988, the other standards you mention (ISO 2014:1976, ISO 2015:1976, ISO 3307:1975 and ISO 4031:1978) were all withdrawn in 1988 and replaced by ISO 8601:1988. Please note that the following was published in 1991:

Technical Corrigendum 1:1991 to ISO 8601:1988

I have arranged for a complementary copy of both ISO 8601 and Technical Corrigendum 1:1991 to ISO 8601:1988 to be sent to you by mail (we cannot fax them unfortunately).

For your interest I am attaching a copy of a recent article from the *ISO Bulletin* entitled "A volcanic date - December 31, 1999". We also present a recent press release on the same topic, entitled "The end of the world as we know it?", on the ISO web site, *ISO Online*, at http://www.iso.ch (see the section "What's new at ISO?").

Yours sincerely,

Graham Kimberley
Information Officer
ISO/IEC Information Centre

MR. KIMBERLEY:

NEARLY A MONTH AND NOT RECEIVED. COULD THE ADDRESS HAVE BEEN INCOMPLETE AS ABOVE?

PLEASE RESEND TO:

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1971

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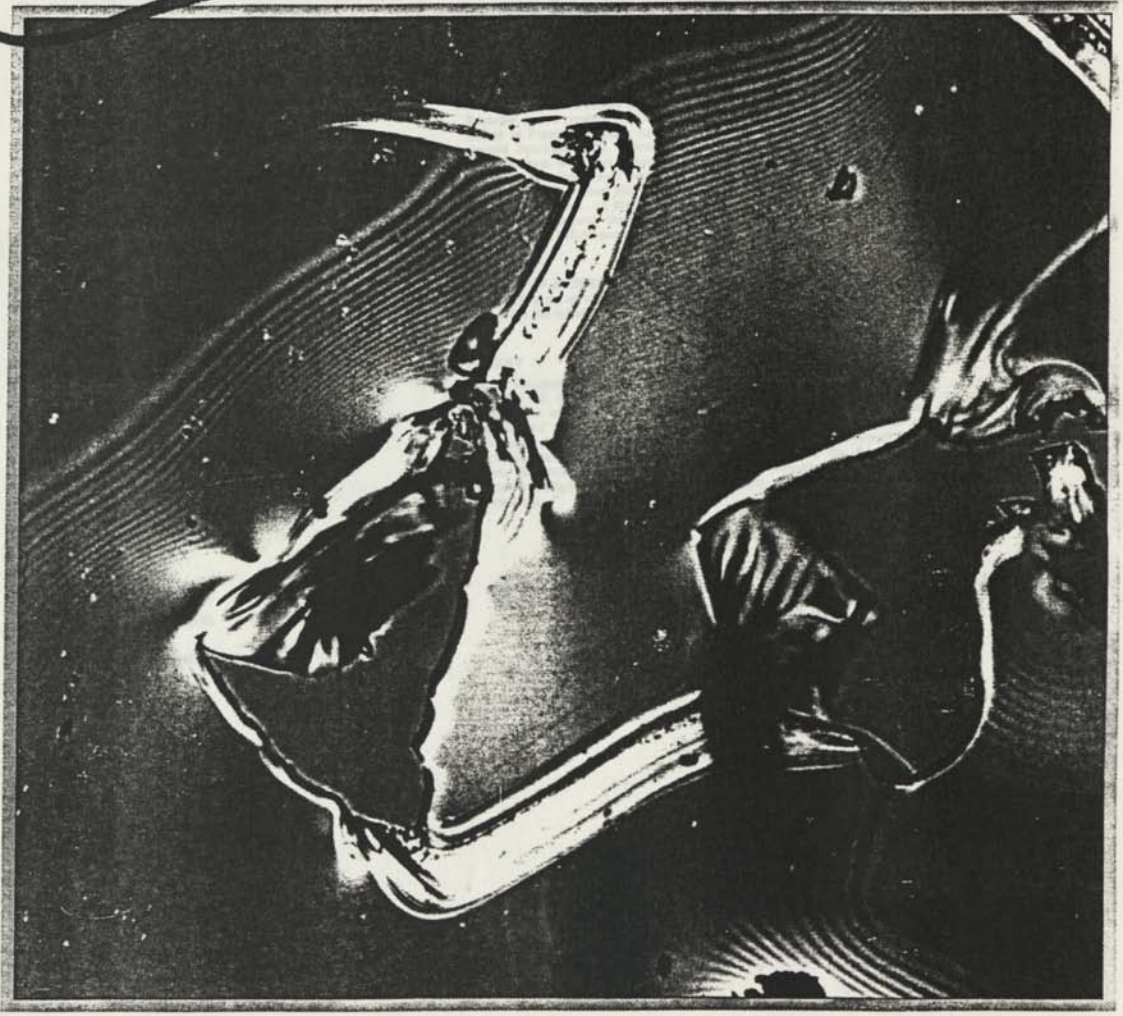

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THE COVER

To see beauty in one's work is a great gift, as evidenced by our cover photo. Chris Mitsios, a metallographic technician in Advanced Systems and Technology, Phoenix, found this artistic conception of the Phoenix Bird arising from the interference patterns on an organometallic deposit affixed to a silicon wafer. He captured the Bird using a Zeiss metallograph with Nomarski lighting technique.

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WHAT'S THE DATE?

By now our readers will have noticed that this Journal always presents the calendar date in the year-month-day order. This is to conform to:

- ISO Recommendation 2014 - Writing of Calendar Dates in All-Numeric Form
- American National Standard X3.30-1971 (Representation for Calendar Date and Ordinal Date for Information Interchange)
- FIPS PUB 4, Calendar Date (US Government)

Although the American Standard derives from Committee X3, on Computers and Information Processing, the need for a standard method of writing the date is universal. ISO had a special committee, DATCO, for this purpose. Here is how ISO put it in the announcement:

"How to avoid confusion when writing the date ....

The worldwide membership of ISO (the International Organization for Standardization) has agreed to standardize the manner of writing dates. Thus, the most junior typist has the opportunity of making a contribution to the removal of one unnecessary obstacle to international communication.

How?

By using the universally-agreed system of descending order when writing the date on any letter or document. This rule applies only when an all-numeric form is used, which might lead to confusion.

Provided that the month is clearly spelled out (even in an abbreviated form), one can write the date however one wishes - 1 April 1971, April 1 1971, or 1971 April 1. There is no ambiguity, so no standard is required.

However, when an American writes the date 4-1-1971 to indicate April the first, an Englishman or a Norwegian, for example, would read the date as the fourth of January.

After studying all the implications of the question, an ISO committee of experts recommended the *descending* order, and ISO Recommendation 2014 has now

ISO Fiscal Calendar

		1972							1973							1974								
WK		M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S		WK
1		03	04	05	06	07	08	09	01	02	03	04	05	06	07	31	01	02	03	04	05	06		1
2		10	11	12	13	14	15	16	08	09	10	11	12	13	14	07	08	09	10	11	12	13	JAN	2
3	JAN	17	18	19	20	21	22	23	15	16	17	18	19	20	21	14	15	16	17	18	19	20		3
4		24	25	26	27	28	29	30	22	23	24	25	26	27	28	21	22	23	24	25	26	27		4
5		31	01	02	03	04	05	06	29	30	31	01	02	03	04	28	29	30	31	01	02	03		5
6		07	08	09	10	11	12	13	05	06	07	08	09	10	11	04	05	06	07	08	09	10	FEB	6
7	FEB	14	15	16	17	18	19	20	12	13	14	15	16	17	18	11	12	13	14	15	16	17		7
8		21	22	23	24	25	26	27	19	20	21	22	23	24	25	18	19	20	21	22	23	24		8
9		28	29	01	02	03	04	05	26	27	28	01	02	03	04	25	26	27	28	01	02	03		9
10		06	07	08	09	10	11	12	05	06	07	08	09	10	11	04	05	06	07	08	09	10		10
11	MAR	13	14	15	16	17	18	19	12	13	14	15	16	17	18	11	12	13	14	15	16	17	MAR	11
12		20	21	22	23	24	25	26	19	20	21	22	23	24	25	18	19	20	21	22	23	24		12
13		27	28	29	30	31	01	02	26	27	28	29	30	31	01	25	26	27	28	29	30	31		13
14		03	04	05	06	07	08	09	02	03	04	05	06	07	08	01	02	03	04	05	06	07		14
15	APR	10	11	12	13	14	15	16	09	10	11	12	13	14	15	08	09	10	11	12	13	14	APR	15
16		17	18	19	20	21	22	23	16	17	18	19	20	21	22	15	16	17	18	19	20	21		16
17		24	25	26	27	28	29	30	23	24	25	26	27	28	29	22	23	24	25	26	27	28		17
18		01	02	03	04	05	06	07	30	01	02	03	04	05	06	29	30	01	02	03	04	05		18
19		08	09	10	11	12	13	14	07	08	09	10	11	12	13	06	07	08	09	10	11	12	MAY	19
20	MAY	15	16	17	18	19	20	21	14	15	16	17	18	19	20	13	14	15	16	17	18	19		20
21		22	23	24	25	26	27	28	21	22	23	24	25	26	27	20	21	22	23	24	25	26		21
22		29	30	31	01	02	03	04	28	29	30	31	01	02	03	27	28	29	30	31	01	02		22
23		05	06	07	08	09	10	11	04	05	06	07	08	09	10	03	04	05	06	07	08	09		23
24	JUN	12	13	14	15	16	17	18	11	12	13	14	15	16	17	10	11	12	13	14	15	16	JUN	24
25		19	20	21	22	23	24	25	18	19	20	21	22	23	24	17	18	19	20	21	22	23		25
26		26	27	28	29	30	01	02	25	26	27	28	29	30	01	24	25	26	27	28	29	30		26
27		03	04	05	06	07	08	09	02	03	04	05	06	07	08	01	02	03	04	05	06	07		27
28		10	11	12	13	14	15	16	09	10	11	12	13	14	15	08	09	10	11	12	13	14	JUL	28
29	JUL	17	18	19	20	21	22	23	16	17	18	19	20	21	22	15	16	17	18	19	20	21		29
30		24	25	26	27	28	29	30	23	24	25	26	27	28	29	22	23	24	25	26	27	28		30
31		31	01	02	03	04	05	06	30	31	01	02	03	04	05	29	30	31	01	02	03	04		31
32		07	08	09	10	11	12	13	06	07	08	09	10	11	12	05	06	07	08	09	10	11	AUG	32
33	AUG	14	15	16	17	18	19	20	13	14	15	16	17	18	19	12	13	14	15	16	17	18		33
34		21	22	23	24	25	26	27	20	21	22	23	24	25	26	19	20	21	22	23	24	25		34
35		28	29	30	31	01	02	03	27	28	29	30	31	01	02	26	27	28	29	30	31	01		35
36		04	05	06	07	08	09	10	03	04	05	06	07	08	09	02	03	04	05	06	07	08		36
37	SEP	11	12	13	14	15	16	17	10	11	12	13	14	15	16	09	10	11	12	13	14	15	SEP	37
38		18	19	20	21	22	23	24	17	18	19	20	21	22	23	16	17	18	19	20	21	22		38
39		25	26	27	28	29	30	01	24	25	26	27	28	29	30	23	24	25	26	27	28	29		39
40		02	03	04	05	06	07	08	01	02	03	04	05	06	07	30	01	02	03	04	05	06		40
41		09	10	11	12	13	14	15	08	09	10	11	12	13	14	07	08	09	10	11	12	13	OCT	41
42	OCT	16	17	18	19	20	21	22	15	16	17	18	19	20	21	14	15	16	17	18	19	20		42
43		23	24	25	26	27	28	29	22	23	24	25	26	27	28	21	22	23	24	25	26	27		43
44		30	31	01	02	03	04	05	29	30	31	01	02	03	04	28	29	30	31	01	02	03		44
45		06	07	08	09	10	11	12	05	06	07	08	09	10	11	04	05	06	07	08	09	10	NOV	45
46	NOV	13	14	15	16	17	18	19	12	13	14	15	16	17	18	11	12	13	14	15	16	17		46
47		20	21	22	23	24	25	26	19	20	21	22	23	24	25	18	19	20	21	22	23	24		47
48		27	28	29	30	01	02	03	26	27	28	29	30	01	02	25	26	27	28	29	30	01		48
49		04	05	06	07	08	09	10	03	04	05	06	07	08	09	02	03	04	05	06	07	08		49
50	DEC	11	12	13	14	15	16	17	10	11	12	13	14	15	16	09	10	11	12	13	14	15	DEC	50
51		18	19	20	21	22	23	24	17	18	19	20	21	22	23	16	17	18	19	20	21	22		51
52		25	26	27	28	29	30	31	24	25	26	27	28	29	30	23	24	25	26	27	28	29		52
53																								53

		1975							1976							1977								
WK		M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S		WK
1		30	31	01	02	03	04	05	29	30	31	01	02	03	04	03	04	05	06	07	08	09		1
2		06	07	08	09	10	11	12	05	06	07	08	09	10	11	10	11	12	13	14	15	16	JAN	2
3	JAN	13	14	15	16	17	18	19	12	13	14	15	16	17	18	17	18	19	20	21	22	23		3
4		20	21	22	23	24	25	26	19	20	21	22	23	24	25	24	25	26	27	28	29	30		4
5		27	28	29	30	31	01	02	26	27	28	29	30	31	01	31	01	02	03	04	05	06		5
6		03	04	05	06	07	08	09	02	03	04	05	06	07	08	07	08	09	10	11	12	13	FEB	6
7	FEB	10	11	12	13	14	15	16	09	10	11	12	13	14	15	14	15	16	17	18	19	20		7
8		17	18	19	20	21	22	23	16	17	18	19	20	21	22	21	22	23	24	25	26	27		8
9		24	25	26	27	28	01	02	23	24	25	26	27	28	29	28	01	02	03	04	05	06		9
10		03	04	05	06	07	08	09	01	02	03	04	05	06	07	07	08	09	10	11	12	13	MAR	10
11		10	11	12	13	14	15	16	08	09	10	11	12	13	14	14	15	16	17	18	19	20		11
12	MAR	17	18	19	20	21	22	23	15	16	17	18	19	20	21	21	22	23	24	25	26	27		12
13		24	25	26	27	28	29	30	22	23	24	25	26	27	28	28	29	30	31	01	02	03		13
14		31	01	02	03	04	05	06	29	30	31	01	02	03	04	04	05	06	07	08	09	10	APR	14
15		07	08	09	10	11	12	13	05	06	07	08	09	10	11	11	12	13	14	15	16	17		15
16	APR	14	15	16	17	18	19	20	12	13	14	15	16	17	18	18	19	20	21	22	23	24		16
17		21	22	23	24	25	26	27	19	20	21	22	23	24	25	25	26	27	28	29	30	01		17
18		28	29	30	01	02	03	04	26	27	28	29	30	01	02	02	03	04	05	06	07	08		18
19		05	06	07	08	09	10	11	03	04	05	06	07	08	09	09	10	11	12	13	14	15	MAY	19
20	MAY	12	13	14	15	16	17	18	10	11	12	13	14	15	16	16	17	18	19	20	21	22		20
21		19	20	21	22	23	24	25	17	18	19	20	21	22	23	23	24	25	26	27	28	29		21
22		26	27	28	29	30	31	01	24	25	26	27	28	29	30	30	31	01	02	03	04	05		22
23		02	03	04	05	06	07	08	31	01	02	03	04	05	06	06	07	08	09	10	11	12	JUN	23
24		09	10	11	12	13	14	15	07	08	09	10	11	12	13	13	14	15	16	17	18	19		24
25	JUN	16	17	18	19	20	21	22	14	15	16	17	18	19	20	20	21	22	23	24	25	26		25
26		23	24	25	26	27	28	29	21	22	23	24	25	26	27	27	28	29	30	01	02	03		26
27		30	01	02	03	04	05	06	28	29	30	01	02	03	04	04	05	06	07	08	09	10	JUL	27
28		07	08	09	10	11	12	13	05	06	07	08	09	10	11	11	12	13	14	15	16	17		28
29	JUL	14	15	16	17	18	19	20	12	13	14	15	16	17	18	18	19	20	21	22	23	24		29
30		21	22	23	24	25	26	27	19	20	21	22	23	24	25	25	26	27	28	29	30	31		30
31		28	29	30	31	01	02	03	26	27	28	29	30	31	01	01	02	03	04	05	06	07		31
32		04	05	06	07	08	09	10	02	03	04	05	06	07	08	08	09	10	11	12	13	14	AUG	32
33	AUG	11	12	13	14	15	16	17	09	10	11	12	13	14	15	15	16	17	18	19	20	21		33
34		18	19	20	21	22	23	24	16	17	18	19	20	21	22	22	23	24	25	26	27	28		34
35		25	26	27	28	29	30	31	23	24	25	26	27	28	29	29	30	31	01	02	03	04		35
36		01	02	03	04	05	06	07	30	31	01	02	03	04	05	05	06	07	08	09	10	11	SEP	36
37		08	09	10	11	12	13	14	06	07	08	09	10	11	12	12	13	14	15	16	17	18		37
38	SEP	15	16	17	18	19	20	21	13	14	15	16	17	18	19	19	20	21	22	23	24	25		38
39		22	23	24	25	26	27	28	20	21	22	23	24	25	26	26	27	28	29	30	01	02		39
40		29	30	01	02	03	04	05	27	28	29	30	01	02	03	03	04	05	06	07	08	09		40
41		06	07	08	09	10	11	12	04	05	06	07	08	09	10	10	11	12	13	14	15	16	OCT	41
42	OCT	13	14	15	16	17	18	19	11	12	13	14	15	16	17	17	18	19	20	21	22	23		42
43		20	21	22	23	24	25	26	18	19	20	21	22	23	24	24	25	26	27	28	29	30		43
44		27	28	29	30	31	01	02	25	26	27	28	29	30	31	31	01	02	03	04	05	06		44
45		03	04	05	06	07	08	09	01	02	03	04	05	06	07	07	08	09	10	11	12	13	NOV	45
46	NOV	10	11	12	13	14	15	16	08	09	10	11	12	13	14	14	15	16	17	18	19	20		46
47		17	18	19	20	21	22	23	15	16	17	18	19	20	21	21	22	23	24	25	26	27		47
48		24	25	26	27	28	29	30	22	23	24	25	26	27	28	28	29	30	01	02	03	04		48
49		01	02	03	04	05	06	07	29	30	01	02	03	04	05	05	06	07	08	09	10	11	DEC	49
50	DEC	08	09	10	11	12	13	14	06	07	08	09	10	11	12	12	13	14	15	16	17	18		50
51		15	16	17	18	19	20	21	13	14	15	16	17	18	19	19	20	21	22	23	24	25		51
52		22	23	24	25	26	27	28	20	21	22	23	24	25	26	26	27	28	29	30	31	01		52
53									27	28	29	30	31	01	02									53

been approved by 25 countries (Austria, Belgium, Canada, Ceylon, France, Germany, Greece, Hungary, India, Italy, Japan, North Korea, South Korea, Netherlands, Poland, Portugal, South Africa, Spain, Sweden, Switzerland, Thailand, U.A.R., United Kingdom, U.S.A., and Yugoslavia). Four countries only (Czechoslovakia, Ireland, Norway, and Iraq) disapproved the proposal - they preferred the ascending order. Four more countries (Australia, Denmark, New Zealand, and Turkey) abstained.

The ISO committee concluded that the advantages of the *descending* order clearly outweighed any disadvantages. In particular, are cited:

- the ease with which the whole date may be treated as a single numeral for the purpose of filing and classification (e.g., for insurance or social security systems);
- arithmetical calculation, particularly in some computer applications;
- the possibility of continuing the order by adding digits for hour-minute-second (see Note 3).

To be precise, ISO recommends that if numbers only are used, the first day of April 1971 should be written: 1971-04-01.

For technical reasons, the hyphen (or the space) is recommended as a separator rather than the point or the stroke.

Of course, a standard is of little use unless it is widely known and understood. That is why ISO now seeks the cooperation of men and women all over the world who prefer order to chaos - and who would not wish to miss an important date because of a misunderstanding.

....and when numbering the weeks

A second document, ISO/R 2015 - Numbering of Weeks, lays down the agreed standard for the numbering of weeks. The calendar week is an important unit for planning and accounting purposes. Delivery dates in purchasing contracts and similar documents are frequently designated by referring to a certain week number. Since methods of numbering the weeks of the year vary from country to country, a uniform system for the numbering of weeks has an increasing importance for international trade and industrial planning.

Briefly, ISO recommends that Monday (rather than Sunday) be regarded as the first day of the week for business and commercial purposes. ISO/R 2015 recommends, too, that the week should always be of seven days and that a week divided by the turn of the year should be attached to the year containing the higher number of days of that week. Thus, for practical purposes, the first week of the year could begin, at one extreme, on December 29, and at the other extreme, on January 4."

For consistency reasons, this Journal has adopted the year-month-day ordering even when the month is spelled out or abbreviated, as well as the 24-hour clock for diurnal time.

Note 1:
X3.30, being primarily computer oriented, has these additional options and constraints:

- The 4 digits of "year" may be reduced to 2 digits for "year of the century", or to 1 digit for "year of the decade". It should be obvious, however, that extreme caution should be exercised in using these options for mechanical processing.
- The 4 digits of "day-month" may be replaced by 3 digits (from 00l through 365 or 366) for "day of the year", thus giving the ordinal date rather than calendar date. Again, caution, although this option is easier for mechanical differencing of two dates.
- No separators are to be used in internal data representation.

Note 2:
FIPS PUB 4, Calendar Date, is available (price - 20 cents US) from either:

- NBS Clearinghouse for Scientific and Technical Information, US Department of Commerce, Springfield, VA 22151, or
- Supt. of Documents
  US Government Printing Office
  Washington, DC 20402
  (refer to SD Catalog No. C 13.52:4)

Note 3:
See Document X3L8/177, 1971 Dec 01, Draft American National Standard for Representations of Local Time of the Day for Information Interchange. It provides standard formats for both the 12-hour and 24-hour timekeeping systems, but only for civil clock time at point of origin. Therefore proper precautions should be taken for interchange, depending upon where the time was recorded, and if it must relate to any other times recorded in different world time zones.

Popular Computing

Volume 8
Number 5
May 1980

86

Thomas R. Parkin:

Measuring Time: Part II

A Star Is Formed

Problem Solution

Problem 66 in issue 19 was the following:

> A succession of random numbers (uniformly distributed in the range from 001 to 999) is drawn. The numbers are progressively totalled until the sum is a prime number, at which time the game ends and the score is the number of numbers drawn.
>
> What is the distribution of the scores?

Bernard Kasten, of Kansas State University, wrote a program (in Microsoft BASIC) to attack this problem in a straightforward manner by generating random numbers and carrying out the indicated procedure. His result for 1700 plays is as follows:

Game length	number of games	Game length	number of games	Game length	number of games
1	577	8	24	15	3
2	351	9	0	16	4
3	269	10	15	17	0
4	171	11	15	18	1
5	117	12	10	19	1
6	78	13	7	20	2
7	48	14	7		

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Measuring Time: Part II

by Thomas R. Parkin

Time is a relative phenomenon. The hiatus between Part I of this essay and this, Part II, can be characterized as relatively nil or inordinately long, depending on your point of view. The editor will incline to the latter; astronomically speaking, the former obtains. In any event, the author has <u>reasons</u> for the gap, but no <u>excuses</u>.

In Part I (in issue number 63, June, 1978), we observed how the Julian and Gregorian calendars were evolved and how they are described. Further, we observed how Joseph Scaliger obtained the Julian period of 7980 years; how he described a novel idea of counting days to yield a Julian Day Number; and, furthermore, how he obtained the epoch, or singular event, beginning the Julian period of 1/1/4713 BC. (An epoch is commonly a <u>period</u> or an era of some extent in time, but, astronomically, epoch also refers to an <u>instant</u> in time when some period commenced.)

In addition, we noted how the forever irritating year numbering error when crossing from 1 AD back to 1 BC came about. Now, we shall attempt to pull all these matters together, reconcile some descrepancies, and, hopefully, provide some rules, useful with computers, to calculate Julian Day Numbers from the date, and vice versa.

Toward the end of Part I, we noted a 60-day difference between the length, in days, of the Julian and Gregorian Julian periods of 7980 years. Since the two calendars differ by the leap year rules bis-a-vis century years, the two calendars differ in elapsed number of days by 3 every 400 years. Thus, since 7980/400 = 19 + 380/400, there will be 19 x 3 = 57 less days in the Gregorian periods due to 76 centuries, plus 3 more days due to the 3 centuries in the 380 years left over, thus yielding 60 days difference.

The American Ephemeris and Nautical Almanac (AE&NA) published for astronomers, navigators, and astrophysicists every year, gives some tables for determining the Julian Day Number (JDN) of any given date from 1697 BC to 2296 AD, defined for suitable calendars. These tables are not trivial to use by any means and, furthermore, they perpetuate one source of one-day error which keeps cropping up in various calculations of JDN, to wit: the tables yield JDN's for day zero of any given month! This concept of a day 0 for January, for example, really means the last day of the previous month, or December 31 of the previous year. Careless preparers of programs to compute JDN often overlook this detail when testing their programs.

There is, of course, another source of persistant error of one day in the JDN; namely, the time of day. Since astronomers work at night, the time from dusk to the next dawn should all be a single day by their reckoning, while the civil calendar persists in changing its date at midnight for any given local time. This intolerable (to the astronomers) state of affairs is easily taken care of by defining the JDN to apply from noon at Greenwich; thus, in the Western world, encompassing all of any one night's observations into the same JDN. Thus, one must specify the date, the calendar used, and the time, if one wants an accurate determination of the JDN.

The AE&NA also gives a table near the front of the book called "CALENDAR, 19XX," and in that table, the "Julian Date" is given for each day of the year. This is different from the "Julian Day Number," since what is implied is both a date and a time of day. For example, January 1, 1979 has a Julian Date (JD) of 2443874.5 (that is, expresses the elapsed integral number of days from the Julian Period epoch, plus the fraction of a day since the last JDN incremented by one, and, refers to 0000 hours, Coordinated Universal Time at the Greenwich meridian.) Note that this JD correlates with the JDN given in the JDN tables (toward the back of the AE&NA); namely, January 0, 1979 (at noon)(really, December 31, 1978) has a JDN of 2443874 expressed as an integer. This fractional version of what should be an integer is another source of confusion about JDN's.

As another, but probably not final, source of confusion regarding JDN, the scientists responsible for certain aspects of the International Geophysical Year decreed that there would be a new epoch for what would be known as the Modified Julian Day (MJD) and that this would be 00 hours, Universal Time, November 17, 1858 AD, Gregorian Calendar. At that moment, the classical astronomer's JDN (really, JD) was 2,400,000.5! This introduction of a change in the JDN to a new MJD with a further adjustment of one-half a day seems to me to be totally unjustified and a typical example of bureaucratic nonsense. Alas, such is the way the world works.

The reader will recall that we examined a chart showing that 1 BC was the name of the year immediately preceeding 1 AD, thus depriving us of a year zero. This designation also causes some confusion for those who would calculate JDN from the date, and this is totally independent of the controversy regarding the year of the birth of Christ.

As a further minor point of confusion regarding calculations of JDN by many proposed schemes, numerous authors and texts fail to point out that integer arithmetic is essential when computing JDN or the date, and, furthermore, most (but NOT all) computer languages and their implementations perform non-frational residue arithmetic when dealing with numbers expressed as integers. For example, when one looks at an ALGOL procedure showing "year/4", where "year" is defined as integer, then "year" = 4, 5, 6, or 7 will all yield one for that quotient, and this is almost never described as the "greatest integer" function.

Now, finally, we have previously noted that not all of the world adopted the Gregorian calendar at the same time; indeed, some have not adopted it to this day! During the 16th, 17th, and 18th centuries, dates were frequently noted as being OS or NS (Old Style, that is, Julian Calendar; or New Style, that is, Gregorian). If these designations appear, they thus determine exactly which calendar is meant. Otherwise, for any given date, one must know which calendar is intended. We shall explore this issue a bit.

At the time Joseph Scaliger proposed the Julian Day Number scheme, he only knew the Julian Calendar, as we have previously stated; hence, all real dates prior to October 4, 1582 are with respect to the Julian Calendar or some calendar other than the Gregorian. If there is any reference to a Gregorian date earlier than October 15, 1582, it is an artificiality which exists only to extrapolate the current calendar backwards.

We shall make some arbitrary distinctions about dates for purposes of this discussion and for describing some computational schemes. Further, throughout the rest of this paper, unless a time-of-day is otherwise specified, we shall adopt the astronomer's definition of JDN; namely, that the number applies to a date as of noon Greenwich time until the next day at noon.

We shall conclude our discussion of sources of error in understanding the JDN by exposing one final egregious selection by Joseph Scaliger. Like the scientist that he was, he chose to begin his numbering of serial numbered days with zero for the first day and not one. This allows one to use the JDN as both a serial number (hence, name) for a given date, and also as a count of elapsed days up to the beginning of the given astronomical day.

Scaliger's cleverness has been the source of endless confusion about JDNs for four centuries. Isn't it marvelous how we humans can complicate our lives? Perhaps this will all be somewhat clearer if we examine a chart which diagrammatically correlates all the items we have mentioned.

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Let us look at Figure 1. Row I spans about three days of elapsed time with some points marked for reference. We are, of course, looking at events from the meridian of Greenwich, and are referring to Universal Time as defined for that line.

Row II gives the Ecclesiastical or Civil date in the Gregorian calendar as it is most commonly accepted in the Western world. The day of the week is also given, since this is uniquely determined by the use of specific dates.

Row III gives the astronomical day as used prior to 1925. This form corresponds to the Julian Day Number period of Noon to the following Noon; its use was generally discontinued after 1925.

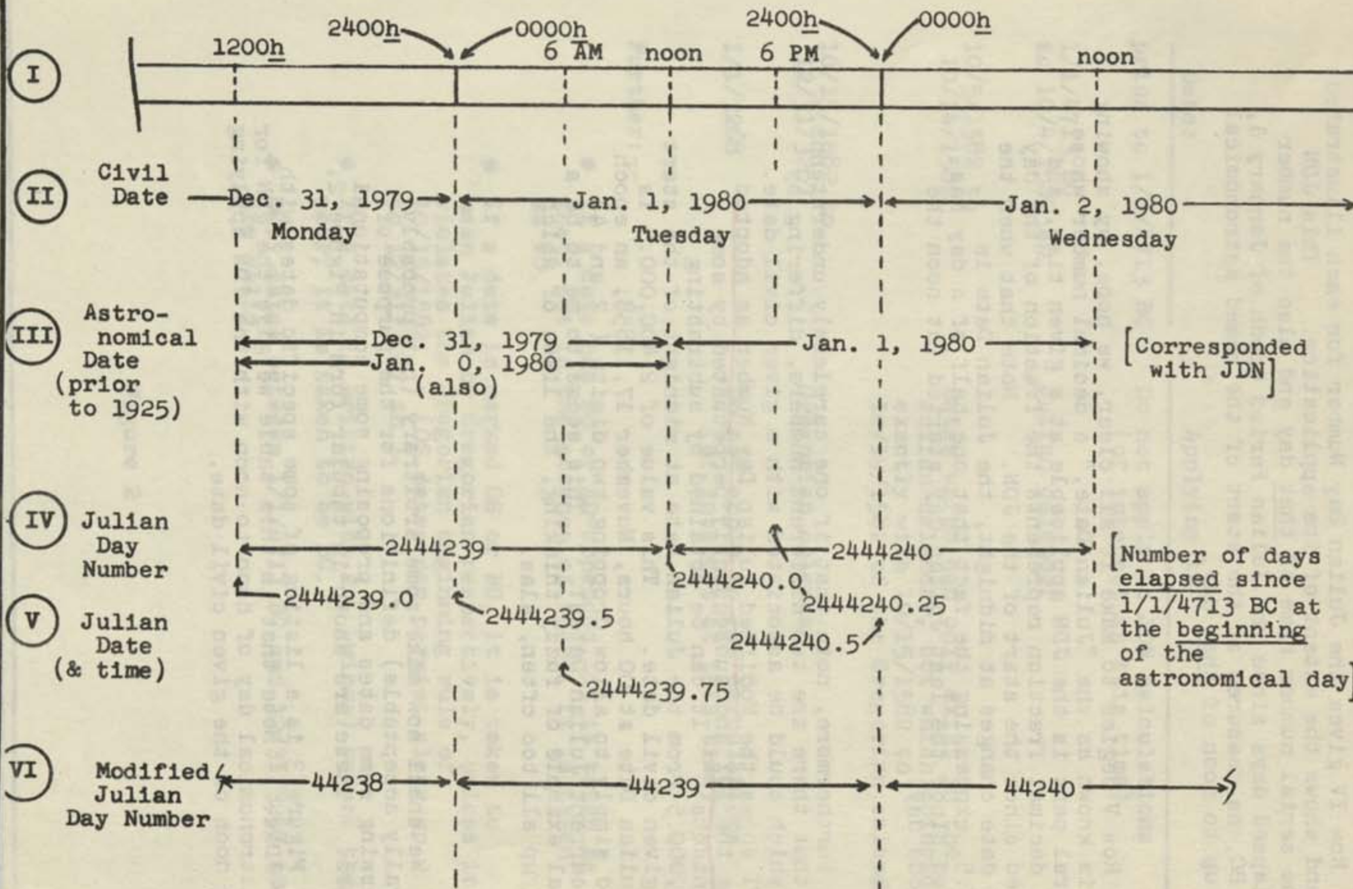

1200h
2400h
0000h
6 AM
noon
6 PM
2400h
0000h
noon
I
II
Civil Date
Dec. 31, 1979
Monday
Jan. 1, 1980
Tuesday
Jan. 2, 1980
Wednesday
III
Astro-nomical Date (prior to 1925)
Dec. 31, 1979
Jan. 0, 1980 (also)
Jan. 1, 1980
[Corresponded with JDN]
IV
Julian Day Number
2444239
2444240
[Number of days elapsed since 1/1/4713 BC at the beginning of the astronomical day]
V
Julian Date (& time)
2444239.0
2444239.5
2444239.75
2444240.0
2444240.25
2444240.5
VI
Modified Julian Day Number
44238
44239
44240

Figure 1

Row IV gives the Julian Day Number for each illustrated day and shows the extent of its application. This JDN is the serial number name of that day and also the number of elapsed days since the Julian Period epoch of January 1, 4713 BC, as measured at the start of the named astronomical day, up to noon of that day.

Row V begins to make it all clear, we hope, by showing what is known as the "Julian Date," a decimal number whose integral part is the JDN applicable at a given time, and whose decimal fraction represents the fraction of the day elapsed since the start of the JDN. Note that when the civil date changes at midnight, the Julian Date is ...XX.5, expressing the fact that one-half of a day has elapsed since the last Julian day started (at noon the previous day).

Furthermore, note that if one carelessly understands JDN, that there are two different numbers, differing by one, which could be associated with a given civil date. Row VI shows the Modified Julian Day Number as adopted during the IGY and subsequently perpetuated by some accountants. It can be obtained by subtracting 2,400,000.5 from the Julian Date at midnight of the start of a given civil date. This value of 2,400,000.5 is the Julian Date at 00 hours, November 17, 1858; an epoch picked simply to allow dropping two digits (2 and 4) from current Julian Dates! This seems to me to be a typical example of fuzzy thinking, the likes of which crops up all too often, alas.

We shall now make some arbitrary (but probably generally acceptable) definitions for the purpose of expressing some dates and proposing some computational schemes. These are shown in tabular form in Figure 2.

Figure 3 is a listing of some specific dates with their JDNs. Note that in this table we give the JDN for the astronomical day of noon-to-noon with the JDN applying after noon of the given civil date.

Dates	Applying to
prior to 1/1/4713 BC	Do not apply to JDN calculations (of interest at this time)
1/1/4713 BC to 10/4/1582 AD	Julian calendar
10/5/1582 to 10/14/1582	Dates which can only exist in the Julian calendar, but which coincide exactly with 10/15/1582 to 10/19/1582 of the Gregorian calendar.
10/15/1582 to 12/31/3267	Gregorian calendar
1/1/3268	Do not apply to JDN calculations (of interest at this time)

Further:--

- If a date has BC or AD appended, it is taken as that, but in the absence of these, it is taken as AD.
- If a date is marked OS or NS, it is taken to mean Julian or Gregorian respectively, unless it violates the Gregorian beginning rule of 10/15/1582. (OS dates can persist clear up to 12/31/3267 AD.)
- If a date is written with a - (minus) before the year, it is taken to be BC.
- Only dates between 1/1/4713 BC and 12/31/3267 AD are valid.

Figure 2

Some Specific Dates

Date	JDN	Remarks
1/1/4713 BC	0	Scalawag Scaliger did this to us!
1/1/4712 BC	366	Yes, 4713 BC was a leap year.
1/1/1 BC	1721058	One BC was also a leap year (see Figure 4)
12/31/1 BC	1721424	Note the absence of a year zero.
1/1/1 AD	1721425	
10/4/1582	2299160	Pope Gregory's date
10/15/1582	2299161	Gregorian Calendar
10/15/1582 OS	2299171	Julian Calendar
1/1/1584	2299604	Note (1) below
1/1/1900	2415021	Note (2) below
1/1/1979	2443875	
1/1/1980	2444240	
5/1/1980	2444361	A proleptic date, perhaps

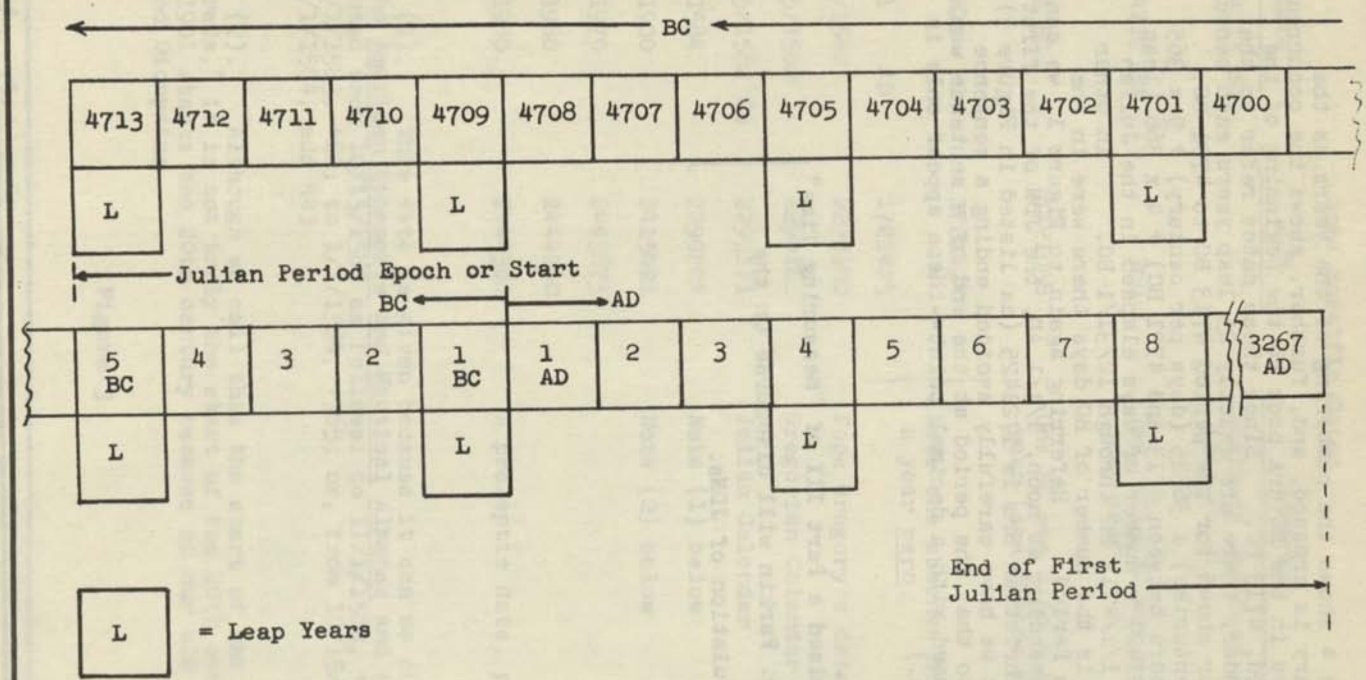
Note (1). This date is given because it can be checked in the American Ephemeris and Nautical Almanac and can be computed from 10/15/1582 as follows: to 11/1/1582, +17; to 1/1/1583, +61; to 1/1/1584, +365; or, from 10/15/1582 to 1/1/1584, add 443.

Note (2). Although we call this the start of the "nineteen hundreds," it is not truly the start of the 20th century; 1/1/1901 starts the 20th century because of our old friend Dionysius.

Figure 3

Figure 4 shows the numbering of the years as the BC/AD boundary is crossed, and, further, shows the occurrence of leap years in the BC era back to the beginning of the Julian Period, 4713 BC. Since these dates refer to the Julian calendar, there are exactly 25 leap years each century plus the four shown for the period 4713 BC to 4701 BC. Thus, 47 (centuries) x 36525 (days per century) + 9 x 365 (non-leap years between 4713 and 4701 BC) + 4 x 366 (leap years) = 1721424 = number of days elapsed in the Julian Period from 1/1/4713 BC through 12/31/1 BC. In other words, this is the number of BC days there were in the first Julian Period. Referring again to Figure 1, we can see that commencing at noon, 1/1/1 AD, the JDN of the first day of the Christian Era is 1721425 (as listed in Figure 3). (Notice that we have carefully avoided ending a sentence with a JDN so that the period at the end of a sentence would not be confused with a decimal point--these appear only in Julian Dates.)

{We are promised a Part III of "Measuring Time" in which Mr. Parkin will discourse on the actual calculation of JDNs.}



BC
4713
4712
4711
4710
4709
4708
4707
4706
4705
4704
4703
4702
4701
4700
L
L
L
L
Julian Period Epoch or Start
BC
AD
5 BC
4
3
2
1 BC
1 AD
2
3
4
5
6
7
8
3267 AD
L
L
L
L
End of First Julian Period
L
= Leap Years

Figure 4

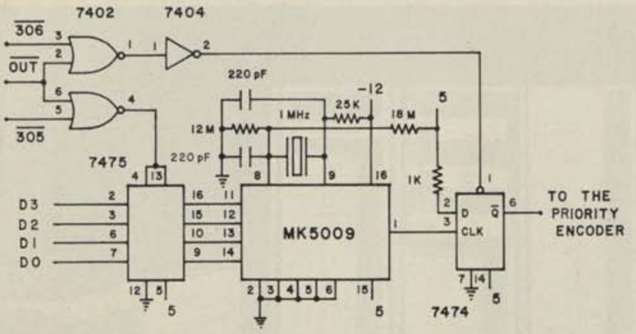
INTERFACING FUNDAMENTALS: REALTIME CLOCK HARDWARE AND SOFTWARE

Peter R. Rony and David G. Larsen
Virginia Polytechnic Institute and State University

Jonathan A. Titus and Christopher A. Titus
Tychon, Inc

To continue the discussion of realtime clocks and thier characteristics, diverse hardware devices and software instructions can be implemented to build and use a realtime clock. Perhaps the simplest one that can be built is a freerunning realtime clock. The schematic for such a device is shown in Fig 1. The "heart" of this circuit is the Mostek Corp MK5009, a counter/time base driven by a 1-MHz quartz crystal. This device contains a number of divide-by-10 counters from which the user may select one to drive the MK5009's output. Four digital inputs to the device are used to select the required decade counter. The truth table for these inputs and the resulting output frequencies are also listed in Fig 1. For input values greater than 1000_2, the counter/time base generates frequencies that are not multiples of 10.

In the Fig 1 schematic, a 4-bit latch (SN7475) is used in the realtime clock interface, between the 8080 based microcomputer and the MK5009. The latch is used to program the counter/time base for a particular frequency; the output clocks a D flip-flop whose output goes to some



INPUTS 2^3	2^2	2^1	2^0	OUTPUT FREQUENCY
0	0	0	0	1 MHz
0	0	0	1	100 kHz
0	0	1	0	10 kHz
0	0	1	1	1 kHz
0	1	0	0	100 Hz
0	1	0	1	10 Hz
0	1	1	0	1 Hz
0	1	1	1	0.1 Hz
1	0	0	0	0.01 Hz

PIN 11 = 2^3, PIN 12 = 2^2, PIN 13 = 2^1, AND PIN 14 = 2^0

Fig 1 Freerunning realtime clock. Schematic shows circuit containing Mostek's MK5009 which is driven by 1-MHz quartz crystal. Truth table associates inputs with resultant output frequencies for counter/time base

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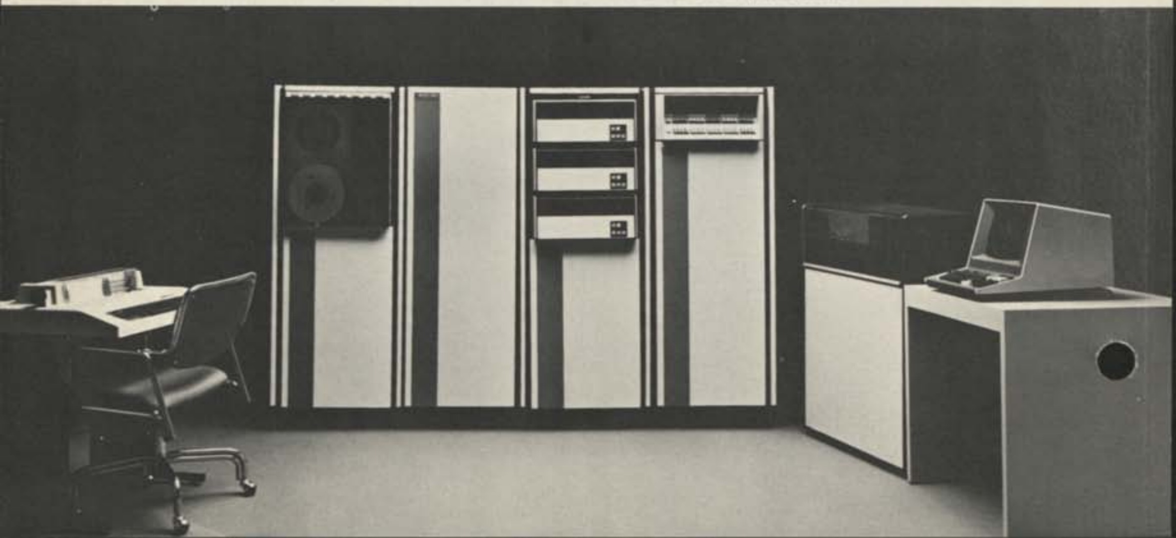
CIRCLE 162 ON INQUIRY CARD



PROGRAM 1

Instructions for the MK5009 Counter/Time Base

```
         *000 000
START,   LXISP    /Load stack pointer with
         STACK    /R/W memory address because
         0        /interrupts can occur.
         MVIA     /Then load A register with
         003      /00000011.
         OUT      /Output this value to
         305      /MK5009 (1-kHz operation).
         OUT      /Clear flip-flop that is
         306      /wired to MK5009.
         EI       /Enable interrupt,
         •        /then execute remainder
         •        /of program.
         •
         *000 070
RTCISS,  •        /Realtime clock interrupted
         •        /microcomputer, so service
         •        /some of peripheral devices.
         OUT      /Then clear flip-flop that
         306      /caused interrupt (MK5009).
         EI       /Re-enable interrupt
         RET      /and return to task that
                  /was interrupted.
```

additional interrupt interface hardware. It will be assumed that this hardware produces an RST7 instruction when the 8080 acknowledges the interrupt. For additional information on interrupt hardware, see Refs 1, 2, and 3.

Instructions that can be used to program the MK5009 are listed in Program 1. After the stack pointer is loaded, the A register is loaded with the value 00000011_2. This value is transferred to output port 305, which is the SN7475 latch in the realtime clock interface. The four least significant bits of this value are the only bits within the 8-bit byte that are actually latched by the SN7475, and the MK5009 is programmed for 1-kHz operation by this value (0011_2). Once the counter/time base has been programmed, the interrupt flip-flop (SN7474) is cleared by the second OUT instruction and the interrupt is enabled (EI).

In 1 ms or less, the 8080 microprocessor will be interrupted by the realtime clock. It has been assumed that when the realtime clock interrupts the 8080, it is vectored to memory location 000 070_8 by the interrupt hardware.[1,2,3] This is where the realtime clock interrupt service subroutine must be stored in memory. In this subroutine, the microprocessor may have to transfer some data between itself and a peripheral device, or it may simply turn some lights and values on or off. However, once these tasks are performed the SN7474 interrupt flip-flop [Fig 1 (a)] is cleared and the interrupt re-enabled. The microprocessor then returns to the program interrupted by the realtime clock.

One characteristic of this realtime clock is that it is freerunning—it cannot be turned off or stopped. It will always generate a square wave with a frequency of 1 kHz.

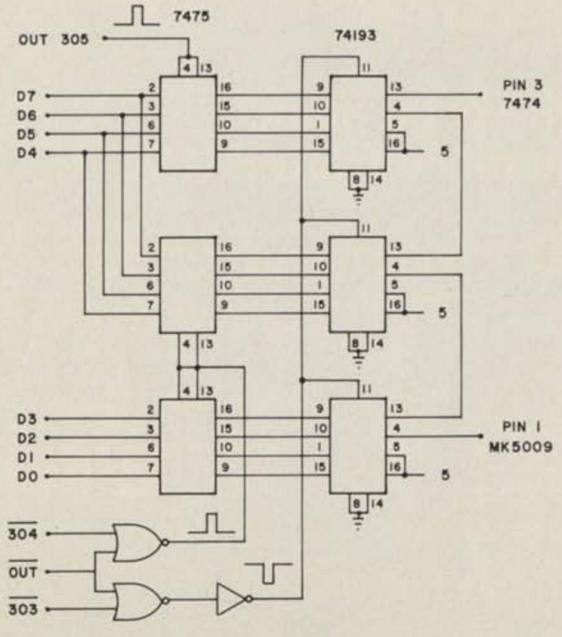


Fig 2 Programmable realtime clock. Addition of programmable down-counters allows interrupts to be generated every 15 or 20 ms. Latches and counters added to interface are wired to the 8080 microprocessor and MK5009 counter/time base

PROGRAM 2

Programming the Counters and MK5009 For a 20-ms Interval

```
         *000 000
START,   LXISP    /Load stack pointer with
         STACK    /R/W memory address because
         0        /interrupts can occur.
         MVIA     /Then load A register with
         003      /0000 0011, to program most
         OUT      /significant counter with 0
         305      /and MK5009 (1 kHz).
         MVIA     /Then load A register with
         024      /00010100 so that two least
         OUT      /significant counters are
         304      /loaded with decimal 20.
         OUT      /Clear interrupt flip-flop.
         306
         OUT      /Then transfer content of
         303      /latches to counters.
         EI       /Enable interrupt and
         •        /then execute remainder
         •        /of program.
         •
         *000 070
RTCISS,  •        /Realtime clock interrupted
         •        /microcomputer, so service
         •        /some of peripheral devices.
         OUT      /Then clear flip-flop that
         306      /caused interrupt and
         OUT      /reload counters with
         303      /content of latches.
         EI       /Re-enable interrupt
         RET      /and return to task that
                  /was interrupted.
```

PROGRAM 3

Time-of-Day Clock Software Without a Counter Chain

```
/This is a time-of-day clock program
/(This is the start of the "Main Task")
         *002 000
START,   MVIA     /Load A register with
         006      /word that will program
         OUT      /MK5009 for 1-Hz operation
         305      /and then output it to latches.
         LXIH     /Load register pair H with ad-
         CURTIM   /dress where current time (CURTIM)
         0        /is stored in memory (BCD format).
         MVIB     /Load B register with
         003      /number of locations used by CURTIM.
ZERO,    MVIM     /Load memory location with 000.
         000
         INXH     /Increment memory address.
         DCRB     /Decrement word count.
         JNZ      /If count is nonzero,
         ZERO     /set another memory location
         0        /to 000.
SKIP,    LXISP    /Load stack pointer because
         STACK    /an interrupt can occur.
         0
         OUT      /Clear interrupt flip-flop.
         306
         EI       /When done, enable interrupt
         •        /and continue to execute
         •        /"Main Task."
         •
/This is the interrupt service subroutine. The
/interrupt hardware generates an RST7 instruction
         *000 070
CLOCK,   PUSHPSW  /When interrupt occurs, save
         PUSHB    /all of registers on stack.
         PUSHD
         PUSHH
ISCNT,   LXIH     /Load register pair H with address
```

(Continued on p 132)

The only method of preventing the 8080 microprocessor from being interrupted by this device is to disable the interrupt by executing a DI instruction. One limitation of this realtime clock is the fact that it can only be programmed to generate the frequencies listed in the truth table of Fig 1.

One of the more practical methods of using this device to generate an interrupt every 15 or 20 ms would be to add some programmable down-counters to the realtime clock. The MK5009 can be used to clock these counters and when they have counted down to zero, the interrupt flip-flop is clocked so that an interrupt occurs. The latches and counters are wired to the microprocessor and counter/time base as shown in Fig 2. The content of the A register is latched by this interface when an OUT 304 or OUT 305 instruction is executed. When an OUT 303 is executed, the content of the latches is loaded into the counters. Since three 4-bit counters are used, the counters can be loaded with any number between 0 and 111111111111_2. Placement of these three counters between the counter/time base and interrupt flip-flop allows the counter/time base to generate a maximum of 4096 output pulses (to the counters) before an interrupt will occur. (Note that the latches in Fig 2 are needed only if the same time interval will be used over and over again; they serve to simplify the software drivers.)

Once these counters and latches are added to the interface, the problem remains of writing a set of instructions that will program the realtime clock for an interval of 5 or 20 ms. For an interval of 20 ms, the software in Program 2 can be executed. This software loads the counters with the number 000000010100_2 and also programs the MK5009 for 1-kHz operation (1-ms time interval). Note that this software not only has to output

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CIRCLE 79 ON INQUIRY CARD

(Program 3 continued)

```
         TOPVAL   /of table that contains max
         0        /number of seconds, minutes, and
                   hours.
         LXID     /Then load register pair
         CURTIM   /D with address where
         0        /time is stored.
         MVIB     /Load B register with number
         003      /of memory locations involved.
UPONE,   LDAXD    /Get number.
         ADI      /Add one to it
         001
         DAA      /and adjust result.
         STAXD    /Save new time.
         CMPM     /Is it too large?
         JNZ      /No, so return from interrupt.
         MIDNGT
         0
NEXT,    MVIA     /Load A register with zero.
         000
         STAXD    /Then save it in current time.
         INXH     /Increment table address.
         INXD     /Increment current time address.
         DCRB     /Decrement number of locations.
         JNZ      /Count is nonzero, so
         UPONE    /next consecutive memory location
         0        /can be incremented.
MIDNGT,  POPH     /Time is valid, so get all
         POPD     /registers off stack.
         POPB
         POPPSW
         OUT      /Now clear interrupt flip-
         306      /flop wired to MK5009.
         EI       /Enable interrupt
         RET      /and return to "Main Task."
CURTIM,  000      /Number of BCD seconds here.
MIN,     000      /Number of BCD minutes here.
HOURS,   000      /Number of BCD hours here.
TOPVAL,  140      /Max number of BCD seconds—60.
         140      /Max number of BCD minutes—60.
         044      /Max number of BCD hours—24.
```

values to the latches in the interface, but also that these values have to be transferred from the latches to the counters. Therefore, an OUT 303 instruction must also be executed when this interface is used.

Other values could have been used to program the realtime clock so that an interrupt occurs every 20 ms. The value 200_{10} could have been loaded into the counters and the counter/time base would have been programmed for 10-kHz (0.1-ms time interval) operation. A value of 2000_{10} could also be used if the counter/time base is programmed for 100-kHz (0.01-ms time interval) operation. In fact, the value of 2000_{10} and a 100-kHz frequency is the best combination, because they generate a time interval that has the greatest resolution, ie, a maximum error of 1 part in 2000_{10}.

When the realtime clock interrupts the 8080, the microprocessor services some peripheral devices and then clears the interrupt flip-flop (OUT 306). The count is then transferred from the latches to the counters when the OUT 303 instruction is executed. This must be done because the counters, after counting to zero, are next decremented to 111111111111_2. Therefore, if the counters were not reloaded, the microprocessor would be interrupted 4096 clock pulses later, rather than the number stored in the latches. After re-enabling the interrupt, the microprocessor returns to the task that was interrupted.

Adding the three 4-bit counters to the realtime clock interface increases its capabilities. Intervals of from 1 μs to 4.096×10^5 s (4.74 days) can be timed. A far greater variety of interrupt intervals also can be selected than were possible with the basic eight frequencies generated by the counter/time base alone.

Another application of a realtime clock is a time-of-day clock, which is simply a peripheral device, or series of memory locations, where the current time of the day is stored and updated. The time may be updated every second or hundredth of a second, depending on the hardware, software, and uses of the clock. One method of constructing a time-of-day clock would be to program the MK5009 for 1-Hz operation and then wire the output of the MK5009 to a counter or divider chain. These chains consist of a divide-by-10 and a divide-by-6 counter for seconds, a divide-by-10 and a divide-by-6 counter for minutes, and a divide-by-3 and a divide-by-10 counter for hours. Rather than use a divide-by-3 and a divide-by-10 counter for a 24-h format, a divide-by-2 and a divide-by-10 counter could be used for a 12-h format. The counter outputs could be wired through 3-state interface devices to the microcomputer's data bus. The microcomputer would then have to execute some accumulator input/output (I/O) or memory-mapped I/O instructions[3,4] to read the time from the time-of-day clock. By using this method, *no* interrupts are required and the software instructions required to read the time are very simple.

Additional instructions could be added so that a time is entered into the microcomputer by means of a cathode-ray tube or teletypewriter. This time would then be written out to the time-of-day clock, so that it is programmed for the correct time when the microcomputer is started. This can only be done if programmable counters are used in the time-of-day clock interface. Of course, at this point it is not necessary to use an MK5009 as a 1-Hz clock source. A 60-Hz signal could be derived from the 110/220-Vac power lines and divided by 60 before being applied to the counter chain.

Hardware for the time-of-day clock can be greatly simplified, but at the expense of more software instructions. In fact, the original freerunning realtime clock (Fig 1 schematic) can still be used. However, the counter/time base will be programmed for 1-Hz operation. This means that if the 8080 microprocessor's interrupt is enabled, it will be interrupted once every second. When this occurs, the interrupt service subroutine must be composed of instructions that cause the time (wherever it is stored) to be incremented by one. Since there is no way of knowing what the microprocessor will be doing when it is interrupted, the time will be stored in three memory locations, rather than in some of the microprocessor's general purpose registers. Therefore, if a program needs to know the time, it will have to read the time from these three memory locations, rather than from a peripheral device.

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Software for a time-of-day clock without a counter chain is listed in Program 3. The instructions that begin at START simply program the counter/time base for 1-Hz operation, set three consecutive memory locations to zero, clear the interrupt flip-flop, and then enable the interrupt. When an interrupt is generated by the counter/time base, the 8080 microprocessor will be vectored to 000 070_8 by the interrupt interface hardware.

When this happens, the microprocessor saves all of the general purpose registers on the stack. The time is then incremented by one, since the last interrupt occurred 1 s ago. The time is stored in three memory locations in a packed binary coded decimal (BCD) format. The number of seconds is stored in CURTIM, the number of minutes in MIN, and the number of hours in HOURS. Once the microprocessor has incremented the time by one, it executes the instructions at MIDNGT. These instructions pop all of the registers off of the stack, clear the interrupt flip-flop, re-enable the interrupt, and cause the microprocessor to return to the task that was interrupted by the freerunning realtime clock.

Although this software appears long and complex, the microprocessor needs at most only 194 μs (assuming a 500-ns cycle time) to increment the time by one and return to the task that was interrupted. The microprocessor is interrupted every second for this amount of time, so an extremely small portion of its time (0.0194%) is used to service this interrupt and update the time.

Notice that the instructions at START initialize the time-of-day clock to a time of 00:00:00. If the time is really 10:45:37 am, the packed BCD number 10 could be stored in the HOURS memory location, the number 45 in the MIN memory location, and the number 37 in the CURTIM memory location. If this is done, the instructions at START would not be executed; instead, program execution would begin at SKIP.

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This article is based, with permission, on a column appearing in *American Laboratory* magazine.

Note: An expanded series of four 3-day hands-on workshops on 8080/8085 design, microcomputer interfacing, software design, and digital electronics are being given by Peter Rony, Paul Field, Christopher Titus, and David Larsen. Participants will have the option of retaining equipment used in these courses. Dates are March 19 to 28, 1979. For more information, contact Linda Leffel, C.E.C., Virginia Polytechnic Institute and State University, Blacksburg, VA 24061, tel: (703) 961-5241.

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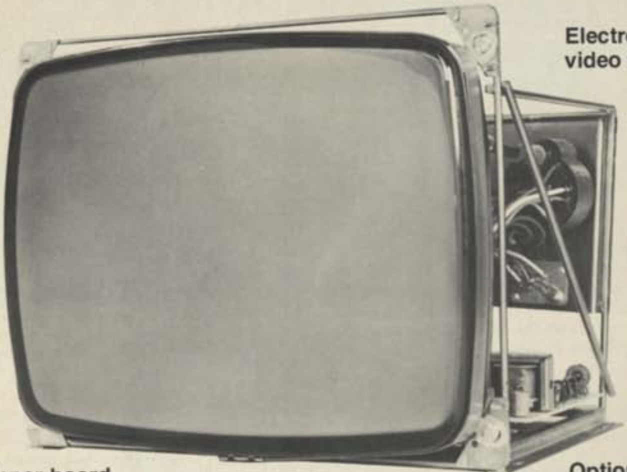

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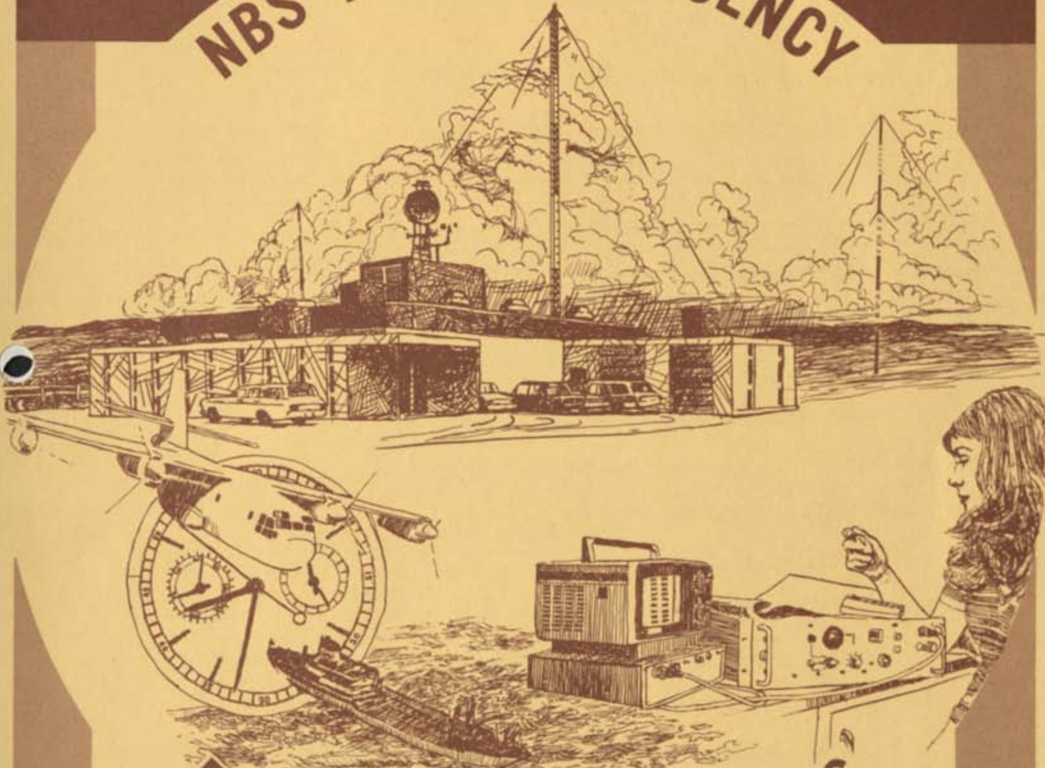

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Jul. 1956 WWVB (KK2XEI) began 60 kHz broadcasts, Boulder, CO

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Aug. 1963 WWVL began high power broadcasts, Ft. Collins, CO

Jul. 1964 WWVH added voice announcements

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Jul. 1971 WWVH relocated to Kauai, HI

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Jan. 1974 Voice announcements changed from Greenwich Mean Time to Coordinated Universal Time (WWV and WWVH)

Mar. 1975 Frequency calibration using network color TV became a nationwide service

Aug. 1975 Line-10 time comparisons using TV synchronization pulses became a nationwide service

ERRATA

NBS SPECIAL PUBLICATION 432, January 1976 Edition

Page 1, Section 1, 3rd line: Both WWV and WWVH broadcast on frequencies of 2.5, 5, 10, and 15 MHz. The 20 and 25 MHz broadcasts from WWV and the 20 MHz broadcast from WWVH were discontinued on Feb. 1, 1977.

Page 2, Figure 1:

1. The white 45-second segments on both the WWV and WWVH formats should be pink. These segments contain the 500-Hz tone.
2. WWV format only: The Propagation Forecasts at 14 minutes after the hour are no longer broadcast. Some of the information previously contained in these forecasts is now included in the Geoalerts at 18 minutes after the hour.
3. WWVH format only: The Geoalerts at 45 minutes after the hour are no longer broadcast.
4. Omega Navigation System Status Reports are now being broadcast on WWV at 16 minutes after the hour and on WWVH at 47 minutes after the hour.

Page 3, Section 1b: Delete the 20 and 25 MHz frequencies from the table.

Page 5: PROPAGATION FORECASTS -- Delete this section.

Add new Section entitled OMEGA NAVIGATION SYSTEM STATUS REPORTS:

Omega Navigation System status reports are broadcast in voice from WWV at 16 minutes after the hour and from WWVH at 47 minutes after the hour. The International Omega Navigation System is a very low frequency (VLF) radio navigation aid operating in the 10 to 14 kHz frequency band. Eight stations are in operation around the world. Omega, like other radio navigation systems, is subject to signal degradation caused by ionospheric disturbances at high latitudes. The Omega announcements on WWV and WWVH are given to provide users with immediate notification of such events and other information on the status of the Omega system.

For more information about the Omega Navigation System, contact:
Mr. David Scull, U. S. Coast Guard HQ, (G-ONSOD/43), Washington, DC 20590.

NBS
TIME AND FREQUENCY DISSEMINATION SERVICES

Sandra L. Howe, Editor

Time and Frequency Division
Institute for Basic Standards
National Bureau of Standards
Boulder, Colorado 80302

(Supersedes NBS Special Publication 236, 1974 Edition)

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NATIONAL BUREAU OF STANDARDS, Ernest Ambler, Acting Director

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FOREWORD

This publication presents a description of the time and frequency dissemination services of the National Bureau of Standards. Those interested in information on the NBS atomic clock system, transmitting antennas, or discussion of technological applications of the dissemination services should refer to Section 8, *Other Publications*.

This SPECIAL PUBLICATION 432 replaces former Special Publication 236. It will be revised and reissued only as necessary to update information.

Contents

NBS Time and Frequency Dissemination Services

Sandra L. Howe

Detailed descriptions are given of the time and frequency dissemination services of the National Bureau of Standards (NBS.) These services include the broadcasts from radio stations WWV, WWVH, WWVB, and WWVL (on an intermittent basis), and new time and frequency calibration services using television. This publication shows the services available on January 1, 1976. It will be updated only when the services are revised or when new services are added. A list of other publications available from the Time and Frequency Division of NBS is also included.

Key words: Broadcast of standard frequencies; frequency calibration; high frequency; low frequency; standard frequencies; television color subcarrier; time calibration; time signals.

Introduction

The time and frequency community is a small community, generally unknown to the world at large, yet vitally important to many of the basic activities of everyday living. Electric power companies, radio and television stations, telephone companies, and navigators of ships and planes all depend heavily on precise frequency and time information. They must have a constantly available source—a reliable, nationally and internationally recognized *standard*—with which to compare and regulate their own timing equipment. For over 50 years, the National Bureau of Standards (NBS) has been providing this standard for most users in the United States.*

Since the inception of the broadcast services from radio station WWV in 1923, NBS has continually improved and expanded its time and frequency dissemination services to meet the ever growing needs of an ever widening community of users. Today, still striving for better ways to serve its public, NBS is making major contributions to the nation's space and defense programs, to worldwide transportation and communications, and to a multitude of industrial operations, as well as providing convenient, highly accurate time service to many thousands of users throughout the world. Services are presently available from stations WWV and WWVB in Fort Collins, Colorado, and from WWVH in Kauai, Hawaii. In addition, new calibration services using network television are also available. This booklet is offered as a guide to these services.

1. WWV and WWVH

NBS broadcasts continuous signals from its high-frequency radio stations WWV and WWVH. The radio frequencies used are 2.5, 5, 10, 15, and 20 MHz. WWV also broadcasts on an additional frequency of 25 MHz. All frequencies carry the same program, but because of changes in ionospheric conditions, which sometimes adversely affect the signal transmissions, most receivers are not able to pick up the signal on all frequencies at all times in all locations. Except during times of severe magnetic disturbances, however—which make all radio transmissions almost impossible—listeners should be able to receive the signal on at least one of the broadcast frequencies. As a general rule, frequencies above 10 MHz provide the best daytime reception while the lower frequencies are best for nighttime reception.

Services provided by these stations include:

Time announcements
Standard time intervals
Standard frequencies
Propagation forecasts
Geophysical alerts
Marine storm warnings
UT1 time corrections
BCD time code

Figure 1 gives the hourly broadcast schedules of these services along with station location, radiated power, and details of the modulation.

1a. Accuracy and Stability

The time and frequency broadcasts are controlled by the primary NBS Frequency Standard in Boulder, Colorado. The frequencies as transmitted are accurate to within one part in 100 billion at all times. Deviations are normally less than one part in 1,000 billion from day to day. However, changes in the propagation medium (causing Doppler effect, diurnal shifts, etc.) result in fluctuations in the carrier frequencies *as received* by the user that may be very much greater than the uncertainty described above.

*The U.S. Naval Observatory provides time standards for the Department of Defense and other interested users.

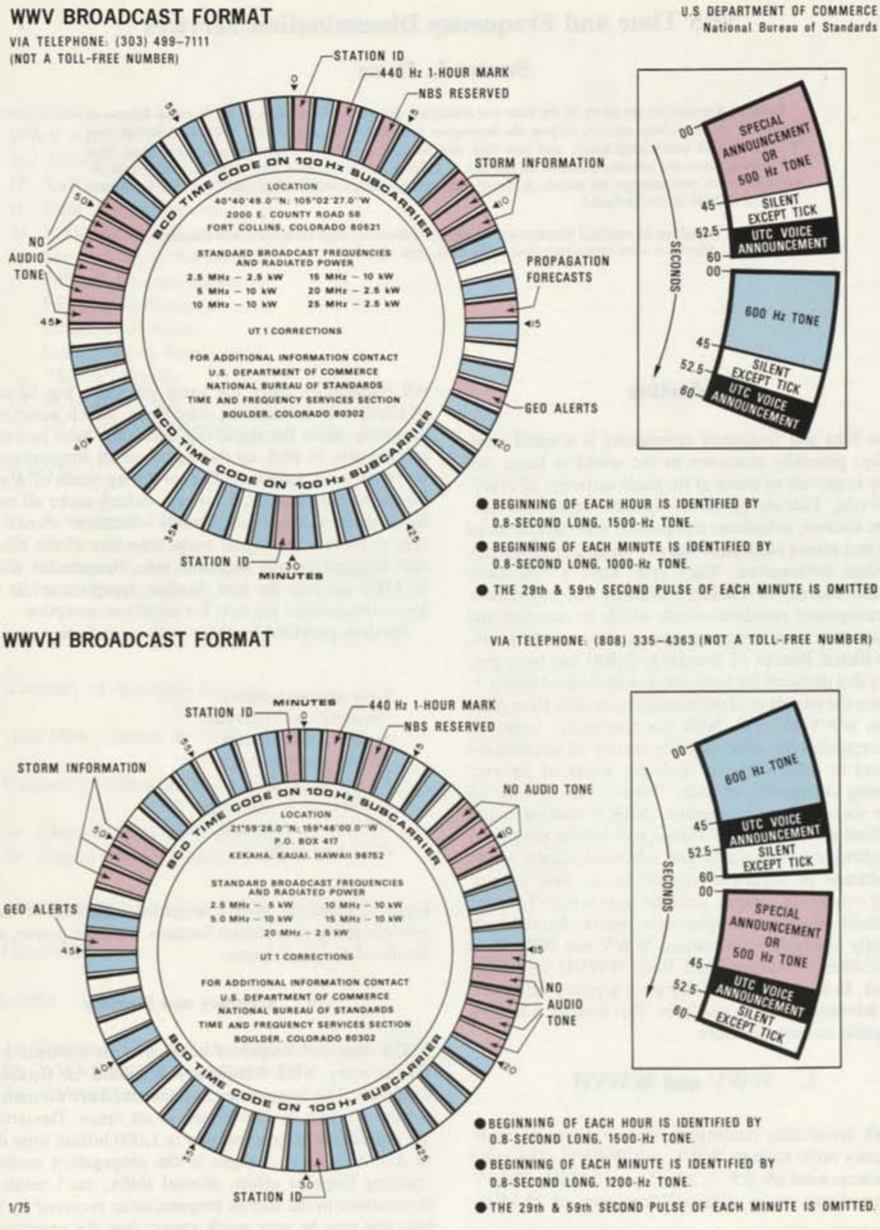

Figure 1. The hourly broadcast schedules of WWV and WWVH.

1b. Radiated Power, Antennas and Modulation

Frequency, MHz	Radiated Power, kW	
	WWV	WWVH
2.5	2.5	5.0
5.0	10.0	10.0
10.0	10.0	10.0
15.0	10.0	10.0
20.0	2.5	2.5
25.0	2.5	—

The broadcasts on 5, 10, 15, and 20 MHz from WWVH are from phased vertical half-wave dipole arrays. They are designed and oriented to radiate a cardioid pattern directing maximum gain in a westerly direction. The 2.5 MHz antenna at WWVH and all antennas at WWV are half-wave dipoles that radiate omnidirectional patterns.

At both WWV and WWVH, double sideband amplitude modulation is employed with 50 percent modulation on the steady tones, 25 percent for the BCD time code, 100 percent for seconds pulses, and 75 percent for voice.

1c. Time Announcements

Voice announcements are made from WWV and WWVH once every minute. To avoid confusion, a man's voice is used on WWV and a woman's voice on WWVH. The WWVH announcement occurs first—at 15 seconds before the minute—while the WWV announcement occurs at 7½ seconds before the minute. Though the announcements occur at different times, the tone markers referred to are transmitted simultaneously from both stations. However, they may not be received at the same time due to propagation effects.

The time referred to in the announcements is "Coordinated Universal Time" (UTC). It is coordinated through international agreements by the International Time Bureau (BIH) so that time signals broadcast from the many stations such as WWV throughout the world will be in close agreement.

The specific hour and minute mentioned is actually the time at the time zone centered around Greenwich, England, and may be considered generally equivalent to the more well-known "Greenwich Mean Time" (GMT). UTC time differs from your local time only by an integral number of hours. By knowing your own local time zone and using the chart of world time zones in figure 3, the appropriate number of hours to add or subtract from UTC to obtain local time can be determined. The UTC time announcements are expressed in the 24-hour clock system —i.e., the hours are numbered beginning with 00 hours at midnight through 12 hours at noon to 23 hours, 59 minutes just before the next midnight.

1d. Standard Time Intervals

The most frequent sounds heard on WWV and WWVH are the pulses that mark the seconds of each minute, except for the 29th and 59th seconds pulses which are omitted completely. The first pulse of every *hour* is an 800-millisecond pulse of 1500 Hz. The first pulse of every *minute* is an 800-millisecond pulse of 1000 Hz at WWV and 1200 Hz at WWVH. The remaining seconds pulses are brief audio bursts (5-millisecond pulses of 1000 Hz at WWV and 1200 Hz at WWVH) that resemble the ticking of a clock. All pulses commence at the *beginning* of each second. They are given by means of double-sideband amplitude modulation.

Each seconds pulse is preceded by 10 milliseconds of silence and followed by 25 milliseconds of silence to avoid interference which might make it difficult or impossible to pick out the seconds pulses. This total 40-millisecond protected zone around each seconds pulse is illustrated in figure 2.

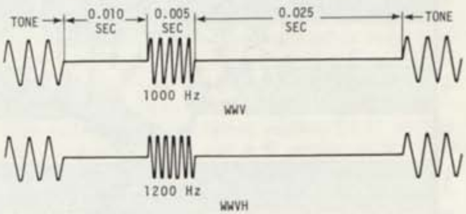

Figure 2. Format of WWV and WWVH seconds pulses.

1e. Standard Audio Frequencies

In alternate minutes during most of each hour, 500 or 600 Hz audio tones are broadcast. A 440 Hz tone, the musical note A above middle C, is broadcast once each hour. In addition to being a musical standard, the 440 Hz tone can be used to provide an hourly marker for chart recorders or other automated devices.

1f. Official Announcements

Forty-five-second announcement segments (see fig. 1) are available on a subscription basis to other Federal agencies to disseminate official and public service information. The accuracy and content of these announcements are the responsibility of the originating agency, not necessarily NBS.

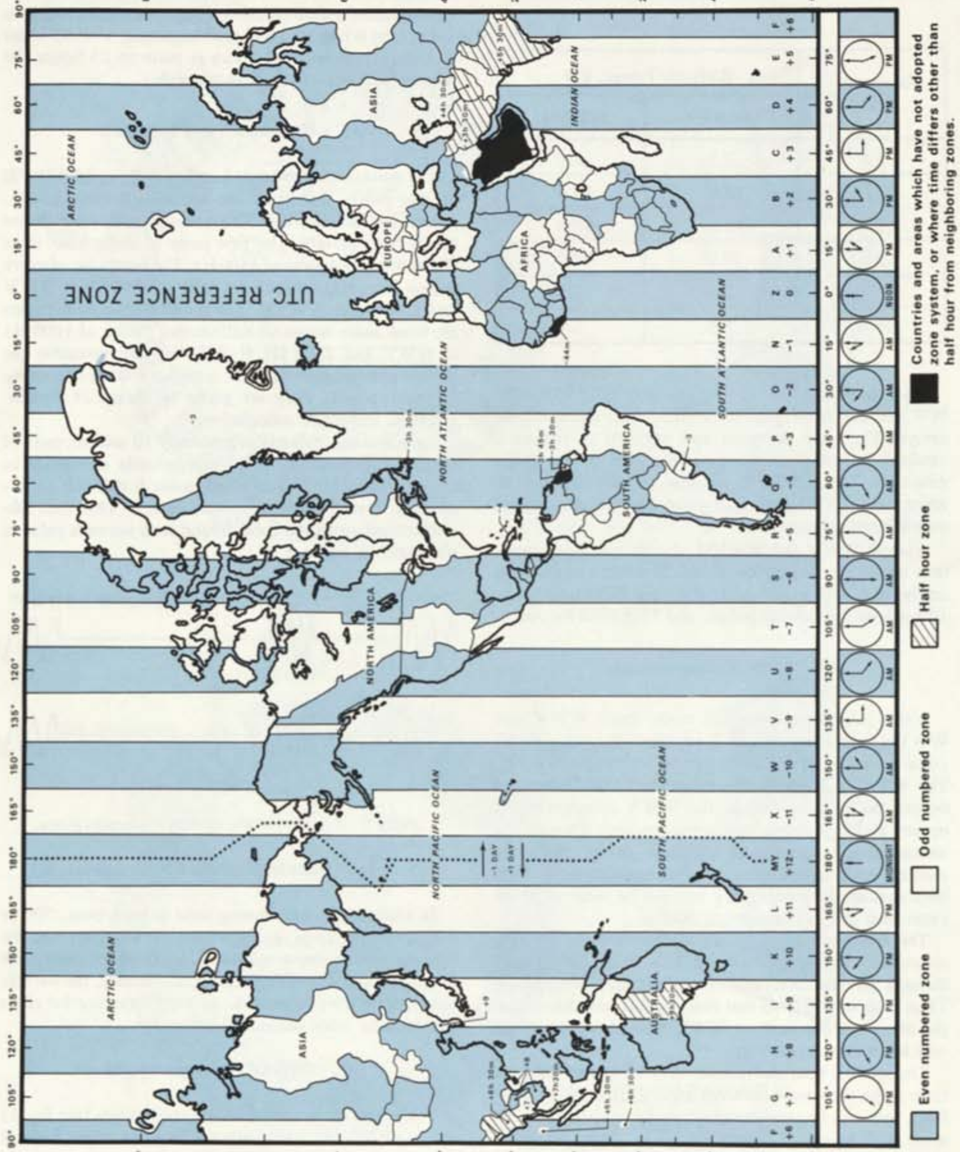

Figure 3. Standard time zones of the world and their relationship to UTC.

Most segments except those reserved for NBS use and the semi-silent periods (see section 1g) are available. Arrangements for use of segments may be made through the *Time and Frequency Services Section, 277.06, National Bureau of Standards, Boulder, CO 80302.*

Propagation Forecasts

The propagation forecasts are given in voice at 14 minutes after each hour from WWV only. They are short-term forecasts of propagation conditions along North Atlantic paths (such as Washington, D.C. to London or New York to Berlin) along with descriptions of current geomagnetic activity, K-index values (a measure of the earth's magnetic field) and solar flux data (a measure of the overall level of solar activity). These forecasts are also applicable to high latitudes provided the appropriate time correction is made.

The propagation forecast announcements are given as a phonetic and a numeral. The phonetic identifies the radio propagation quality at the time the forecast is issued (0100, 0700, 1300, or 1900 UTC). The numeral indicates the quality expected during the six-hour period after the forecast is issued. The meanings of the phonetics and numerals are:

Phonetic	**Meaning**
Whiskey	Disturbed
Uniform	Unsettled
November	Normal

Numeral	**Meaning**
One	Useless
Two	Very poor
Three	Poor
Four	Poor-to-fair
Five	Fair
Six	Fair-to-good
Seven	Good
Eight	Very good
Nine	Excellent

If, for example, propagation conditions are normal and expected to be good during the next six hours, the coded forecast announcement would be "November Seven."

The K-index is a measure of variation, or disturbance, in the earth's magnetic field during the three-hour period ending about one hour prior to issue of the forecast. The K-figures range from 0 (very quiet) to 9 (extremely disturbed). The solar flux measurements are taken at 2800 MHz three times daily. The flux value is closely associated with the well-known daily sunspot number and is coming to be preferred to sunspot number as a measure of solar activity.

A typical announcement might be:

"The radio propagation quality forecast at 0100 is good. Current geomagnetic activity is normal. The coded forecast is November Seven" (and then repeated). "The K-index at 0100 UTC is 2" (repeated), "tending to increase. The 2800 Megahertz solar flux index is 70 units" (repeated), "tending to remain constant."

The forecasts are prepared by the *Telecommunications Services Center, Office of Telecommunications, Boulder, CO 80302.* Information regarding these forecasts may be obtained by writing to this address.

Geophysical Alerts

Current geophysical alerts (Geoalerts) are broadcast in voice from WWV at 18 minutes after each hour, and from WWVH at 45 minutes after each hour. The messages are changed daily at 0400 UTC with provisions to provide real-time data alerts of outstanding occurring events. These are followed by a summary of selected solar and geophysical events during the previous 24 hours. Inquiries regarding these messages should be addressed to the *Space Environment Laboratory, National Oceanic and Atmospheric Administration, Boulder, CO 80302.*

Marine Storm Warnings

Weather information about major storms in the Atlantic and eastern North Pacific are broadcast in voice from WWV at 8, 9, and 10 minutes after each hour. Similar storm warnings covering the eastern and central North Pacific are given from WWVH at 48, 49, and 50 minutes after each hour. An additional segment (at 11 minutes after the hour on WWV and at 51 minutes on WWVH) may be used when there are unusually widespread storm conditions. The brief messages are designed to tell mariners of storm threats in their areas. If there are no warnings in the designated areas, the broadcasts will so indicate. The ocean areas involved are those for which the U.S. has warning responsibility under international agreement. The regular times of issue by the National Weather Service are 0500, 1100, 1700, and 2300 UTC for WWV and 0000, 0600, 1200, and 1800 UTC for WWVH. These broadcasts are updated effective with the next scheduled announcement following the time of issue.

Mariners might expect to receive a broadcast similar to the following:

"North Atlantic weather West of 35 West at 1700 UTC: Hurricane Donna, intensifying, 24 North, 60 West, moving northwest, 20 knots, winds 75 knots; storm, 65 North, 35 West, moving east, 10 knots; winds 50 knots, seas 15 feet."

Information regarding these announcements may be obtained from the *Director, National Weather Service, Silver Spring, MD 20910.*

1g. "Silent" Periods

These are periods with no tone modulation. However, the carrier frequency, seconds pulses, time announcements, and 100-Hz BCD time code continue. The main silent periods extend from 45 to 51 minutes after the hour on WWV and from 15 to 20 minutes after the hour on WWVH. An additional 3-minute period from 8 to 11 minutes after the hour is silent on WWVH.

1h. BCD Time Code

A binary coded decimal (BCD) time code is transmitted continuously by WWV and WWVH on a 100-Hz subcarrier. The 100-Hz subcarrier is synchronous with the code pulses so that 10-millisecond resolution is attained. The time code provides a standard timing base for scientific observations made simultaneously at different locations. It has application, for example, where signals telemetered from a satellite are recorded along with the time code pulses. Data analysis is then aided by having accurate, unambiguous time markers superimposed directly on the recording.

The WWV/WWVH time code format presents UTC information in serial fashion at a rate of one pulse per second. Groups of pulses can be decoded to ascertain the current minute, hour, and day of year. While the 100-Hz subcarrier is not considered one of the standard audio frequencies, the code does contain the 100-Hz frequency and may be used as a standard with the same accuracy as the audio frequencies. A description of the time code is contained in the Appendix.

1i. UT1 Time Corrections

The UTC time scale broadcast by WWV and WWVH runs at a rate that is almost perfectly constant because it is based on ultra-stable atomic clocks. This time scale meets the needs of most users. Somewhat surprisingly, however, some users of time signals need time which is not this stable. In applications such as very precise navigation and satellite tracking, which must be referenced to the rotating earth, a time scale that speeds up and slows down with the earth's rotation rate must be used. The particular time scale needed is known as UT1 and is inferred from astronomical observations.

To be responsive to these users, information needed to obtain UT1 time is included in the UTC broadcasts. This occurs at two different levels of accuracy. First, for those users needing to know UT1 only to within about one second (this includes nearly all boaters/navigators), occasional corrections of exactly one second—called "leap" seconds—are inserted into the UTC time scale whenever needed to keep the UTC time signals within ± 0.9 second of UT1 at all times. These leap seconds may be either positive or negative and are coordinated under international agreement by the International Time Bureau (BIH) in Paris. Ordinarily, a positive leap second must be added about once per year (usually on June 30 or December 31), depending on how the earth's rotation rate is behaving in each particular year. Information on how to assign dates to events that occur near the time of a leap second insertion is given in the Appendix.

The second level of correction is included in the UTC broadcasts for the very small number of users who need UT1 time to better than one second. These corrections, in units of 0.1 second, are encoded into the broadcasts by using double ticks or pulses after the start of each minute. The amount of correction is determined by counting the number of successive double ticks heard each minute. The 1st through the 8th seconds ticks indicate a "plus" correction, and the 9th through the 16th, a "minus" correction. For example, if the 1st, 2nd, and 3rd ticks are doubled, the correction is "plus" 0.3 second: UT1 = UTC + 0.3 second, or if UTC is 8:45:17, then UT1 is 8:45:17.3. If the 9th, 10th, 11th, and 12th ticks are doubled, the correction is "minus" 0.4 second, or as in the above example, UT1 = 8:45:16.6.

2. WWVB

WWVB transmits continuously on a standard radio carrier frequency of 60 kHz. Standard time signals, time intervals, and UT1 corrections are provided by means of a BCD time code. The station is located on the same site as WWV. Effective coverage area is the continental U.S.

2a. Accuracy and Stability

The frequency of WWVB is normally within its prescribed value to better than 1 part in 100 billion. Deviations from day to day are less than 5 parts in 1,000 billion. Effects of the propagation medium on received signals are relatively minor at low frequencies; therefore, frequency comparisons to better than 1 part in 100 billion are possible using appropriate receiving and averaging techniques.

2b. Station Identification

WWVB identifies itself by advancing its carrier phase 45° at 10 minutes after every hour and returning to normal phase at 15 minutes after the hour. WWVB can also be identified by its unique time code.

2c. Radiated Power, Antenna, and Coverage

The effective radiated power from WWVB is 13 kW. The antenna is a 122-meter, top-loaded vertical installed over a radial ground screen. Some measured field intensity contours are shown in figure 4.

2d. BCD Time Code

WWVB broadcasts time information in the form of a

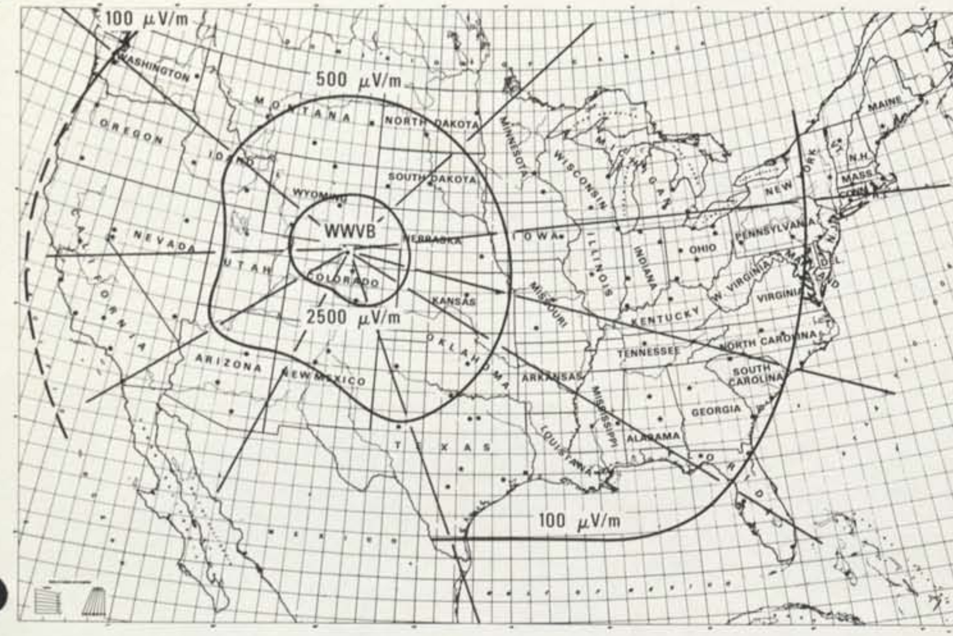

Figure 4. Measured field intensity countours of WWVB at 13 kW ERP.

BCD time code. The time code is synchronized with the 60-kHz carrier and is broadcast continuously at a rate of one pulse per second. Each pulse is generated by reducing the carrier power 10 dB at the beginning of the second, so the leading edge of every negative-going pulse is on time. Details of the WWVB time code are presented in the Appendix.

3. WWVL

WWVL is an experimental station. Regular operations were curtailed on July 1, 1972, and it now broadcasts experimental programs only on an intermittent basis, depending upon need and availability of funds. Transmissions can be made available on a subscription basis to public organizations and other Federal agencies. Arrangements for use should be made through the *Time and Frequency Services Section, National Bureau of Standards, Boulder, CO 80302.*

4. Summary of Broadcast Services

The services provided by the NBS radio stations are summarized in the following chart. Coordinates for the stations are also listed.

STATION	DATE SERVICE BEGAN	RADIO FREQUENCIES	AUDIO FREQUENCIES	MUSICAL PITCH	TIME INTERVALS	TIME SIGNALS	UT1 CORRECTIONS	OFFICIAL ANNOUNCEMENTS
WWV	1923	X	X	X	X	X	X	X
WWVH	1948	X	X	X	X	X	X	X
WWVB	1956	X			X	X	X	
WWVL	1960	X						

COORDINATES:

WWV	40°40'49.0"N	105°02'27.0"W
WWVB	40°40'28.3"N	105°02'39.5"W
WWVL	40°40'51.3"N	105°03'00.0"W
WWVH	21°59'26.0"N	159°46'00.0"W

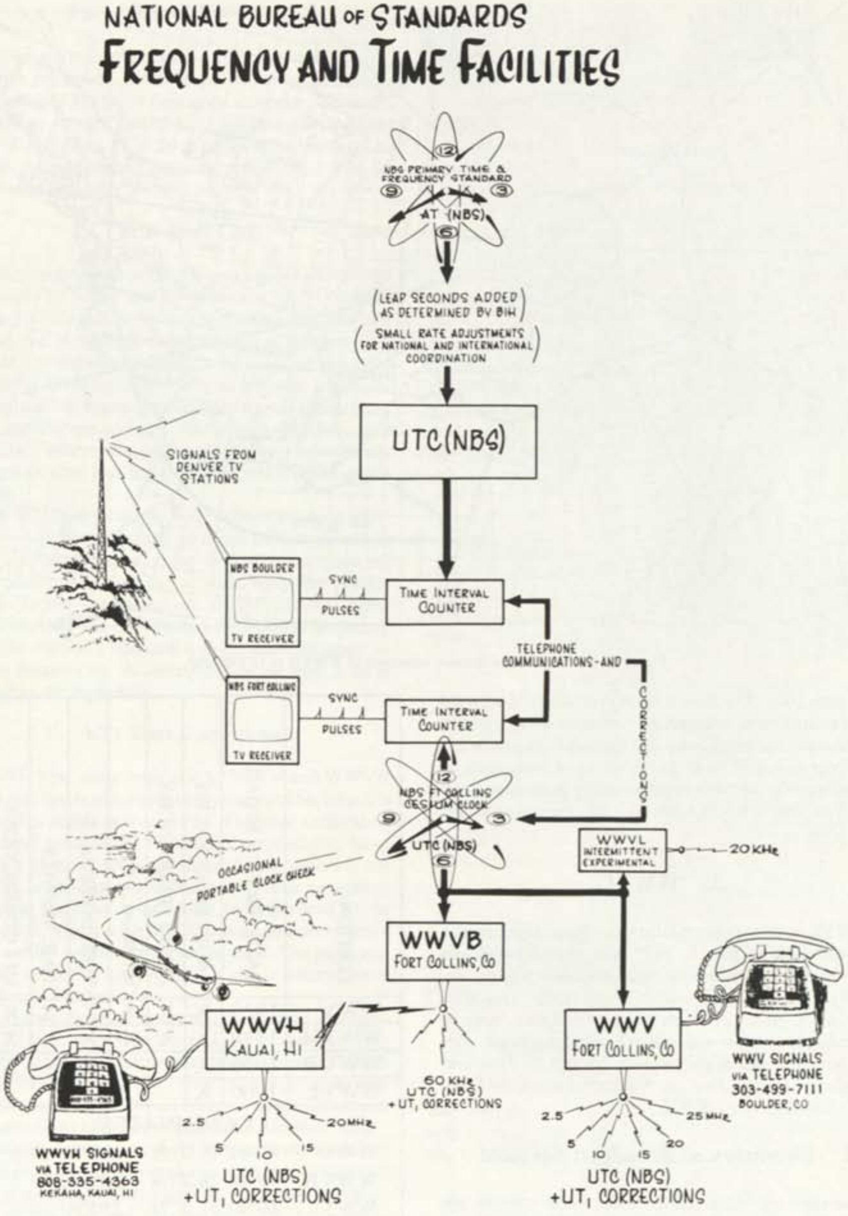

Figure 5. The NBS frequency control system.

5. How NBS Controls the Transmitted Frequencies

A simplified diagram of the NBS frequency control system is shown in figure 5. The entire system depends upon the reference shown in this diagram as the NBS Primary Time and Frequency Standard. This standard is comprised of a number of commercial cesium beam clocks, up to two primary cesium beam frequency and time standards, and computer-aided measurement and computation methods which combine all of the clock data to generate an accurate and uniform time scale, AT (NBS). Another scale, UTC (NBS), is also generated by adding leap seconds and small corrections to AT (NBS) as needed to keep UTC (NBS) synchronized with the internationally coordinated time scale, UTC, which is maintained by the BIH.

Utilizing the line-10 horizontal synchronizing pulses from a local television station, the Fort Collins master clock is compared on a regular basis with the UTC (NBS) time scale. All other clocks and time-code generators at the Fort Collins site are then compared with the Fort Collins master clock. Frequency corrections of the WWVB and WWVL quartz crystal oscillators are based on their phase relative to the UTC (NBS) time scale.

The transmissions from WWV and WWVH are controlled by three commercial cesium standards located at each site. To insure accurate time transmission from each station, the time-code generators are compared with the stations' master clock several times each day.

Control of the signals transmitted from WWVH is based not only upon the cesium standards, but upon signals from WWVB as received by phase-lock receivers. The cesium standards controlling the transmitted frequencies and time signals are continuously compared with the received signals.

To insure that systematic errors do not enter into the system, the UTC (NBS) time scale is occasionally compared with the transmitting station clocks by the use of a very precise portable atomic clock.

6. Frequency Calibration Service Using Network Television

For those users who require only frequency calibrations, an alternative to the radio broadcasts is available. This new service provides a means of calibrating oscillators traceable to NBS. It gives the user the option of calibrating his oscillator quickly at very low cost with modest accuracy or of expending more time and money for higher accuracy.

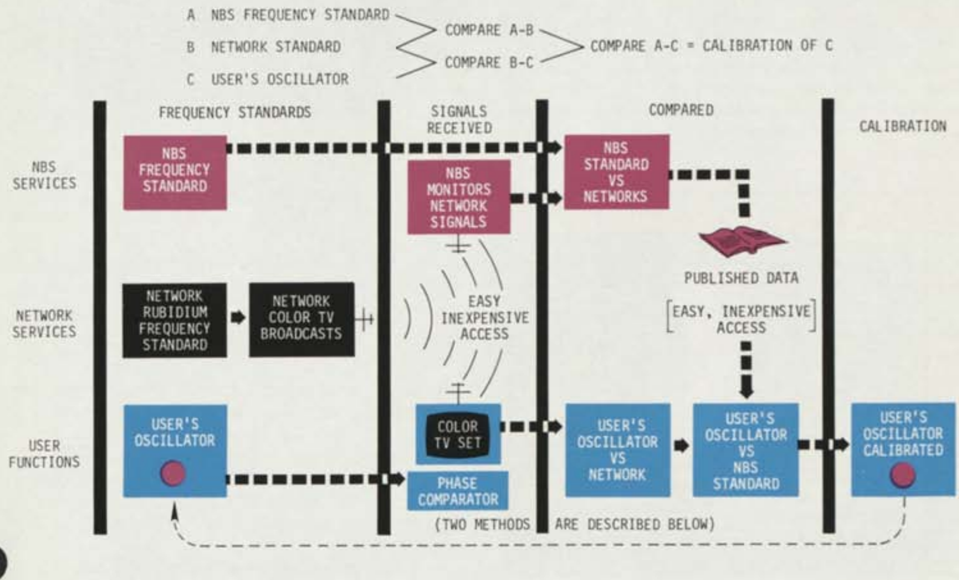

Figure 6. How the frequency calibration service using color television works.

The service is very reliable because the networks use extremely stable rubidium oscillators to generate the 3.58 MHz color subcarrier frequency which is transmitted with all color programs. The color signal is then used as a transfer standard. Any oscillator that has a frequency of 10/N MHz, where N is any integer from 1 to 100, can be calibrated.

If a user wants to make a calibration, he compares the color signal coming from the network centers in New York City (or Los Angeles for those on the West Coast) with his local oscillator. NBS monitors the same network signals and publishes the difference between the network oscillators and the NBS Frequency Standard in the monthly *NBS Time and Frequency Services Bulletin*. A user then knows two things: (1) the difference between his oscillator and the network oscillators (by measurement) and (2) the difference between the networks and NBS (by publication). With this information, he can easily compute the difference between his oscillator and NBS (see fig. 6). Thus, his calibration is traceable to the NBS Frequency Standard.

NBS has developed two methods for making these frequency calibrations. Equipment is commercially available for both methods.

6a. Color Bar Comparator Method

The color bar comparator is a simple circuit that connects to a standard color television set (fig.7). It produces a colored bar on the screen that changes color or moves across the screen at a rate that depends on the frequency difference between the user's oscillator and the TV network signal. By timing these changes with a stopwatch and referring to the data published by NBS, an oscillator can be rapidly calibrated to an accuracy of 1 part in 1 billion.

Figure 7. Prototype of a color bar comparator.

6b. Digital Offset Computer Method

The second method, using a digital offset computer, provides an automatic means of calibrating high-quality crystal or atomic oscillators. It compares a signal from the user's oscillator with the TV color signal and displays the frequency difference on the TV screen (fig.8) as parts in 100 billion. If the measurements are averaged over about 15 minutes, a calibration accuracy of one part in 100 billion can usually be achieved.

More information on this service, including circuit details and lists of equipment manufacturers, is available upon request from the *Time and Frequency Services Section, NBS, Boulder, CO 80302*.

Figure 8. Prototype of a digital offset computer.

7. Time Comparisons Using Television Synchronization Pulses

In the previous section, methods were described for using the *frequency* of a network television signal as a transfer standard to link the user to the NBS Frequency Standard. In a similar way, it is also possible to use a particular synchronization pulse present in the normal television picture signal as a *time* transfer standard to allow clock comparisons to be made with the UTC (NBS) atomic time scale.

To use this technique, a user first makes a simple time difference measurement at a specified time during the day between his local clock and a particular television signal pulse (line-10 (odd) horizontal synchronization pulse) obtained from a normal television receiver. Commercial equipment is available which can be used for this purpose. NBS also measures, at the same specified time, the time difference between the TV synchronization pulse as received in Boulder, Colorado and the UTC (NBS) time scale and publishes the data in the monthly *NBS Time and Frequency Services Bulletin*. The difference between the local measurement and the published NBS measurement then represents the time difference between the user's clock and UTC (NBS) plus a propagation delay.

If the propagation delay can be determined—for example, by a portable clock measurement, then this part of the measurement can be subtracted out, leaving only the actual time difference between the local and NBS clocks. Although the propagation delay of the TV signals through the nationwide TV network distribution system has been shown to be relatively constant to within a few microseconds for long periods extending over weeks or months, occasional large changes of many milliseconds do occur due to network rerouting of TV signals. These large changes are usually easy to recognize, especially if a user regularly monitors more than one of the major TV networks.

Even if the propagation delays are not measured or otherwise determined, the line-10 technique can still provide useful information about the *stability* performance of a user's time scale or clock relative to NBS. As long as the delay remains constant, daily line-10 comparisons will show whether a user's clock is gaining or losing time relative to NBS, even though the exact time difference cannot be determined without knowing the value for the propagation delay.

NBS publishes daily line-10 measurements for all three major television networks and for both East Coast and West Coast-originated transmissions. The West Coast data are suppied by the Hewlett-Packard Co. in Santa Clara, California and are referenced to UTC (NBS) with an accuracy of about 0.5 microsecond. West Coast data is for use only by those users in the Pacific Time Zone. For current specific times during the day when each network is measured, potential users of the line-10 time transfer technique should either consult a current issue of the *NBS Time and Frequency Services Bulletin* or contact the *Time and Frequency Services Section, NBS, Boulder, CO 80302*.

8. Other Publications

The Time and Frequency Division offers a variety of publications about the NBS atomic time and frequency standards, the associated dissemination services and how to use them. These publications are available upon request.

For information about the atomic clock, primary time and frequency standard, as well as special time and frequency calibration, test, and measurement services, write to the *Frequency and Time Standards Section, NBS, Boulder, CO 80302* or call (303) 499-1000, x 3276. The following are available:

General Information

Frequency Standards and Clocks: A Tutorial Introduction, Helmut Hellwig, Nat. Bur. Stand. (U.S.), Tech. Note 616, 69 pages, Revised (March 1974).

Technical Publications

Accuracy Evaluation and Stability of the NBS Primary Frequency Standards, D. J. Glaze, H. Hellwig, et al, IEEE Trans. on Instr. & Meas., Vol. IM-23, No. 4 (Dec. 1974).

Atomic Frequency Standards: A Survey, H. Hellwig, Proc. IEEE, Vol. 63, No. 2 (Feb. 1975).

Time and Frequency, H. Hellwig, D.W. Allan, F.L. Walls, Proc. 5th Intl. Conf. on Atomic Masses and Fundamental Constants (AMCO-5), Paris, France (June 2-6, 1975).

An Accurate Algorithm for an Atomic Time Scale, D. W. Allan, H. Hellwig, D. J. Glaze, Metrologia, Vol. 11, (1975).

For more detailed technical information on how to use the time and frequency dissemination services, the following publications are available from the *Time & Frequency Services Section, NBS, Boulder, CO 80302* (Phone (303) 499-1000, x3212):

Frequency Standard Hides in Every Color TV Set, D. Davis, Electronics (May 10, 1971).

Calibrating Crystal Oscillators with TV Color-reference Signals, D. Davis, Electronics (March 20, 1975).

The Use of NBS High Frequency Broadcasts for Time & Frequency Calibrations, N. Hironaka and C. Trembath, Nat. Bur. Stand. (U.S.), Tech. Note 668 (May 1975).

Characterization and Concepts of Time-Frequency Dissemination, J. L. Jespersen, B.E.Blair, and L.E. Gatterer, Proc. IEEE, Vol. 60, No. 5, May 1972.

Appendix

1A. Dating of Events in the Vicinity of Leap Seconds

2A. WWV/WWVH Time Code

3A. WWVB Time Code

1A Dating of Events in the Vicinity of Leap Seconds

When leap second adjustments are necessary to keep the broadcast time signals (UTC) within ± 0.9 second of the earth-related UT1 time scale, the addition or deletion of exactly 1 second occurs at the end of the UTC month. By international agreement, first preference is given to December 31 or June 30, second preference to March 31 or September 30, and third preference to any other month.

When a positive leap second is required—that is, when UT1 is slow relative to UTC—an additional second is inserted beginning at 23h 59m 60s of the last day of the month and ending at Øh Øm Øs of the first day of the following month. In this case, the last minute of the month in which there is a leap second contains 61 seconds. To assign dates to events which occur around this extra second, refer to figure 1A.

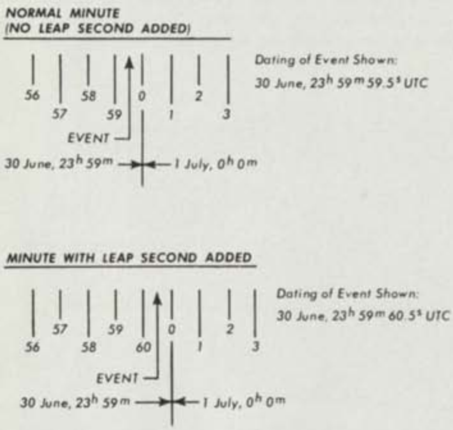

Figure 1A. Dating of events in the vicinity of a leap second.

Assuming that unexpected large changes do not occur in the earth's rotation rate in the future, it is likely that positive leap seconds will continue to be needed about once per year. If, however, the earth should speed up significantly at some future time, so that UT1 runs at a *faster* rate than UTC, then provision is also made for negative leap seconds in the UTC time scale. In this case, exactly one second would be *deleted* at the end of some UTC month, and the last minute would contain only 59 seconds.

Positive leap seconds were inserted in all NBS broadcasts at the end of June 1972, December 1972, December 1973, December 1974, and December 1975.

2A. WWV/WWVH Time Code

The WWV/WWVH time code is a modified version of the IRIG-H format. Data is broadcast on a 100-Hz subcarrier at a rate of one pulse per second. Certain pulses in succession comprise binary-coded groups representing decimal numbers. The binary-to-decimal weighting scheme is 1-2-4-8 with the least significant binary digit always transmitted first. The binary groups and their basic decimal equivalents are shown in the following table:

	BINARY GROUP	DECIMAL
Weight:	1 2 4 8	EQUIVALENT
	0 0 0 0	0
	1 0 0 0	1
	0 1 0 0	2
	1 1 0 0	3
	0 0 1 0	4
	1 0 1 0	5
	0 1 1 0	6
	1 1 1 0	7
	0 0 0 1	8
	1 0 0 1	9

In every case, the decimal equivalent of a BCD group is derived by multiplying each binary digit times the weight factor of its respective column and then adding the four products together. For instance, the binary sequence 1010 in the 1-2-4-8 scheme means $(1 \times 1) + (0 \times 2) + (1 \times 4) + (0 \times 8) = 1 + 0 + 4 + 0 = 5$, as shown in the table. If fewer than nine decimal digits are needed, one or more of the binary columns may be omitted.

In the standard IRIG-H code, a binary 0 pulse consists of exactly 20 cycles of 100-Hz amplitude modulation (200 milliseconds duration), whereas a binary 1 consists of 50 cycles of 100 Hz (500 milliseconds duration). In the WWV/WWVH broadcast format, however, all tones are suppressed briefly while the seconds pulses are transmitted (see sec. 1c).

Because the tone suppression applies also to the 100-Hz subcarrier frequency, it has the effect of deleting the first 30-millisecond portion of each binary pulse in the time code. Thus, a binary 0 contains only 17 cycles of 100-Hz amplitude modulation (170 milliseconds duration) and a binary 1 contains 47 cycles of 100 Hz (470 milliseconds duration). The leading edge of every pulse coincides with a positive-going zero crossing of the 100-Hz subcarrier, but it occurs 30 milliseconds after the beginning of the second.

Within a time frame of one minute, enough pulses are transmitted to convey in BCD language the current minute, hour, and day of year. Two BCD groups are needed to express the hour (00 through 23); and three groups are needed to express the day of year (001 through 366). When representing units, tens, or hundreds, the basic 1-2-4-8 weights are simply multiplied by 1, 10, or 100 as appropriate. The coded information always refers to time at the beginning of the one-minute frame. Seconds may be determined by counting pulses within the frame.

Each frame commences with a unique spacing of pulses to mark the beginning of a new minute. No pulse is transmitted during the first second of the minute. Instead, a one-second space or hole occurs in the pulse train at that time. Because all pulses in the time code are 30 milliseconds late with respect to UTC, each minute actually begins 1030 milliseconds (or 1.03 seconds) prior to the leading edge of the first pulse in the new frame.

For synchronization purposes, every ten seconds a so-called position identifier pulse is transmitted. Unlike the BCD data pulses, the position identifiers consist of 77 cycles of 100 Hz (770 milliseconds duration).

UT1 corrections to the nearest 0.1 second are broadcast via BCD pulses during the final ten seconds of each frame. The coded pulses which occur between the 50th and 59th seconds of each frame are called control functions. Control function #1, which occurs at 50 seconds, tells whether the UT1 correction is negative or positive. If control function #1 is a binary 0, the correction is negative; if it is a binary 1, the correction is positive. Control functions #7, #8, and #9, which occur respectively at 56, 57, and 58 seconds, specify the amount of UT1 correction. Because the UT1 corrections are expressed in tenths of a second, the basic binary-to-decimal weights are multiplied by 0.1 when applied to these control functions.

Control function #6, which occurs at 55 seconds, is programmed as a binary 1 throughout those weeks when Daylight Saving Time is in effect and as a binary 0 when Standard Time is in effect. The setting of this function is changed at 0000 UTC on the date of change. Throughout the U.S. mainland, this schedule allows several hours for the function to be received before the change becomes effective locally—i.e., at 2:00 a.m. local time. Thus, control function #6 allows clocks or digital recorders operating on local time to be programmed to make an automatic one-hour adjustment in changing from Daylight Saving Time to Standard Time and vice versa.

Figure 2A depicts one frame of the time code as it might appear after being rectified, filtered, and recorded. In this example, the leading edge of each pulse is considered to be the positive-going excursion. The pulse train in the figure is annotated to show the characteristic features of

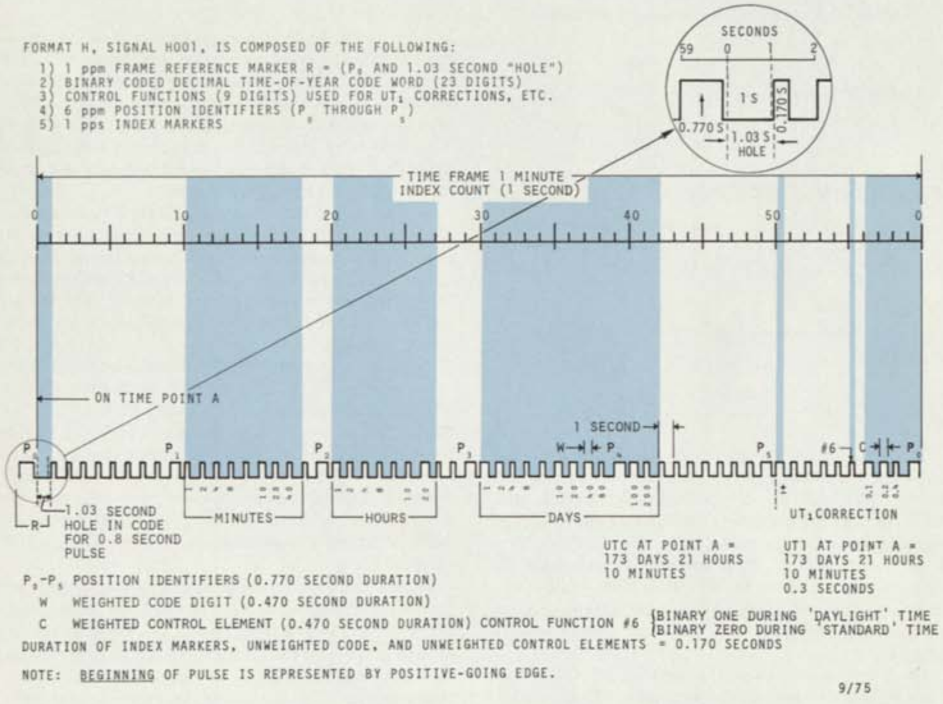

Figure 2A. WWV and WWVH time code format.

the time code format. The six position identifiers are denoted by symbols P_1, P_2, P_3, P_4, P_5, and P_0. The minutes, hours, days, and UT1 sets are marked by brackets, and the applicable weighting factors are printed beneath the coded pulses in each BCD group. With the exception of the position identifiers, all uncoded pulses are set permanently to binary 0.

The first ten seconds of every frame always include the 1.03-second hole followed by eight uncoded pulses and the position identifier P_1. The minutes set follows P_1 and consists of two BCD groups separated by an uncoded pulse. Similarly, the hours set follows P_2. The days set follows P_3 and extends for two pulses beyond P_4 to allow enough elements to represent three decimal digits. The UT1 set follows P_5, and the last pulse in the frame is always P_0.

In figure 2A, the least significant digit of the minutes set is $(0 \times 1) + (0 \times 2) + (0 \times 4) + (0 \times 8) = 0$; the most significant digit of that set is $(1 \times 10) + (0 \times 20) + (0 \times 40) = 10$. Hence, at the beginning of the 1.03-second hole in that frame, the time was exactly 10 minutes past the hour. By decoding the hours set and the days set, it is seen that the time of day is in the 21st hour on the 173rd day of the year. The UT1 correction is +0.3 second. Therefore, at point A, the correct time on the UT1 scale is 173 days, 21 hours, 10 minutes, 0.3 second.

3A. WWVB Time Code

The WWVB time code is generated by shifting the power of the 60-kHz carrier. The carrier power is reduced 10 db at the beginning of each second and restored to full power 200 milliseconds later for a binary zero, 500 milliseconds later for a binary one, and 800 milliseconds later for a reference marker or position identifier. Certain groups of pulses are encoded to represent decimal numbers which identify the minute, hour, and day of year. The binary-to-decimal weighting scheme is 8-4-2-1 with the most significant binary digit transmitted first. Note that this weighting sequence is the reverse of the WWV/WWVH code. The BCD groups and their basic decimal equivalents are tabulated below:

	BINARY GROUP	DECIMAL
Weight:	8 4 2 1	EQUIVALENT
	0 0 0 0	0
	0 0 0 1	1
	0 0 1 0	2
	0 0 1 1	3
	0 1 0 0	4
	0 1 0 1	5
	0 1 1 0	6
	0 1 1 1	7
	1 0 0 0	8
	1 0 0 1	9

The decimal equivalent of each group is derived by multiplying the individual binary digits by the weight factor of their respective columns and then adding the four products together. For example, the binary sequence 1001 in 8-4-2-1 code is equivalent to $(1 \times 8) + (0 \times 4) + (0 \times 2) + (1 \times 1) = 8 + 0 + 0 + 1 = 9$, as shown in the table. If fewer than nine decimal digits are required, one or more of the high-order binary digits may be dispensed with.

Once every minute, in serial fashion, the code format presents BCD numbers corresponding to the current minute, hour, and day on the UTC scale. Two BCD groups identify the minute (00 through 59); two groups identify the hour (00 through 23); and three groups identify the day of year (001 through 366). When representing units, tens, or hundreds, the basic 8-4-2-1 weights are multiplied by 1, 10, or 100 respectively. The coded information refers to the time at the beginning of the one-minute frame. Within each frame, the seconds may be determined by counting pulses.

Every new minute commences with a frame reference pulse which lasts for 0.8 second. Also, every ten-second interval within the minute is marked by a position identifier pulse of 0.8-second duration.

UT1 corrections to the nearest 0.1 second are transmitted at seconds 36 through 44 of each frame. Coded pulses at 36, 37, and 38 seconds indicate the positive or negative relationship of UT1 with respect to UTC. Pulses at 36 and 38 seconds are transmitted as binary ones only if UT1 is *early* with respect to UTC, in which case a correction must be *added* to the UTC signals to obtain UT1. The pulse transmitted at 37 seconds is a binary one if UT1 is *late* with respect to UTC, in which case the required UT1 correction must then be *subtracted*. The magnitude of the UT1 correction is transmitted as a BCD group at 40, 41, 42, and 43 seconds. Because UT1 corrections are expressed in tenths of seconds, the basic 8-4-2-1 weight of that particular binary group is multiplied by 0.1 to obtain its proper decimal equivalent.

Figure 3A shows a sample frame of the time code in rectified or dc form. The negative-going edge of each pulse coincides with the beginning of a second. Position identifiers are labeled P_1, P_2, P_3, P_4, P_5, and P_0. Brackets show the demarcation of the minutes, hours, days, and UT1 sets. The applicable weight factor is printed beneath the coded pulses in each BCD group. Except for the position identifiers and the frame reference marker, all uncoded pulses are binary zeros.

In figure 3A, the most significant digit of the minutes set is $(1 \times 40) + (0 \times 20) + (0 \times 10) = 40$; the least significant digit of that set is $(0 \times 8) + (0 \times 4) + (1 \times 2) + (0 \times 1) = 2$. Thus, at the beginning of the frame, UTC was precisely 42 minutes past the hour. The sets for hours and days reveal further that it is the 18th hour of the 258th day of the year. The UT1 correction is -0.7 second, so at the beginning of the frame the correct time on the UT1 scale was 258 days, 18 hours, 41 minutes, 59.3 seconds.

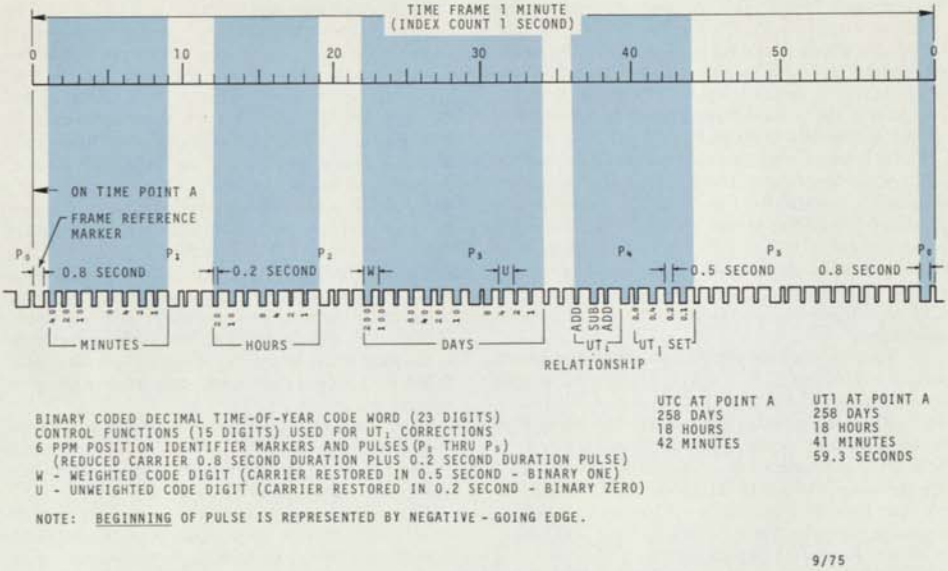

Figure 3A. WWVB time code format.

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Telephone Time of Day Service

WWV and WWVH broadcasts may be heard via telephone. Since the RF carriers cannot be detected over telephone circuits, only the audio portion of the broadcasts may be heard. Accuracy of the time signals as received anywhere in the contiguous 48 states is 30 milliseconds or better.

By calling (303) 499-7111 in Boulder, Colorado, the user will hear the live broadcasts as transmitted from WWV. This service is automatically limited to three minutes per call. Similar time-of-day broadcasts from WWVH can be heard by dialing (808) 335-4363 on the island of Kauai, Hawaii. NOTE: These are long distance toll calls for those users outside the local dialing area.

About the Announcers

The station identification and time-of-day announcements are pre-recorded—not "live." The regular announcer for WWV is Mr. Don Elliott of Atlanta, Georgia. Mrs. Jane Barbe, also of Atlanta, is the announcer for WWVH.

Tours

Guided tours are available at all of the NBS radio stations. Visiting hours at WWV, WWVB, and WWVL are every Wednesday, except holidays, from 2:00 to 4:00 p.m. Special tours may be scheduled at other times only by prior arrangement with the engineer-in-charge. WWVH does not have regularly scheduled visiting hours—arrangements for visiting the site should be made in advance.

Tours of the NBS Boulder Laboratories, including visits to the atomic clock and the other dissemination services, are available. Information can be obtained from the *Program Information Office, NBS, Boulder, CO 80302.*

Inquiries About the Stations

Correspondence pertaining directly to station operations may be addressed to:

Engineer-in-Charge
NBS Radio Stations WWV/WWVB/WWVL
2000 East County Road 58
Fort Collins, CO 80521
Telephone: (303) 484-2372

Engineer-in-Charge
NBS Radio Radio Station WWVH
P. O. Box 417
Kekaha, Kauai, HI 96752
Telephone: (808) 335-4361

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NATIONAL BUREAU OF STANDARDS, E. U. Condon, *Director*

Standard Time
Throughout the World

by R. E. Gould

National Bureau of Standards Circular 496

Issued August 1, 1950

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Washington 25, D. C. Price 15 cents

PREFACE

The problem of time in different localities is a matter of primary concern in mobern travel and communication. It is important, therefore, that there should be available some source of specific information on the subject of standard time. This Circular is intended to present this information in a form that will meet the needs of the general public. The lists, tables, and information given have been compiled from a study of authentic, officially published material. This publication is the fourth edition on the same subject and supersedes C280 (1925), C399 (1932), and C406 (1935), all of which bore the same title. It contains an historical sketch on the development of the standard time system, a time zone map of the United States, a list of radio stations transmitting time signals, a list of the times used in several large cities, a table of the legal time used in the various countries of the world, notes on summer time, and other useful information regarding standard time.

E. U. Condon, *Director.*

CONTENTS

Standard Time Throughout the World

By R. E. Gould

I. Introduction

The measurement of time is based upon the motion of the earth in relation to certain heavenly bodies. One revolution of the earth in its orbit around the sun is known as a year, and one rotation of the earth on its axis is known as a day. When the day is measured in relation to the stars, we have sidereal time; when it is measured in relation to the sun, we have solar time. Sidereal time is used chiefly by astronomers, while solar time is used for most civil purposes.

The solar day is measured as the time elapsed between two successive passages of the sun through any given meridian. It is well known that the days are not equal throughout the year, for they have a total variation of about 30 minutes during the year. Since the days are not equal, "mean solar time" has been adopted for general use and is defined as the time kept by a "fictitious sun" moving at a uniform speed in the equator at the average speed of rotation of the earth, thus making days of equal length. It is "mean noon" when this "fictitious or mean sun" crosses the meridian. Mean solar time makes it possible to use clocks and watches to divide the day into hours, minutes, and seconds.

There is a definite relation between sidereal time and mean solar time, so that star time observations made by astronomers may be converted to solar time for our daily use. Standard time is mean solar time determined by the time of a definite meridian. The earth is divided into zones, and the time for each zone is the time for the meridian which passes approximately through the middle of the zone.

Determinations of time are made by astronomers at various observatories throughout the world by observing the apparent passages of *relatively constant* stars through a given meridian. The observations are made in sidereal time and converted to mean solar time for general use. In the United States these determinations are made at the U. S. Naval Observatory in Washington, D. C., and are good to approximately 0.01 second.

Until about 1930 high precision clocks were the best means of subdividing the day into equal parts of hours, minutes, or seconds. The highest accuracy obtained from such clocks as the Riefler and the Shortt was about 0.01 second a day or approximately 1 part in 8.5 million.

The vibrations of quartz-crystals, introduced about 1930 as a means of electrical frequency control, introduced a more uniform subdivision, which could be determined to better than 1 part in 100 million, and from which time signals of very high accuracy could be obtained. Today such crystals are used at the National Bureau of Standards and at many observatories for broadcasting standard time signals.

II. Historical Sketch

From ancient days man has reckoned time by the apparent motion of the heavenly bodies. The rotation of the earth on its axis from west to east causes these bodies to "rise" in the east and "set" in the west. Consequently points to the east of us have sunrise before we do, or, as we say, their time is faster than ours; while points to the west have time that is slower than ours. This rotation of the earth about its axis once in 24 hours gives a time change of 1 hour for every 15° of longitude. Thus, if observations were made on the transit of the sun across the meridian at points separated by 15° of longitude, the time of transit at two such points would differ by 1 hour. If the separation of the points of observation were decreased, the difference in time would be decreased in the same proportion. These times would all be true local times, using the transit of the sun across the meridian as a standard.

Since the distance around the earth is less at points not on the Equator than at the Equator, the distance on the earth's surface corresponding to a time difference is also less in the same proportion. For example, at the Equator 15° corresponds to about 1,040 miles, while at the latitude of New York, 15° corresponds to only about 784 miles. Or, at the Equator, a difference of about 17 miles makes a time difference of 1 minute, while in the latitude of New York a difference of only 13 miles makes a difference of 1 minute in true local time.

The need of a uniform time was felt in the United States about 1870, and the railroads gradually adopted a system specifying important centers or junction points at which changes of 1 hour should be made. As means of communication still further developed, it became apparent that some system of international time must be established.

In 1884 an international congress was called in Washington to consider the subject of a world standard of time. The world was divided into zones, each covering 15° of longitude, the time for each zone being that of the meridian passing through its approximate center and the time in adjacent zones differing by 1 hour. The meridian passing through the observatory at Greenwich, England, was chosen as the zero meridian from which all time should be reckoned. Although there was no definite agreement as to the adoption of this time by the different nations, the plan was gradually accepted.

The adoption of time differing from Greenwich by an odd number of half hours soon made its appearance. This slight departure from the original plan is of advantage in some places, since it more nearly agrees with true local time. In Newfoundland the time is 3½ hours slower than Greenwich time, in Burma 6½ hours faster, and in India it is 5½ hours faster. New Zealand adopted a system of world time in 1868. Sweden and Great Britain also set up a similar system about 1879. After the International Congress in 1884 the International Time Zone System spread rapidly, and today nearly all countries of the world use the system, at least for official purposes.

III. Standard Time in the United States

1. Time Zones

Although the United States has used standard time since 1883, no legislative action for the country as a whole is recorded until March 19, 1918, when Congress directed the Interstate Commerce Commission to establish limits for the various time zones in this country. Changes in these boundaries have been made from time to time, in order that the time changes may occur at such points as to result in a minimum of inconvenience.

The United States is divided into four standard time zones, each approximately 15° of longitude in width. All places in each zone use, instead of their own local time, the time counted from the transit of the "mean sun" across the meridian which passes through the approximate center of that zone. These time zones are designated as Eastern, Central, Mountain, and Pacific, and the time in these zones is reckoned from the 75th, 90th, 105th, and 120th meridians west of Greenwich, respectively. The time in the various zones is slower than Greenwich time by 5, 6, 7, and 8 hours, respectively.

The question of changing from the time of one time zone to that of an adjacent zone arises in practice largely in the operation of railroads. Because of the inconvenience of changing the time by the necessary amount of 1 hour at every point where a railroad crosses one of these boundary lines, the more convenient practice has usually been followed of making the change at some terminal or division point on the road, at some junction point, or at the boundary line between the United States and Canada. The practical result is that the boundaries of the time zones are defined by the lines connecting these points of railroad time change. Because of the location of these railroad junctions or terminals the resulting lines are somewhat irregular. Figure 1 shows the time zones and present boundary lines as defined by the Interstate Commerce Commission. Cities and towns located on these zone boundaries usually take the time of the zone to the East of the line.

2. Time in Territories and Insular Possessions

Standard time is also used in the territories outside of the continental United States. The places and the time used are given below:

Alaska (see table 1)	10 hours slower than Greenwich.
Guam	10 hours faster than Greenwich.
Hawaii	10 hours slower than Greenwich.
Midway	11 hours slower than Greenwich.
Panama Canal Zone	5 hours slower than Greenwich.
Puerto Rico	4 hours slower than Greenwich.
Samoa	11 hours slower than Greenwich.
Virgin Islands	4 hours slower than Greenwich.

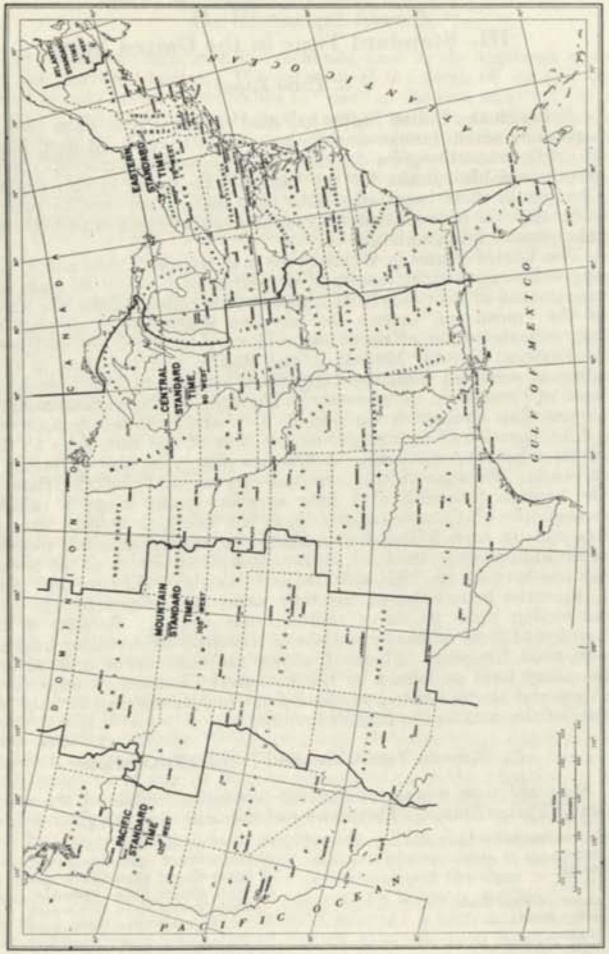

FIGURE 1.—*Time zones of the United States.*

3. Time in Several Large Cities of the United States at 12 Noon, Eastern Standard Time

Atlanta, Ga	12 noon.	Milwaukee, Wis	11 a. m.
Baltimore, Md	12 noon.	Minneapolis, Minn	11 a. m.
Birmingham, Ala	11 a. m.	Newark, N. J	12 noon.
Boston, Mass	12 noon.	New Haven, Conn	12 noon.
Charleston, S. C	12 noon.	New Orleans, La	11 a. m.
Chicago, Ill	11 a. m.	New York, N. Y	12 noon.
Cincinnati, Ohio	12 noon.	Norfolk, Va	12 noon.
Cleveland, Ohio	12 noon.	Omaha, Nebr	11 a. m.
Columbus, Ohio	12 noon.	Philadelphia, Pa	12 noon.
Dallas, Tex	11 a. m.	Pittsburgh, Pa	12 noon.
Denver, Colo	10 a. m.	Portland, Oreg	9 a. m.
Des Moines, Iowa	11 a. m.	Providence, R. I	12 noon.
Detroit, Mich	12 noon.	Richmond, Va	12 noon.
Hartford, Conn	12 noon.	Rochester, N. Y	12 noon.
Houston, Tex	11 a. m.	Salt Lake City, Utah	10 a. m.
Indianapolis, Ind	11 a. m.	San Francisco, Calif	9 a. m.
Kansas City, Mo	11 a. m.	Seattle, Wash	9 a. m.
Los Angeles, Calif	9 a. m.	St. Louis, Mo	11 a. m.
Louisville, Ky	11 a. m.	St. Paul, Minn	11 a. m.
Memphis, Tenn	11 a. m.	Washington, D. C	12 noon.

4. Time Signals in the United States

The standard time for the United States is derived from star observations made at the U. S. Naval Observatory, Washington, D. C. Time signals based on these time determinations are broadcast by the following stations: NSS—U. S. Naval Radio Station, Annapolis, Md.; NPG—U. S. Naval Radio Station, Mare Island, Calif.; NPM—U. S. Naval Radio Station, Pearl Harbor, Hawaii; NBA—U. S. Naval Radio Station, Balboa, Canal Zone; WWV—Standard Frequency Station of the National Bureau of Standards, Beltsville, Md.; WWVH—Standard Frequency Station of the National Bureau of Standards, Maui, Hawaii.

All U. S. Navy time signals are given in a standard manner. The signals begin 5 minutes before the hour and consist of a dash on each second, except on the following seconds: 55 minutes (29, 51, and 56 to 59 seconds); 56 minutes (29, 52, and 56 to 59 seconds); 57 minutes (29, 53, and 56 to 59 seconds); 58 minutes (29, 54, and 56 to 59 seconds); 59 minutes (29, and 51 to 59 seconds).

Beginning exactly on the hour a much longer dash is sent. In all cases the exact second is denoted by the beginning of the dash, the end being without significance. Note that the number of seconds sounded immediately following the single second omission and preceding the long omission at the end of each minute indicates the number of minutes of the signal yet to be sent. For instance, the signal for 56 minutes and 52 seconds is omitted and then 3 seconds are sounded, indicating that 3 minutes of the signal remain to be transmitted.

These time signals, if received directly and automatically, are seldom in error by as much as 0.10 second. The average error is generally less than 0.01 second. The signals broadcast by Naval stations are transmitted on continuous waves, and can be heard only with radio receivers that are suited to such code reception.

The National Bureau of Standards stations, WWV and WWVH, transmit continuously (day and night) standard frequencies and superimposed time signals on several carrier frequencies. These transmissions are modulated waves and may be heard with ordinary radiophone receivers. A pulse 0.005 second in duration is transmitted every second, except the beginning of the last second of each minute. These pulses consist of 5 cycles of a 1,000-cycle audio note and are heard as clicks on the receivers. At precisely 1 minute before each hour and at every 5 minutes thereafter, the audio frequencies are interrupted for exactly 1 minute, to permit time announcements under the International Morse Code, using four digits on the 24-hour system. The first two digits indicate the hours and the last two the minutes. Universal Time (u. t.) is given. In addition to code announcements, a voice announcement of eastern standard time follows the code time on WWV. The time signals beat continuously without interruptions, even during the announcements. (WWVH is an experimental station. The signals are interrupted for approximately 4 minutes immediately after each hour and half hour, and for 30 minutes at 1700 and 1900 u. t.)

These signals of the National Bureau of Standards may be received on the following frequencies (note that 440 cycles per second is musical A above middle C):

WWV		WWVH	
Frequency	Other modulation	Frequency	Other modulation
kc	*c/s*	*kc*	*c/s*
2, 500	440 or 600	5, 000	440 or 600
5, 000	440 or 600	10, 000	440 or 600
10, 000	440 or 600	15, 000	440 or 600
15, 000	440 or 600	------	----------
20, 000	440 or 600	------	----------
25, 000	440 or 600	------	----------
30, 000	None	------	----------
35, 000	None	------	----------

For work of the highest uniformity of time interval markings, transmissions by WWV are to be preferred over those of other stations. The WWV signals are uniform within 0.001 second per day, as broadcast. Deviations from Naval Observatory time have not exceeded 0.05 second. The WWVH signals are synchronized within 0.001 second to those broadcast by Station WWV.

Further information on the standard frequency signals may be obtained from the National Bureau of Standards, Washington 25, D. C. Intercomparisons of the different time signals, including those from WWV, are made at frequent intervals each day and the Naval Observatory publishes correction sheets, which may be obtained from the Observatory without charge.

IV. Time in Foreign Countries

1. Time Zones of the World

Standard time for the world, like longitude, is counted from Greenwich as the prime meridian. As explained in section II, places to the east of Greenwich have faster time than Greenwich, while places to the west have slower time. The world is divided into time zones of approximately 15° for every hour. Since Greenwich is in the 0 zone, the number of any zone, if added algebraically to the time in Greenwich, will give the corresponding time in that particular zone. It must be remembered that not all countries follow the International Time Zone System, but that some use the time of some principal city as a standard and others have no standard of time.

2. International Date Line

The International Meridian Conference in 1884 established as the prime meridian, from which time was to be counted, the meridian passing through Greenwich, England. The meridian 180° from this prime meridian was made the International Date Line, but in order to include islands of the same group in the same day it has been necessary to vary the line from the 180th meridian at some places. The official date line runs from 70° N. to 60° S. in accordance with the following description:

Starting at the 180th meridian at 70° N., thence
southeasterly to 169° W., 65° N., thence
southwesterly to 170° E., 52°30′ N., thence
southeasterly to the 180th meridian at 48° N., thence
southerly on the 180th meridian to 5° S., thence
southeasterly to 172° 30′ W., 15°30′ S., thence
southerly on 172° 30′W. to 45°30′ S., thence
southwesterly to the 180th meridian at 51°30′ S., thence
southerly on the 180th meridian to 60° S.

When crossing this line in a westerly direction (i. e., from west longitude to east longitude), the date must be advanced 1 day, and when crossing in an easterly direction (east longitude to west longitude), the date must be set back 1 day.

3. Time in Several Important Cities

The following list gives the time in some important cities of the world, outside of continental United States, at 12 noon eastern standard time.

Alexandria, Egypt	7 p. m.	Lima, Peru	12 noon.
Athens, Greece	7 p. m.	London, England	5 p. m.
Baghdad, Iraq	8 p. m.	Madrid, Spain	5 p. m.
Bangkok, Siam	12 midnight.	Manila, Philippine Islands.	1 a. m. next day.
Batavia, Java	1 a. m. next day.	Mexico City, Mexico	11 a. m.
Berlin, Germany	6 p. m.	Montevideo, Uruguay	1:30 p. m.
Bombay, India	10:30 p. m.	Montreal, Quebec	12 noon.
Brussels, Belgium	5 p. m.	Paris, France	5 p. m.
Bucharest, Rumania	7 p. m.	Perth, Western Australia	1 a. m. next day.
Buenos Aires, Argentina	1 p. m.	Rio de Janeiro, Brazil	2 p. m.
Cape Town, South Africa.	7 p. m.	Rome, Italy	6 p. m.
Caracas, Venezuela	12:30 p. m.	Shanghai, China	1 a. m. next day.
Copenhagen, Denmark	6 p. m.	Sydney, New South Wales.	3 a. m. next day.
Dawson, Yukon	8 a. m.	Tokyo, Japan	2 a. m. next day.
Edmonton, Alberta	10 a. m.	Valpariso, Chile	1 p. m.
Freetown, Sierra Leone	5 p. m.	Vancouver, British Columbia.	9 a. m.
Geneva, Switzerland	6 p. m.	Vienna, Austria	6 p. m.
Halifax, Nova Scotia	1 p. m.	Wellington, New Zealand.	5 a. m. next day.
Havana, Cuba	12 noon.	Winnepeg, Manitoba	11 a. m.
Hong Kong, China	1 a. m. next day.		
Honolulu, Hawaii	7 a. m.		

4. Time Zone Names

Many of the time zones of the world have been given special names in accordance with their locations. The following is a list of some of the better-known zone names.

Time zone name	Standard meridian
Western Europe time—Greenwich time	0°.
Central Europe time	15° E.
Eastern Europe time	30° E.
India time	82½° E.
Burma time	97½° E.
Indo-China time	105° E.
China time—Philippine time	120° E.
Japan time	135° E.
South Australia time	142½° E.
Eastern Australia time—New Guinea time	150° E.
New Zealand time—Fiji time	180° E.
Hawaiian standard time—Alaska standard time	150° W.
Yukon time	135° W.
Pacific standard time	120° W.
Mountain standard time	105° W.
Central standard time	90° W.
Eastern standard time	75° W.
Venezuela time	67½° W.
Atlantic time	60° W.
St. John time	52½° W.

5. Zone Numbers and Letters

The different time zones of the world are numbered east and west of Greenwich. The zone number when added or subtracted, as indicated, from the time of the zone gives the corresponding Greenwich time. Thus, zones to the east have faster time than Greenwich and are indicated as minus (−), while those to the west have slower time and are indicated as plus (+). For convenience in telegraphic and other communications and records, letters have also been assigned to the zones. The system of numbering and lettering is shown in the following table.

Faster than Greenwich			Slower than Greenwich		
Standard meridian east	Zone No.	Zone letter	Standard meridian west	Zone No.	Zone letter
Degrees			*Degrees*		
0	0	Z	0	0	Z
15	−1	A	15	+1	N
30	−2	B	30	+2	O
45	−3	C	45	+3	P
60	−4	D	60	+4	Q
75	−5	E	75	+5	R
90	−6	F	90	+6	S
105	−7	G	105	+7	T
120	−8	H	120	+8	U
135	−9	I	135	+9	V
150	−10	K	150	+10	W
165	−11	L	165	+11	X
180	−12	M	180	+12	Y

6. Time Designations

Certain abbreviations have been adopted as standard in designating time: The time from midnight to noon is indicated by a. m. (ante meridiem); that from noon to midnight by p. m. (post meridiem). Noon is expressed as 12 m (meridies); midnight as 12 p. m.; e. s. t. indicates eastern standard time; c. s. t., central standard time; m. s. t., mountain standard time; P. s. t., Pacific standard time; etc. Greenwich time is expressed as G. c. t. (Greenwich civil time), G. m. t. (Greenwich mean time), or u. t. (universal time). The expression u. t. is preferred.

Before 1925, the astronomical day started at noon, while the civil day started at midnight. This astronomical time was designated as G. m. t. Beginning in January 1925 the astronomical day was changed to start at midnight, thus agreeing with the civil day, and the use of G. c. t. was adopted in most countries. The British Almanac and some others continued to indicate this new time as G. m. t., even though it differed from the former G. m. t. by 12 hours. This led to some confusion, and the use of u. t. (universal time) was gradually adopted to express Greenwich time. This designation may be found in some astronomical tables used jointly with either G. m. t. or

G. c. t. In following old records, it is important to remember that the beginning of the astronomical day was changed from noon to midnight on January 1, 1925.

In some countries the hours of the day are numbered from 0 to 24 beginning at midnight. This is less confusing than the double 12 system used in this country.

The corresponding times in the two systems are:

24-hour system	Double-12 system	24-hour system	Double-12 system
1	1 a. m.	13	1 p. m.
2	2 a. m.	14	2 p. m.
3	3 a. m.	15	3 p. m.
4	4 a. m.	16	4 p. m.
5	5 a. m.	17	5 p. m.
6	6 a. m.	18	6 p. m.
7	7 a. m.	19	7 p. m.
8	8 a. m.	20	8 p. m.
9	9 a. m.	21	9 p. m.
10	10 a. m.	22	10 p. m.
11	11 a. m.	23	11 p. m.
12	12 noon.	0 or 24	12 midnight.

7. Comparison of Time

Figure 2 illustrates clearly the difference in time as one travels from place to place upon the earth. On this chart the outer circle shows the longitude east and west of Greenwich; the middle circle gives the time as compared with noon in Washington, D. C., and the inner circle shows the time difference from Greenwich. This diagram will be found useful in picturing the relative locations of various countries and for computing the comparative time between them.

Example: The standard meridian for Japan is 135° E. and that for Turkey is 30° E. What is the time in each place at noon in Washington and what is the time difference between Japan and Turkey?

Following the radius through 135° E. toward the center, we find that the time in Japan is 9 hours faster than Greenwich and that its time is 2 a. m. next day when it is noon in Washington.

Following the radius through 30° E. toward the center, we find that the time for Turkey is 2 hours faster than Greenwich and that its time is 7 p. m. when it is noon in Washington.

Since Japan is 9 hours faster than Greenwich and Turkey is only 2 hours faster than Greenwich, Japan must be 9 hours minus 2 or 7 hours faster than Turkey.

Where parts of an hour are involved the fraction may be added to the full hour difference shown in the diagram.

Example: Honolulu takes the time of 150° W. What time is it in Honolulu when it is noon in Washington, and what is the time difference between Honolulu and Greenwich?

Following the radius through 150° W. toward the center, we find that Honolulu is 10 hours slower than Greenwich, and that at noon in Washington it is 7 a. m. in Honolulu.

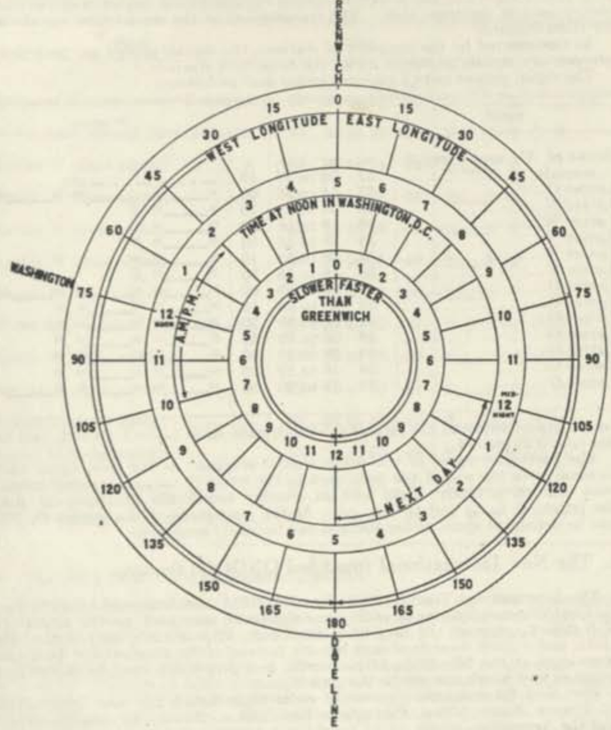

FIGURE 2. *Compar..tive time chart.*

8. Foreign Time Signals

There are a number of radio stations throughout the world that broadcast time signals. The systems of transmitted signals used by the different stations are not the same. A few stations use a special system of their own, but most stations use one of the systems described below.[1] The signals are preceded by warning or some kind of preliminary signals to indicate the station.

(a) The United States System (previously described).

(b) The International (ONOGO) System.

[1] The descriptions were taken from Radio Navigational Aids, published by the Hydrographic Office, Navy Department.

This system was adopted at the Conférence Internationale de l'Heure, 1912. It is better known as the ONOGO system because of the sequence of the Morse letters used in the time code. The transmission of the actual time signals lasts for three minutes.

As transmitted by the majority of stations, the signals proper are preceded by preparatory signals as shown under the respective stations.

The signal proper lasts 3 minutes and is sent as follows:

Signal	Times	Diagram
	m. s. m. s.	
Series of X's sent every 5 seconds	57 00 to 57 49	— · · — — · · — etc.
Letter O	57 55 to 58 00	55 — 56 57 — 58 59 — 60
Letter N	58 08 to 58 10	08 — 09 · 10
Letter N	58 18 to 58 20	18 — 19 · 20
Letter N	58 28 to 58 30	28 — 29 · 30
Letter N	58 38 to 58 40	38 — 39 · 40
Letter N	58 48 to 58 50	48 — 49 · 50
Letter O	58 55 to 59 00	55 — 56 57 — 58 59 — 60
Letter G	59 06 to 59 10	06 — 07 08 — 09 · 10
Letter G	59 16 to 59 20	16 — 17 18 — 19 · 20
Letter G	59 26 to 59 30	26 — 27 28 — 29 · 30
Letter G	59 36 to 59 40	36 — 37 38 — 39 · 40
Letter G	59 46 to 59 50	46 — 47 48 — 49 · 50
Letter O	59 55 to 00 00	55 — 56 57 — 58 59 — 60

In the transmission of the signals ONOGO, each dash (—) = 1 second, and each dot (.) = 0.25 second.

The particular signal of this series that is accepted as the time signal varies: in some cases the end of the final dash in the letter O (— — —), representing an even minute, is taken; while another country specifically mentions the dot of the letters N (— .) and G (— — .). As the exactitude of the signals O, N, G, can be depended upon, either method can be safely employed.

c. The New International (modified ONOGO) System

The International Time Commission, July 1925, recommended that the International (Onogo) System of radio time signals be amended, by the substitution of 6 dots (.) sent at the fifty-fifth, fifty-sixth, fifty-seventh, fifty-eighth, fifty-ninth, and sixtieth seconds of each minute, instead of the 3 one-second dashes that commence at the fifty-fifth, fifty-seventh, and fifty-ninth seconds of the last 3 minutes, and which constitute the time signals.

The New International System of radio time signals has now been adopted by France, South Africa, Portuguese East Africa, Brazil, Victoria (Australia), and the Argentine.

The signal proper is as follows:

Signal	Time	Diagram
	m. s. m. s.	
Series of X's sent every 5 seconds	57 00 to 57 50	— · · — — · · — etc.
A dot each second (time signals)	57 55 to 58 00	55· 56· 57· 58· 59· 60·
Letter N (time signal)	58 08 to 58 10	8 — 9 · 10
Letter N (time signal)	58 18 to 58 20	18 — 19 · 20
Letter N (time signal)	58 28 to 58 30	28 — 29 · 30
Letter N (time signal)	58 38 to 58 40	38 — 39 · 40
Letter N (time signal)	58 48 to 58 50	48 — 49 · 50
A dot each second (time signals)	58 55 to 59 00	55· 56· 57· 58· 59· 60·
Letter G (time signal)	59 06 to 59 10	6 — 7 8 — 9 · 10
Letter G (time signal)	59 16 to 59 20	16 — 17 18 — 19 · 20
Letter G (time signal)	59 26 to 59 30	26 — 27 28 — 29 · 30
Letter G (time signal)	59 36 to 59 40	36 — 37 38 — 39 · 40
Letter G (time signal)	59 46 to 59 50	46 — 47 48 — 49 · 50
A dot each second (time signals)	59 55 to 00 00	55· 56· 57· 58· 59· 60·

d. The Rhythmic (Coincidence) System

The International Time Commission of 1925 adopted the New International System of rhythmic wireless time signals, which is described herein. This system has been adopted by Great Britain, France, U. S. S. R., Germany, French Indo-China, and other countries.

The rhythmic system consists of 306 signals transmitted in the space of 300 seconds or 5 minutes of mean time. The signals falling exactly on the minute are short dashes (—) of 0.4 second duration. Between the dashes 60 dots (.) of 0.1 second each are transmitted. Each minute therefore is divided into 61 intervals. This vernier arrangement permits coincidence to be obtained between the chronometer beat (tick) and the radio signal. Chronometers beating half seconds will afford two coincidences each minute, while those beating only on the second will give one coincidence each minute. Due to the vernier arrangement, these signals permit chronometer comparisons of accuracy approaching 0.01 second.

In 1948 there was built at the National Bureau of Standards a means of controlling the frequency of these crystals to an accuracy of approximately 1 part in 20 million. This apparatus, known as the "atomic clock," is still in the development stage, but it gives promise of still higher time precision and control of timing measurements to approximately 1 part in 1 billion.

The following foreign stations broadcast radio time signals. For details as to the times of transmission, the frequencies used, and the type of system of signals, consult the Radio Navigational Aids (latest edition), published by the Hydrographic Office, Navy Department, Washington 25, D. C.

877453—50——3

Europe:
- Denmark:
  - Skamlebaek.
- France:
  - Paris—Pontoise: FYP and others.
- Germany:
  - Nauen: DFY.
- Great Britain:
  - Rugby: GBR.
  - BBC: GR, GS, GV, and GW series.
- Poland:
  - Warsaw: SPI.
- Portugal:
  - Monsanto: CTB, CTW.
  - Centocella: 1MB.
- Spain:
  - Cadiz (San Carlos): EBC.
- Sweden:
  - Stockholm: SBA.
- USSR:
  - Moscow: RAI and others.
  - Leningrad (Detskoe Selo): RET.

Asia:
- China:
  - Hong Kong: ZBW.
  - Shanghai (Frelupt): XSG.
  - Peiping (Peking): XPK.
- India:
  - Calcutta: VWC.
  - Colombo: VPB.
- Indo China:
  - Saigon: FZS3.
  - Kien An: FRK.
- Iraq:
  - Basrah: YIB.
- Japan:
  - Tokyo: JJC and JJY.
  - Choshi: JCS.
- USSR:
  - Theodosia: VEK.
  - Vladivostok: RTH and others.

Africa:
- Eritrea:
  - Massawa: IRG.
- Italian Somaliland:
  - Mogadiscio: ISC.
- Mozambique:
  - Laurenço Marques: CRL.
- Union of South Africa:
  - Capetown: ZSC.

North America:
- Canada:
  - Camperdown: VCS.
  - Halifax: CFH.
  - Ottawa: CHU.
- Mexico:
  - Mexico City: XDA and others.

South America:
- Argentina:
  - Darsena Norte: LOL.
  - Monte Grande: LQC and others.
- Brazil:
  - Rio de Janeiro: PRR.
  - Observatorie Nacional: PPE.
- Chile:
  - Valparaiso—Las Salinas: CCL and others.
- Peru:
  - Callao: OBE.
  - Lima: OAZ.
- Uruguay:
  - Montivedeo: CXG.

Australia and East Indies:
- Australia:
  - Perth: VIP.
  - Sydney: VIS.
  - Melbourne: VIM.
  - Adelaide: VIA.
- Sarawak:
  - Kuching: VQF.
- New Zealand:
  - Wellington: ZMO and others.
  - Christchurch: 3YA.

9. Legal Time Used in the Different Countries

Nearly every country of the world has established a legal time upon which to operate and also a legal time for islands and dependencies under its control. Table 1, page 15, shows the authorized time and compares this time with both Greenwich, England, and Washington, D. C. Where the legal time conforms to the International Standard Time System, the standard-time meridian is indicated.

TABLE 1. *Standard time in the different countries* [a]

Country	General location	Standard meridian		Zone		Time compared to Greenwich (hours faster or slower: "f"=faster; "s"=slower)	Time compared to Washington (hours faster or slower: "f"=faster; "s"=slower)
		East	West	Number	Letter		
		Degrees	*Degrees*				
Admiralty Islands	South Pacific	150		−10	K	10f	15f.
Afghanistan	Asia	65		−4	D	4f	9f.
Alaska	North America.						
Juneau, Ketchikan, Sitka			120	+8	U	8s	3s.
Cordova			135	+9	V	9s	4s.
Central part			150	+10	W	10s	5s.
West coast, Aleutian Islands			165	+11	X	11s	6s.
Albania [b]	Europe	15		−1	A	1f	6f.
Algeria	Africa	0		0	Z	0	5f.
Amirante Islands	Indian Ocean	60		−4	D	4f	9f.
Amsterdam Island	do	75		−5	E	5f	10f.
Anamba Islands	do	105		−7	G	7f	12f.
Andaman Islands	do	97½		−6½		6½f	11½f.
Andora [b]	Europe	0		0	Z	0	5f.
Anglo-Egyptian Sudan	Africa	30		−2	B	2f	7f.
Angola	do	15		−1	A	1f	6f.
Anguilla Island	West Indies		60	+4	Q	4s	1f.
Annobon Island	South Atlantic	0		0	Z	0	5f.
Antiqua Island	West Indies		60	+4	Q	4s	1f.
Arabia [c]	Asia (45° E).						
Aden [b]		45		−3	C	3f	8f.
Argentina [b]	South America		60	+4	Q	4s	1f.
Aru Islands	East Indies	135		−9	I	9f	14f.
Ascension Island	South Atlantic	0		0	Z	0	5f.
Auckland Island [d]	South Pacific (165° E).						
Austral (Tubuai) Islands	South Pacific		150	+10	W	10s	5s.

See footnotes at end of table.

TABLE 1. *Standard time in different countries*—Continued

Country	General location	Standard meridian		Zone		Time compared to Greenwich (hours faster or slower: "f"=faster; "s"=slower)	Time compared to Washington (hours faster or slower: "f"=faster; "s"=slower)
		East	West	Number	Letter		
		Degrees	*Degrees*				
Australia [b]	South Pacific						
Western Australia [b]		120		−8	H	8f.	13f.
Northern Territory,[b] South Australia.[b]		142½		−9½		9½f.	14½f.
New South Wales,[b] Queensland, Victoria.[a]		150		−10	K	10f.	15f.
Austria [b]	Europe	15		−1	A	1f.	6f.
Azores Islands [b]	North Atlantic	0		0	Z	0.	5f.
Bahama Islands	North Atlantic		75	+5	R	5s.	0.
Bahrein Islands	Persian Gulf	60		−4	D	4f.	9f.
Balearic Islands [b]	Mediterranean Sea	0		0	Z	0.	5f.
Bali Island	East Indies	120		−8	H	8f.	13f.
Balleny Islands [c]	Anarctic Ocean (162° E).						
Bangka Island	East Indies	105		−7	G	7f.	12f.
Barbados Island [b]	West Indies		60	+4	Q	4s.	1f.
Bear Island [a]	Arctic Ocean (20° E).						
Bechuanaland	Africa	30		−2	B	2f.	7f.
Belgium [b]	Europe	0		0	Z	0.	5f.
Bennett Island	Arctic Ocean	150		−10	K	10f.	15f.
Bermuda Islands [b]	North Atlantic		60	+4	Q	4s.	1f.
Bhutan	Asia	87½		−5½		5½f.	10½f.
Billiton Islands	East Indies	105		−7	G	7f.	12f.
Bolivia	South America		60	+4	Q	4s.	1f.
Borneo [b]	East Indies	120		−8	H	8f.	13f.
Brazil	South America.						
Fernando Noronha Island, Isle de Trinidade.			30	+2	O	2s.	3f.
Bahia, Ceara, Esperito Santo, Goyaz, Miranhao, Minas-Geraes, Para, Parana, Pernambuco, Piauhy, Rio de Janeiro, Rio Grande do Norte, Rio Grande do Sul, Santa Catherina, Sao Paulo.			45	+3	P	3s.	2f.
Amazonas, Matto Grosso			60	+4	Q	4s.	1f.
Acre Territory			75	+5	R	5s.	0.
British Honduras [b]	Central America		90	+6	S	6s.	1s.
Bulgaria	Europe	30		−3	C	3f.	8f.
Burma	Asia	97½		−6½		6½f.	11½f.
Cameroons	Africa	15		−1	A	1f.	6f.
Campbell Island [c]	Antarctic Ocean (170° E).						
Canada	North America.						
Belle Isle, Labrador,[b] Newfoundland.[b]			52½	+3½		3½s.	1½f.
Anticosti Island, Cape Breton Island, Magdalen Island, New Brunswick,[b] Nova Scotia,[b] Prince Edward Island, Quebec (east of 68° W),[b] Sable Island.			60	+4	Q	4s.	1f.
Melville Peninsula (east), Ontario (east of 90° W.),[b] Quebec (west of 68 W.),[b] Southampton Island.			75	+5	R	5s.	0.
Manitoba, Ontario (west of 90° W.), Melville Peninsula (west), Northwest Territories (east).			90	+6	S	6s.	1s.
Alberta, Saskatchewan, Northwest Territories (middle).			105	+7	T	7s.	2
British Columbia, Northwest Territories (west).			120	+8	U	8s.	3s.
Yukon			135	+9	V	9s.	4s.
Arctic Islands [c]	North of Canada.						

See footnotes at end of table.

TABLE 1. *Standard time in the different countries*[a]—Continued

Country	General location	Standard meridian East	Standard meridian West	Zone Number	Zone Letter	Time compared to Greenwich (hours faster or slower: "f"=faster; "s"=slower)	Time compared to Washington (hours faster or slower: "f"=faster; "s"=slower)
		Degrees	Degrees				
Canary Islands[b]	North Atlantic		15	+1	N	1s	4f.
Cape Verde Islands	do		30	+2	O	2s	3f.
Caroline Islands	North Pacific	150		−10	K	10f	15f.
Cayman Islands	West Indies		75	+5	R	5s	0.
Celebes Islands	East Indies	120		−8	H	8f	13f.
Ceram Islands	do	135		−9	I	9f	14f.
Ceylon Island[b]	Indian Ocean	82½		−5½		5½f	10½f.
Chad	Africa	15		−1	A	1f	6f.
Chagos Archipelago[b]	Indian Ocean	75		−5	E	5f	10f.
Channel Islands[b]	English Channel	0		0	Z	0	5f.
Chatham Island[b]	South Pacific	180		−12	M	12f	17f.
Chile[b]	South America		60	+4	Q	4s	1f.
China	Asia.						
Western part		75		−5	E	5f	10f.
Mid-Western part		90		−6	F	6f	11f.
Mid-Eastern part, Hainan, Palekoi, Hongkong, Macao.		105		−7	G	7f	12f.
Eastern part		120		−8	H	8f	13f.
Christmas Island	Indian Ocean	105		−7	G	7f	12f.
Cocos (Keeling) Islands	do	97½		−6½		6½f	11½f.
Colombia	South America		75	+5	R	5s	0f.
Comoro Islands	Indian Ocean	45		−3	C	3f	8f.
Congo	Africa.						
Western part		15		−1	A	1f	6f.
Eastern part		30		−2	B	2f	7f.
Cook Islands	South Pacific (160° W)					10 hr 38 min s	5 hr 38 min s.
Corsica Island[b]	Mediterranean Sea	0		0	Z	0f	5f.
Costa Rica	Central America		90	+6	S	6s	1s.
Crete Island[b]	Mediterranean Sea	30		−2	B	2f	7f.
Cuba[b]	West Indies		75	+5	R	5s	0f.
Curacao Island	Caribbean Sea		67½	+4½		4½s	½f.
Cyprus Island[b]	Mediterranean Sea	30		−2	B	2f	7f
Czechoslovakia	Europe	15		−1	A	1f	6f.
Dahomey	Africa	0		0	Z	0	5f.
Denmark[b]	Europe	15		−1	A	1f	6f.
Dodecanese Islands	Mediterranean Sea	30		−2	B	2f	7f.
Dominica Island	West Indies		60	+4	Q	4s	1f.
Dominican Republic[b]	do		75	+5	R	5s	0.
Ecuador	South America		75	+5	R	5s	0.
Egypt[b]	Africa	30		−2	B	2f	7f.
Eire[b]	British Isles	0		0	Z	0	5f.
Ellice Islands	South Pacific	180		−12	M	12f	17f.
El Salvador	Central America		90	+6	S	6s	1s.
England[b]	British Isles	0		0	Z	0f	5f.
Equatorial Africa, French	Africa	15		−1	A	1f	6f.
Eritrea	do	45		−3	C	3f	8f.
Estonia	Europe (U. S. S. R.)	30		−2	B	2f	7f.
Ethiopia	Africa	45		−3	C	3f	8f.
Falkland Islands[b]	South Atlantic		60	+4	Q	4s	1f.
Fanning Island	North Pacific		165	+11	X	11s	6s.
Faroe Islands	Norwegian Sea	0		0	Z	0	5f.
Fernando Po Island	South Atlantic	0		0	Z	0	5f.
Fiji Islands[b]	South Pacific	180		−12	M	12f	17f.
Finland[b]	Europe	30		−2	B	2f	7f.
Flores Islands	East Indies	120		−8	H	8f	13f.
Formosa (Taiwan) Island	China Sea	135		−9	I	9f	14f.
France[b]	Europe	0		0	Z	0	5f.
Gabon	Africa	15		−1	A	1f	6f.
Galapagos Islands[c]	South Pacific (90° W).						
Gambia	Africa	0		0	Z	0	5f.
Germany[b]	Europe	15		−1	A	1f	6f.
Gibraltar[b]	do	0		0	Z	0	5f.
Gilbert Islands	Pacific Ocean	180		−12	M	12f	17f.
Gold Coast[b]	Africa	0		0	Z	0	5f.
Great Britain[b]	Europe	0		0	Z	0	5f.

See footnotes at end of table.

TABLE 1. *Standard time in the different countries* [a]—Continued

Country	General location	Standard meridian		Zone		Time compared to Greenwich (hours faster or slower: "f"=faster; "s"=slower)	Time compared to Washington (hours faster or slower: "f"=faster; "s"=slower)
		East	West	Number	Letter		
		Degrees	*Degrees*				
Great Lyakhov Island	Arctic Ocean	135		−9	I	9f	14f.
Greece [b]	Europe	30		−2	B	2f	7f.
Greenland	Arctic Ocean.						
Scoresby Sound			30	+2	O	2s	3f.
Angmagssalik, Disko Island, Western Coast.			45	+3	P	3s	2f.
Interior [c]							
Grenada Island	West Indies		60	+4	Q	4s	1f.
Guadalupe Island [c]	North Pacific (120° W).						
Guadeloupe Island	West Indies		60	+4	Q	4s	1f.
Guam Island	North Pacific	150		−10	K	10f	15f.
Guatemala	Central America		90	+6	S	6s	1s.
Guiana, British, Dutch, French [b]	South America		52½	+3½		3½s	1½f.
Guinea	Africa.						
French,[b] Spanish		0		0	Z	0	5f.
Portuguese			15	+1	N	1s	4f.
Hadramaut (Mukalla)	Arabia	45		−3	C	3f	8f.
Haiti	West Indies		75	+5	R	5s	0.
Halmahera Islands	East Indies	135		−9	I	9f	14f.
Hawaiian Islands	North Pacific		150	+10	W	10s	5s.
Hebrides Islands	British Isles	0		0	Z	0	5f.
Honduras	Central America		90	+6	S	6s	1s.
Hungary [b]	Europe	15		−1	A	1f	6f.
Iceland [b]	North Atlantic		15	+1	N	1s	4f.
India [b]	Asia	82½		−5½		5½f	10½f.
Indo-China [b]	do	120		−8	H	8f	13f.
Iran	do	52½		−3½		3½f	8½f.
Iraq [b]	do	45		−3	C	3f	8f.
Ireland, Northern [b]	British Isles	0		0	Z	0	5f.
Isle of Man	do	0		0	Z	0	5f.
Isle of Pines	West Indies		75	+5	R	5s	0.
Italy [b]	Europe	15		−1	A	1f	6f.
Ivory Coast	Africa	0		0	Z	0	5f.
Jamaica	West Indies		75	+5	R	5s	0.
Jan Mayen Island	Arctic Ocean		15	+1	N	1s	4f.
Japan [b]	Asia	135		−9	I	9f	14f.
Java	East Indies	120		−8	H	8f	13f.
Juan Fernandez Islands	South Pacific		60	+4	Q	4s	1f.
Kamaran Island [b]	Red Sea	45		−3	C	3f	8f.
Kamchatka	Asia	165		−11	L	11f	16f.
Karaginski Island	Bering Sea	165		−11	L	11f	16f.
Kei Islands	East Indies	135		−9	I	9f	14f.
Kenya	Africa	45		−3	C	3f	8f.
Kerguelon Islands [c]	Indian Ocean.						
Kodiak Island	Gulf of Alaska		150	+10	W	10s	5s.
Komandorski Islands	Bering Sea	165		−11	L	11f	16f.
Korea	Asia	135		−9	I	9f	14f.
Kotelni Island	Arctic Ocean	135		−9	I	9f	14f.
Kuril Islands	Asia	135		−9	I	9f	14f.
Labrador	North America		52½	+3½		3½s	1½f.
Laccadive Islands	Indian Ocean	82½		−5½		5½f	10½f.
Latvia [a]	Europe (U. S. S. R.)	30		−2	B	2f	7f.
Liberia	Africa					0 hr 44 min s	4 hr 16 min f.
Libya [a]	do	15		−1	A	1f	6f.
Liechtenstein	Europe	15		−1	A	1f	6f.
Lithuania [a]	Europe (U. S. S. R.)	30		−2	B	2f	7f.
Lombok Island	East Indies	120		−8	H	8f	13f.
Lord Howe Island	South Pacific	157½		−10½		10½f	15½f.
Loyalty Islands	do	165		−11	L	11f	16f.
Luxembourg [a]	Europe	0		0	Z	0	5f.
Macquarie Islands [c]	Antarctic Ocean (157° E)						
Madagascar Island	Indian Ocean	45		−3	C	3f	8f.
Madeira Islands	North Atlantic	0		0	Z	0	5f.
Malay States, Confederated	Asia	112½		−7½		7½f	12½f.

See footnotes at end of table.

TABLE 1. *Standard time in the different countries* [a]—Continued

Country	General location	Standard meridian East	Standard meridian West	Zone Number	Zone Letter	Time compared to Greenwich (hours faster or slower: "f"=faster; "s"=slower)	Time compared to Washington (hours faster or slower: "f"=faster; "s"=slower)
		Degrees	Degrees				
Maldive Islands	Indian Ocean					4 hr 54 min f	9 hr 54 min f.
Malta Island [a]	Mediterrean Sea	15		−1	A	1f	6f.
Manchuria	Asia	135		−9	I	9f	14f.
Marianas (Ladrone) Islands	South Pacific	150		−10	K	10f	15f.
Marquesas Islands	do		150	+10	W	10s	5s.
Marshall Islands	North Pacific	180		−12	M	12f	17f.
Martinique Island	West Indies		60	+4	Q	4s	1f.
Mauritania [a]	Africa	0		0	Z	0	5f.
Mauritius Island	Indian Ocean		60	+4	Q	4s	1f.
Mexico [a]	North America.						
Aguascalientes, Campeche, Chiapas, Chihuahua, Coahuila, Durango, Guanajuato, Guerrero, Jalisco, Mexico, Michoacan, Morelos, Nuevo Leon, Oaxaca, Puebla, Queretaro, Quintana Roo, San Luis Potosi, Tabasco, Tamaulipas, Tlaxcala, Yucatan.			90	+6	S	6s	1s.
Baja California (south of 28° N.), Nayarit, Sinaloa, Sonora.			105	+7	T	7s	2s.
Baja California (north of 28° N.)			120	+8	U	8s	3s.
Midway Island	North Pacific		165	+11	X	11s	6s.
Miquelon Island [a]	Gulf of St. Lawrence		60	+4	Q	4s	1f.
Moluccas (Spice) Islands	East Indies	120		−8	H	8f	13f.
Monaco [b]	Europe	0		0	Z	0	5f.
Mono Island	East Indies	165		−11	L	11f	16f.
Morocco [b]	Africa	0		0	Z	0	5f.
Mozambique	do	30		−2	B	2f	7f.
Nansei Islands	Japan	135		−9	I	9f	14f.
Natuna Islands	East Indies	105		−7	G	7f	12f.
Nauru Island	South Pacific	172½		−11½		11½f	16½f.
Nepal	Asia	82½		−5½		5½f	10½f.
Netherlands	Europe	0		0	Z	0	5f.
New Britain Island	East Indies	150		−10	K	10f	15f.
New Caledonia Islands	South Pacific	165		−11	L	11f	16f.
Newfoundland [b]	North America		57½	+3½		3½s	1½f.
New Guinea Island	East Indies.						
Western part (Dutch)	East Indies	135		−9	I	9f	14f.
Eastern part (British)		150		−10	K	10f	15f.
New Hebrides Islands	South Pacific	165		−11	L	11f	16f.
New Ireland Island	East Indies	150		−10	K	10f	15f.
New Siberia Island	Arctic Ocean	150		−10	K	10f	15f.
New Zealand [b]	South Pacific	180		−12	M	12f	17f.
Nicaragua	Central America		90	+6	S	6s	1s.
Nicobar Islands	Indian Ocean	97½		−6½		6½f	11½f.
Nigeria	Africa	15		−1	A	1f	6f.
Niger Territory	do						
Western part		0		0	Z	0	5f.
Eastern part		15		−1	A	1f	6f.
Niue (Savage) Island	South Pacific					11 hr 20 min s	6 hr 20 min s.
Norfolk Island	do	172½		−11½		11½f	16½f.
Northern Ireland [b]	British Isles	0		0	Z	0	5f.
Norway [b]	Europe	15		−1	A	1f	6f.
Nova Zembla Island	Arctic Ocean	60		−4	D	4f	9f.
Nunivak Island	Bering Sea		165	+11	X	11s	6s.
Nyasaland	Africa	30		−2	B	2f	7f.
Ocean Island	South Pacific	165		−11	L	11f	16f.
Ogasawara Island	North Pacific	150		−10	K	10f	15f.
Orkney Islands	British Isles	0		0	Z	0	5f.
Pakistan	Asia	87½		−5½		5½f	10f.
Palau Islands	North Pacific	150		−10	K	10f	15½f.
Palestine [b]	Asia	30		−2	B	2f	7f.

See footnotes at end of table.

TABLE 1. *Standard time in the different countries* ª—Continued

Country	General location	Standard meridian		Zone		Time compared to Greenwich (hours faster or slower: "f"=faster; "s"=slower)	Time compared to Washington (hours faster or slower: "f"=faster; "s"=slower)
		East	West	Number	Letter		
		Degrees	*Degrees*				
Palma Island	Mediterranean Sea	0		0	Z	0	5f.
Panama	Central America		75	+5	R	5s	0.
Panama Canal Zone	do		75	+5	R	5s	0.
Paraguay	South America		60	+4	Q	4s	1f.
Perim Island	Arabian Sea	45		−3	C	3f	8f.
Peru [b]	South America		75	+5	R	5s	0.
Pescadores Islands	East Indies	120		−8	H	8f	13f.
Philippine Islands	North Pacific	120		−8	H	8f	13f.
Poland	Europe.						
Western part		15		−1	A	1f	6f.
Eastern part		30		−2	B	2f	7f.
Portugal [b]	Europe	0		0	Z	0	5f.
Pribolof Islands	Bering Sea		165	+11	X	11s	6s.
Principe Island	South Atlantic	0		0	Z	0	5f.
Puerto Rico	West Indies		60	+4	Q	4s	1f.
Queen Charlotte Islands	North Pacific		120	+8	U	8s	3s.
Rapa Island	South Pacific	150		−10	K	10f	15f.
Raratonga Island	do					10 hr 38 min, s	5 hr 38 min s.
Reunion Island	Indian Ocean	60		−4	D	4f	9f.
Rhodes, Isle of	Mediterranean Sea	30		−2	B	2f	7f.
Rhodesia	Africa.						
Northern		30		−2	B	2f	7f.
Southern		30		−2	B	2f	7f.
Rio de Oro	Africa		15	+1	N	1s	4f.
Rio Muni	do	0		0	Z	0	5f.
Rodriquez Island	Indian Ocean	60		−4	D	4f	9f.
Rumania	Europe	30		−2	B	2f	7f.
Russia [b] (see U. S. S. R.)	do.						
Sakhalin Island	Japan	135		−9	I	9f	14f.
Samoa Islands	South Pacific		165	+11	X	11s	6s.
San Marino [b]	Europe	15		−1	A	1f	6f.
Santa Cruz Islands	South Pacific	165		−11	L	11s	16f.
Sao Thome Island [b]	South Atlantic	0		0	Z	0	5f.
Sarawak	Borneo	120		−8	H	8f	13f.
Sardinia Island [b]	Mediterranean Sea	15		−1	A	1f	6f.
Saudi Arabia [e]	Asia.						
Savage (Niuc) Islands	South Pacific					11 hr 20 min s	6 hr 20 min s.
Schouten Islands	East Indies	135		−9	I	9f	14f.
Scotland	British Isles	0		0	Z	0	5f.
Senegal [b]	Africa	0		0	Z	0	5f.
Seychelles Islands	Indian Ocean	60		−4	D	4f	9f.
Shetland Islands	British Isles	0		0	Z	0	5f.
Siam	Asia	105		−7	G	7f	12f.
Sicily Island [b]	Mediterranean Sea	15		−1	A	1f	6f.
Sierra Leone	Africa	0		0	Z	0	5f.
Society Islands	South Pacific		150	+10	W	10s	5s.
Sokotra Island	Arabian Sea	45		−3	C	3f	8f.
Solomon Islands	South Pacific	165		−11	L	11f	16f.
Somaliland	Africa.						
British, French, Italian		45		−3	C	3f	8f.
South Georgia Islands	South Atlantic					2 hr 7 min s	2 hr 53 min f.
South Orkney Islands [e]	do						
South Sandwich Islands [e]	do						
South Shetland Islands [e]	do						
Southwest Africa	Africa	30		−2	B	2f	7f.
Soviet Union (See U. S. S. R.)	Europe and Asia.						
Spain [b]	Europe	0		0	Z	0	5f.
Spitzbergen [e]	Arctic Ocean (12°E).						
Staten Island	South Atlantic		60	+4	Q	4s	1f.
St. Croix Island	West Indies		60	+4	Q	4s	1f.
St. Helena Island	South Atlantic	0		0	Z	0	5f.
St. Lawrence Island	Bering Sea		165	+11	X	11s	6s.
St. Lucia Island	West Indies		60	+4	Q	4s	1f.
St. Matthew Island	Bering Sea		165	+11	X	11s	6s.
St. Miguel Island	North Atlantic	0		0	Z	0	5f.
St. Pierre Island [b]	Gulf of St. Lawrence		60	+4	Q	4s	1f.
St. Thomas Island	West Indies		60	+4	Q	4s	1f.
St. Vincent Island	do		60	+4	Q	4s	1f.

See footnotes at end of table.

TABLE 1. *Standard time in the different countries* [a]—Continued

Country	General location	Standard meridian East	Standard meridian West	Zone Number	Zone Letter	Time compared to Greenwich (hours faster or slower: "f"=faster; "s"=slower)	Time compared to Washington (hours faster or slower: "f"=faster; "s"=slower)
		Degrees	Degrees				
Straits Settlements	Asia	112½		−7½		7½f	12½f.
Sudan (French West Africa)	Africa.						
Eastern part		0		0	Z	0	5f.
Western part			15	+1	N	1s	4f.
Sumatra Island	East Indies	105		−7	G	7f	12f.
Sumba Island	do	120		−8	H	8f	13f.
Sumbawa Island	do	120		−8	H	8f	13f.
Sweden	Europe	15		−1	A	1f	6f.
Switzerland [b]	do	15		−1	A	1f	6f.
Syria [b]	Asia	30		−2	B	2f	7f.
Tanganyika	Africa	45		−3	C	3f	8f.
Tangier	do	0		0	Z	0	5f.
Tanimbar Islands	East Indies	135		−9	I	9f	14f.
Tasmania Island [b]	South Pacific	150		−10	K	10f	15f.
Thaddeus Island	Arctic Ocean	150		−10	K	10f	15f.
Timor Island	East Indies	135		−9	I	9f	14f.
Timor Laut Island	do	135		−9	I	9f	14f.
Tobago Island	West Indies		60	+4	Q	4s	1f.
Togoland	Africa	0		0	Z	0	5f.
Tonga (Friendly) Islands	South Pacific					12 hr. 19 min. f	17 hr. 19 min. f
Transjordan [a]	Asia (38° E).						
Trinidad Island	West Indies		60	+4	Q	4s	1f.
Tuamotu (Low) Archipelago	South Pacific		150	+10	W	10s	5s.
Tunisia	Africa	15		−1	A	1f	6f.
Turkey [b]	Europe and Asia	30		−2	B	2f	7f.
Turks Island	West Indies		75	+5	R	5s	0.
Ubangi Shari	Africa	15		−1	A	1f	6f.
Uganda	do	45		−3	C	3f	8f.
Union of South Africa [b]	do	30		−2	B	2f	7f.

Country	General location	Standard meridian East	Standard meridian West	Zone Number	Zone Letter	Time compared to Greenwich	Time compared to Washington
United States of America [b]	North America.						
Eastern			75	+5	R	5s	0
Central			90	+6	S	6s	1s.
Mountain			105	+7	T	7s	2s.
Pacific			120	+8	U	8s	3s.
Alaska			150	+10	W	10s	5s.
Uruguay [b]	South America		60	+3		3s	2f.
U. S. S. R. [b]	Europe and Asia.						
Estonia, Karelo-Finnish, Latvia, Lithuania, Moldavia, Russia, Ukraine, White Russia.		30		−2	B	2f	7f.
Armenia, Azerbaijan, Georgia		45		−3	C	3f	8f.
Kazak, Tadzhik, Turkmen, Uzbek.		60		−4	D	4f	9f.
Kirghiz, W. Siberian Region		75		−5	E	5f	10f.
Approximately 82½° to 97½°		90		−6	F	6f	11f.
Buryat-Mongol, E. Siberian Region.		105		−7	G	7f	12f.
Approximately 112½° to 127½°		120		−8	H	8f	13f.
Kuril Islands, Sakhalin		135		−9	I	9f	14f.
Approximatey 142½° to 157½°		150		−10	K	10f	15f.
Approximately 157½° to 172½°		165		−11	L	11f	16f.
Approximately 172½° to coast		180		−12	M	12f	17f.
Vatican City [b]	Europe	15		−1	A	1f	6f.
Venezuela	South America		67½	+4½		4½s	½f.
Virgin Islands	West Indies		60	+4	Q	4s	1f.
Volcano Islands	Sea of Japan	135		−9	I	9f	14f.
Wake Island	North Pacific	180		−12	M	12f	17f.
Wales	British Isles	0		0	Z	0	5f.
Wrangell Island	Arctic Ocean	180		−12	M	12f	17f.
Yap Island	North Pacific	150		−10	K	10f	15f.
Yugoslavia	Europe	15		−1	A	1f	6f.
Zanzibar Island	Indian Ocean	45		−3	C	3f	8f.

[a] See Time Zone Chart of the World No. 5192, published by Hydrographic Office, Navy.
[b] Fast time in use during part of the year. See list under section V.
[c] No definite standard time used.

V. Summer, or Daylight Saving, Time

The use of summer, or daylight saving, time developed largely during the World War I. The plan was to advance the time in a certain area by a definite amount during the summer months to permit greater use of daylight hours. In the United States, Congress in the Act for Saving Daylight, passed in March 1918, advanced the time for all sections of the country 1 hour from the last Sunday in April to the last Sunday in September, the change being made at 2 a. m. when it would cause the least disturbance in schedules. This act was reenacted in October 1919 omitting the daylight saving clause, but some States and communities continued to use daylight saving time by local legislation. The use is by no means general and is entirely a matter of local legislation, having no effect on standard time or time zone boundaries.

Canada took similar action by the adoption of the Daylight Saving Act of 1918. This act lapsed after that year, but, as in the United States, certain sections still continue to use daylight saving time by local legislation. In Europe "summer time" was used by many countries, but the method and time of application varied greatly. Some countries have retained the summer time laws and still use advanced time for certain periods of the year.

The following is a list of countries recorded as making use of fast time during the summer months. Unless otherwise indicated, this "summer time" is usually 1 hour faster than the corresponding standard time, the exact dates being fixed annually.

Aden.
Albania.
Andora.
Argentina.
Australia.
Austria.
Azores Is.
Balleric Is.
Barbados Is.
Belgium.
Bermuda Is.
Borneo (North Borneo) and Sarawak.
British Honduras.
Canada.[a]
Canary Is.
Ceylon.
Chagos Arch.
Channel Is.
Chatham Is.
Chile.
Corsica I.
Crete I.
Cuba.[b]
Cypress I.
Denmark.
Dominican Republic.
Egypt.
Eire.
England.
Falkland Is.[c]
Fiji Is.
Finland.
France.
Germany.
Gibraltar.
Gold Coast.[d]
Great Britain.
Greece.
Guiana, French.[e]
Guinea, French.
Hungary.
Iceland.
India, British and French.
Indo-China.
Iraq.
Ireland, Northern.
Italy.
Japan.
Kamaran Is.
Kamchatka.
Kenya.
Labrador.[f]
Latvia.
Libya.
Lithuania.

[a] Used by local legislation in Nova Scotia, New Brunswick, Quebec, Ontario, and Saskatchewan, mostly in large cities.
[b] 1 hour fast from midnight first Saturday in June to first Saturday in September each year.
[c] 1 hour fast last Saturday in September to next to last Saturday in March.
[d] Jan. 1 to Aug. 31 each year, rest of year 00:20 fast.
[e] ½ hour fast, third Sunday in September to third Sunday in March.
[f] 1 hour fast midnight second Sunday in May to first Sunday in October.

Luxembourg.[g]
Malta I.
Mauritania.
Mexico.
Miquelon I.
Monaco.
Morocco.[h]
Netherlands.
Newfoundland.
New Zealand.
Northern Ireland.
Norway.
Pakistan.
Palestine.
Perim I.
Peru.
Portugal.[h]
San Marino.
Sao Thome I.
Sardinia I.
Senegal.
Sicily I.
Spain.[h]
St. Pierre I.
Switzerland.
Syria.
Tasmania.
Turkey.
Uganda.
Union of South Africa.
United States of America.[i]
Uruguay.
USSR.[j]
Vatican City.

[g] 1 hour fast April to October, dates fixed annually.
[h] 1 hour or 2 hours fast, fixed annually.
[i] Local legislation only, fixed each year.
[j] 1 hour fast the year round.

VI. Selected References

The following list is intended to give the reader sources of general and specific information on standard time. The indexes of the publications named give specific references to the subject. Where no date is given, the reference listed is of frequent, usually annual, issue. The latest issues should be called for in revising information given in this Circular.

British Astronomical Association (London) Journal.
Bureau des Longitudes (France) Annuaire.
Bureau of Foreign and Domestic Commerce (Washington).
    Geographic News Bulletins.
Bureau of International Telecommunication Union (Berne).
    Stations performing special services.
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    Title 49, Part 139.
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    An act for saving daylight Mar. 19, 1918. Chapter 24, paragraphs 1–5, 40 Stat.
    Reenactment of above act omitting the daylight saving clause Aug. 20, 1919. Chapter 51, 41 Stat. 280.
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    Corrections for Radio Stations WWV and WWVH.
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Time Zone Map of the World.
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Present Status of Standard Time, vol. IV, appendix IV, 1905
Corrections to Naval Observatory Time Signals.
World Almanac and Book of Facts.
Published annually by New York World-Herald.

WASHINGTON, December 20, 1949

O

bobbemer

From: "j" <jimhum1@att.net>
To: <bob@bobbemer.com>
Sent: Sunday, November 11, 2001 8:28 PM
Subject: This and That

Here are just a few comments of my history in the computer industry. I think you and I met at one time, but I can't imagine just when that might have been. Many of the names you mention on the Web Site are people I either knew of, knew, met, or worked with. Fletcher Jones was at Chance Vought in Dallas in the early 50s when I was there. I didn't know him well, and have always wondered if the CSC Fletcher was really the same Fletcher. I never met him after he moved to Calif.

We had a CPC at Chance Vought, then a 650. I tell people I did data reduction for missile test firings, production control for jet airplanes, and wrote 10,000 pay checks a week, and we had 56 characters of memory. (At least that's what I remember the 604 had.) I tell people, "It ain't what you got, it's what you do with it."

I worked for RAND in the mid 50s. While my travel orders and plane tickets said Dr. Humberd, and the first formal computer class I taught at RAND had 17 Phds as students, my two years of High School was enough to get me by!!

I remember going to Lockheed to get data for a project at RAND, and met Tony Fokker, the son of the man who designed the Fokker-Wolfe airplane. I remember going to UCLA and "almost" did something with the SWAC, and spent several weeks at MIT and the Whirlwind, learning about SAGE. They took away our pencils and paper, and had guards at the door to make sure we didn't steal any secrets. What little we might have written would have looked so silly, they wanted to save us the embarrassment. Can you imagine, they thought we could remember something about an AN/FSQ-7, that filled a four story building. While the whole thing was still secret, they gave us a copy of Colliers Magazine with an article that told more than any one was to know about SAGE. I do have a Xerox of that article.

The most important and most fun part of the years in the Computer business was the three weeks I had to learn the RCA 110-A Saturn Ground Control System, create the training course, then go to Huntsville and teach NASA and Boeing how to do it. The computer didn't exist, so I had to read blueprints to get some answers. I also did nearly the same for the RCA 4102, the Atlantic Range Picket Ship computer. Since everyone got to the moon and back, I figure that I did my job correctly (with 100,000 people helping me of course).

The stupid part is that I didn't bother to keep copies of many of the manuals and things I worked on, but I do have the original ditto copy of the 110-A training manual. It was hidden in the bottom of a box in the attic, so the ditto didn't fade. Now it makes about as much sense to me as the Income Tax instruction booklet.

I didn't mean to run on and on, my friends have long ago learned not to start a conversation about old computers or travel in Europe. Come to think of it, you did neither!!

Did I mention Travel in Europe. I guess you will have to visit my Web Site,

http://www.InvitationToTravel.com

to see what I would talk about if I didn't have the Web Site to send you to.

If more of this computer drivel might be of interest to anyone you know, let me know. I did work on a lot of interesting computer projects.

You list your travels: Well I didn't keep records that well, but it seems I flew 1200 to 1400 times, to 70 airports in 37 states, rented 700 cars, and spent 800 to 1000 nights in hotels. That travel continued in private life. In addition to nearly 1,000 nights in Europe, during a recent cruise to celebrate our 50th, when we arrived at a "new" port, that was port number 124 we have touched by ferry or cruise ship, on about 50 major islands and/or countries on 5 Continents. One of the early ports was Singapore where I spent my 18th birthday on a troop ship on my way from Manila to Calcutta.

enough, enough!!!

Jim Humberd

From: D DONALD E FREEMAN <BNQL77A@prodigy.com>
To: bbemer@bmrsoftware.com <bbemer@bmrsoftware.com>
Date: Tuesday, May 25, 1999 2:54 PM
Subject: LMSD

Hi Bob,
Saw your photo and references in Time 1/18/99, which tickled a few memory cells. You may or may not remember me (Don Freeman), but I was a budding math major out of UCLA and it was you who hired me as a programmer ($2.10/hour) into your computer group (or was it Bernie Rudin....no matter you were the chief). You guys gave me a beat up old metal desk, a IBM 650 manual, and soon after the engineers were coming over for me and others like me to help solve their engineering problems. I was programming them in machine language (Load distributor), or in FLAIR which if my memory is correct, you wrote.
Then you turned me lose on the 701 doing the same thing, only in FLOP. Remember that one card bootstrap loader? Copy left, copy right,k etc.

Anyway Bob, you and your group there started me on a carrer in computing which ended about 10 years ago when I retired from IBM, I want to thank you for having faith in me in those days. Some of the guys in the bull pen were Chuck Wimberly, and his cousin, Ray Cianci, Dick Talmadge, Ben ???,
Dick (The optomitrist), I am coming up blank on some of these names. You probably remember them.
Las I heard from Bernie Rudin he was managing the IBM Scientific Center in LA. That was 12-15 myears ago.

Glad to see you are still active in computing. I just retruned from several months in Ecuador and my assessment of their Y2K readiness is that the banks are probably in fairly good shape. Many have converted from NCR several years back. Large companies/industries are strugglingj, and the government.....that is an open switch.

Best of luck in your efforts, Bob.

Regards, Don Freeman
BNQL77A@PRODIGY.COM
....

bobbemer

From: <ecrosby@iupui.edu>
To: <bob@bobbemer.com>
Sent: Saturday, July 21, 2001 11:19 AM
Subject: fan mail

Found your site entirely by accident and thought I'd send a note saying that I'm tickled pink to know about you. My computer education did include some historical stuff, because one of my profs used to lunch with Eckert or Mauchly, but we sure didn't learn about everyone. Now, of course, the students I teach don't know anybody before Ted Nelson.

Anyhow, thanks a bunch for inventing ASCII. In 1979 I was anti-computer just on general principles, but by 1980 I was hooked! Library work, which is what I do mostly, is greatly improved by automation, despite the Nicholson Bakers of the world.

Ellen Crosby

bobbemer

From: "Terry" <terry@ritchie.com>
To: <bob@bobbemer.com>
Sent: Friday, July 20, 2001 10:29 AM
Subject: Thanks!

Hello,

Just wanted to send you a quick note to say thanks for helping to shape computers into what they are today.

The ASCII set is pure genius.

Thanks again,

Terry Ritchie

PURCHASE ORDER

TO:

BOB BEMBER SOFTWARE, INC.
Attn: BOB BEMER
3267 LA VILLA ROAD
GRAFORD TX , 76449
Tel: (940) 799-4016
Fax:

ORDER NO. 781-2-00042
DATE: 09/01/2001

SHIP TO

ATTN: ELTON DARITY
TX HIGHER EDUC. COORDINATING BOARD
1200 E. ANDERSON LANE, RM. 1.116
AUSTIN TX 78752

AGENCY

TEXAS HIGHER EDUC. COORDINATING BOARD
P.O. BOX 12788
AUSTIN, TEXAS 78711

Item No.	Class & Item	Description	Quantity and Unit	Unit Price	Extension
1	ANNUAL APPLICATION SOFTWARE LEASE FOR "SCREEN ENVIRONMENT" SOFTWARE. SEPTEMBER 01, 2001 THROUGH AUGUST 31, 2002. SCREEN ENVIRONMENT SOFTWARE FEATURES: 1. MUST OPERATE ON BULL DPS 9000/552-1 DATA CENTER COMPUTER MAINFRAME SYSTEM. 2. OPERATES ON ANY INTELLIGENT ASYNCHRONOUS WORKSTATION IN (CHAR) MODE OR SYNCHRONOUS WORKSTATION IN (TEXT) MODE. 3. OPERATES ON BOTH PC (MSDOS) AND HOST COOPERATIVELY. 4. WINDOWING UP TO EIGHT FILES CONCURRENTLY WITH FULL VERTICAL AND HORIZONTAL WINDOW MOVEMENT WHERE EACH WINDOW REMEMBERS IT'S OWN SETTINGS AND WINDOW SIZES ARE ADJUSTABLE IN NUMBER OF LINES AND COLUMNS. 5. FUNCTIONALLY TO INCLUDE OVER WRITES, WORD PROCESSING STYLE, NO LINE LENGTH LIMITS, AND NO EFFECTIVE LIMIT ON INPUT BUFFER LENGTH. 6. MUST RECOGNIZE FILES WHETHER THEY ARE DATA PROGRAMS OR DOCUMENTS. 7. AGENCY CONTACT: ELTON DARITY PHONE #: 512-427-6175 FAX #: 512-427-6179 EMAIL: ELTON.DARITY@THECB.STATE.TX.US 8. VENDOR CONTACT: BOB BEMER. PHONE #: 940-779-4016 EMAIL: BOB@BOBBEMER.COM		1 YR	$7,440.00	$7,440.00

SEP 1 0 2001

See reverse side for invoicing instructions and other important contractual provisions

STATE SALES TAX EXEMPTION CERTIFICATE: The undersigned claims an exemption from taxes under Chapter 20, Title 122A. Revised Civil Statutes of Texas, for purchase of tangible personal property described in this numbered order, purchased from contractor and/or shipper listed above, as this property is being secured for the exclusive use of the State of Texas.

Approved: Kenneth Dudley
Authorized Signature

ED PCC: K

I. INVOICING INSTRUCTIONS

To receive payment, vendors must submit an invoice to Business Services Accounts Payable, Texas Higher Education Coordinating Board (THECB).

THE INVOICE SHOULD INCLUDE BUT IS NOT LIMITED TO INCLUDING:

(1) invoice must be mailed to Business Services Accounts Payable, Texas Higher Education Coordinating Board, P.O. Box 12788, Austin, TX 78711

(2) the vendor's name, mailing and e-mail (if applicable) address must be in the same order as stated on the Purchase Order;

(3) the name and telephone number of a person designated by the vendor to answer questions regarding the invoice;

(4) the THECB name and delivery address;

(5) the THECB purchase order number;

(6) the contract number or other reference number, if applicable;

(7) a valid Texas identification number (TIN) issued by the Comptroller of Public Accounts;

(8) a description of each item for the goods or services listed on the purchase order in sufficient detail to identify the order that relates to the invoice. Item numbers must be shown to correspond with the item numbers of the purchase order;

(9) quantity delivered, unit and total price of each item must be shown and all prices extended on the invoice. All extensions on the invoice must be totaled and grand total shown;

(10) discounts, if applicable, must be stated, extended and deducted to arrive at a Net Total for the invoice;

(11) shipment date of merchandise must be shown on invoice;

(12) date of Purchase Order must be shown on invoice;

(13) other relevant information supporting and explaining the payment requested or identifying a successor organization to an original vendor, if necessary.

II. OTHER IMPORTANT CONTRACTUAL PROVISIONS

Dispute Resolution process: The dispute resolution process provided for in Chapter 2260 of the Government Code shall be used, as further described herein, by the Texas Higher Education Coordinating Board and the contractor to attempt to resolve any claim for breach of contract made by the contractor:

(1) A contractor's claims for breach of this contract that the parties cannot resolve in the ordinary course of business shall be submitted to the negotiation process provided in Chapter 2260, subchapter B, of the Government Code. To initiate the process, the contractor shall submit written notice, as required by subchapter B, to Kenneth Vickers, Assistant Commissioner for Administrative Services Divsion. Said notice shall specifically state that the provisions of Ch. 2260, subchapter B, are being invoked. A copy of the notice shall also be given to all other representatives of the Texas Higher Education Coordinating Board and the contractor otherwise entitled to the notice under the parties' contract. Compliance by the contractor with subchapter B is a condition precedent to the filing of a contested case proceeding under Chapter 2260, subchapter C, of the Government Code.

(2) The contested case process provided in Chapter 2260, subchapter C, of the Government Code is the contractor's sole and exclusive process for seeking a remedy for any and all alleged breaches of contract by the Texas Higher Education Coordinating Board if the parties are unable to resolve their disputes under subparagraph (A) of this paragraph.

(3) Compliance with contested case process provided in subchapter C is a condition precedent to seeking consent to sue from the Legislature under Chapter 107 of the Civil Practices and Remedies Code. Neither the execution of this contract by the Texas Higher Education Coordinating Board nor any other conduct of any representative of the Texas Higher Education Coordinating Board relating to the contract shall be considered a waiver of sovereign immunity to suit.

(4) The submission, processing and resolution of the contractor's claim is governed by the published rules adopted by the Texas Higher Education Coordinating Board pursuant to Ch. 2260 hereafter enacted or subsequently amended. These rules are found at 19 T.A.C. 1, when available.

(5) Neither the occurrence of an event nor the pendency of a claim constitute grounds for the suspension of performance by the contractor, in whole or in part.

Withholding of payment: Please note that, according to the Texas Government Code, Section 403.055 (h) any payments due under this contract will be applied towards any debt, including but not limited to delinquent taxes and child support that is owed to the State of Texas.

Material Safety Data Sheets: Vendor must provide, at no cost, at least one copy of any applicable Manufacturer's Material Safety Data Sheet(s) (MSDS) with each shipment during the term of the contract. If OSHA or Federal or State laws provide for additional requirements, those requirements are in addition to the MSDS requirement.

OSHA: All electrical items must meet all applicable OSHA standards and regulations, and bear the appropriate listed from ULL, FMRC, or NEMA.

TO:

BOB BEMBER SOFTWARE, INC.
Attn: BOB BEMER
3267 LA VILLA ROAD
GRAFORD TX , 76449
Tel: 9407994016
Fax:

ORDER NO. 781-2-00042

DATE: 09/01/2001

SHIP TO
ATTN: ELTON DARITY TX HIGHER EDUC. COORDINATING BOARD 1200 E. ANDERSON LANE, RM. 1.116 AUSTIN TX 78752

AGENCY

TEXAS HIGHER EDUC. COORDINATING BOARD
P.O. BOX 12788
AUSTIN, TEXAS 78711

Item No.	Class & Item	Description	Quantity and Unit	Unit Price	Extension
	9. THE ATTACHED THECB STANDARD CONTRACT PROVISIONS SHALL BE A PART OF THIS PURCHASE ORDER.				
	OTHER IMPORTANT CONTRACTUAL PROVISIONS ARE INCORPORATED ON REVERSE SIDE OF PAGE 1.				
		DELIVERY: 0 DAYS ARO			
		PURCHASE ORDER TOTAL			**$7,440.00**

TEXAS HIGHER EDUCATION COORDINATING BOARD
CONTRACT PROVISIONS
PO NO.: 781-2-00042
DATED: 09/01/2001

ADVANCED TECHNOLOGY CLAUSE
THE VENDOR EXPRESSLY ACKNOWLEDGES THAT STATE FUNDS MAY NOT BE EXPENDED IN CONNECTION WITH THE PURCHASE OF AN AUTOMATED INFORMATION SYSTEM UNLESS THAT SYSTEM MEETS CERTAIN STATUTORY REQUIREMENTS RELATING TO ACCESSIBILITY BY PERSONS WITH VISUAL IMPAIRMENTS. ACCORDINGLY, THE VENDOR REPRESENTS AND WARRANTS TO TEXAS HIGHER EDUCATION COORDINATING BOARD THAT THE TECHNOLOGY PROVIDED TO TEXAS HIGHER EDUCATION COORDINATING BOARD FOR PURCHASE IS CAPABLE, EITHER BY VIRTUE OF FEATURES INCLUDED WITHIN THE TECHNOLOGY OR BECAUSE IT IS READILY ADAPTABLE BY USE WITH OTHER TECHNOLOGY, OF:

PROVIDING EQUIVALENT ACCESS FOR EFFECTIVE USE BY BOTH VISUAL AND NON-VISUAL MEANS;
PRESENTING INFORMATION, INCLUDING PROMPTS USED FOR INTERACTIVE COMMUNICATIONS, IN FORMATS INTENDED FOR NON-VISUAL USE; AND BEING INTEGRATED INTO NETWORKS FOR OBTAINING, RETRIEVING, AND DISSEMINATING INFORMATION USED BY INDIVIDUALS WHO ARE NOT BLIND OR VISUALLY IMPAIRED.

FOR PURPOSES OF THIS PARAGRAPH, THE PHRASE "EQUIVALENT ACCESS" MEANS A SUBSTANTIALLY SIMILAR ABILITY TO COMMUNICATE WITH OR MAKE USE OF THE TECHNOLOGY, EITHER DIRECTLY BY FEATURES INCORPORATED WITHIN THE TECHNOLOGY OR BY OTHER REASONABLE MEANS SUCH AS ASSISTIVE DEVICES OR SERVICES WHICH WOULD CONSTITUTE REASONABLE ACCOMMODATIONS UNDER THE FEDERAL AMERICANS WITH DISABILITIES ACT OR SIMILAR STATE OR FEDERAL LAWS. EXAMPLES OF METHODS BY WHICH EQUIVALENT ACCESS MAY BE PROVIDED INCLUDE, BUT ARE NOT LIMITED TO, KEYBOARD ALTERNATIVES TO MOUSE COMMANDS AND OTHER MEANS OF NAVIGATING GRAPHICAL DISPLAYS, AND CUSTOMIZABLE DISPLAY APPEARANCE.

ASSIGNMENT OR SUBCONTRACTING. ASSIGNMENT OR SUBCONTRACTING. NO RIGHTS OR INTEREST IN THE CONTRACT SHALL BE ASSIGNED OR DELEGATION OF ANY OBLIGATION MADE BY VENDOR WITHOUT WRITTEN PERMISSION OF THE COORDINATING BOARD. ANY ATTEMPTED ASSIGNMENT OF DELEGATION BY VENDOR SHALL BE WHOLLY VOID AND TOTALLY INEFFECTIVE FOR ALL PURPOSES UNLESS MADE IN CONFORMITY WITH THIS PARAGRAPH. VENDOR SHALL NOT SUBCONTRACT WITH ANY THIRD PARTY FOR ANY OF THE SERVICES UNDER THIS CONTRACT UNLESS APPROVED IN WRITING BY THE CONTRACT MANAGER.

APPLICABLE LAW AND VENUE. THE CONTRACT AND ITS INCORPORATED DOCUMENTS SHALL BE GOVERNED BY AND CONSTRUED IN ACCORDANCE WITH THE LAWS OF THE STATE OF TEXAS. THE VENUE OF ANY SUIT BROUGHT CONCERNING THE CONTRACT OR ITS INCORPORATED DOCUMENTS IS FIXED IN ANY COURT OF COMPETENT JURISDICTION IN TRAVIS COUNTY, TEXAS, AND ALL PAYMENTS SHALL BE DUE AND PAYABLE IN TRAVIS COUNTY TEXAS.

COORDINATING BOARD RIGHT TO TERMINATE FOR CAUSE. COORDINATING BOARD MAY TERMINATE THIS CONTRACT, IN WHOLE OR IN PART, IMMEDIATELY UPON NOTICE TO VENDOR, OR AT SUCH LATER DATE AS COORDINATING BOARD MAY ESTABLISH IN SUCH NOTICE, UPON THE OCCURRENCE OF ANY MATERIAL BREACH OR DEFAULT CAUSES BY THE VENDOR.

IN THE EVENT COORDINATING BOARD MUST TERMINATE THIS CONTRACT AS A RESULT OF A MATERIAL BREACH OR DEFAULT BY THE VENDOR AND SUCH BREACH OR DEFAULT CAUSES OR CONTRIBUTES TO A LOSS BY COORDINATING BOARD, COORDINATING BOARD SHALL, IN ADDITION TO ITS RIGHT TO TERMINATE THIS CONTRACT, HAVE THE RIGHT TO SEEK AND OBTAIN LEGAL AND EQUITABLE RELIEF, INCLUDING THE RIGHT TO RECOVER DAMAGES FROM THE VENDOR. ALL REMEDIES DESCRIBED IN THIS CONTRACT SHALL BE DEEMED TO BE CUMULATIVE.

AMERICANS WITH DISABILITIES ACT. VENDOR SHALL COMPLY WITH AND CERTIFY COMPLIANCE WITH THE AMERICANS WITH DISABILITIES ACT IN ITS EMPLOYMENT, SERVICE DELIVERY AND BUSINESS OPERATIONS.

CHILD SUPPORT. UNDER SECTION 231.006 OF THE TEXAS FAMILY CODE, VENDOR CERTIFIES THAT THE BUSINESS ENTITY NAMED IN THIS AGREEMENT IS NOT INELIGIBLE TO RECEIVE THE SPECIFIED GRANT, LOAN, OR PAYMENT AND ACKNOWLEDGES THAT THIS AGREEMENT MAY BE TERMINATED AND PAYMENT

MAY BE WITHHELD IF THIS CERTIFICATION IS INACCURATE.

CANCELLATION. THIS CONTRACT CAN BE CANCELED BY EITHER PARTY, WITHOUT PENALTY, EITHER IN WHOLE OR IN PART, WITH 30 DAYS WRITTEN NOTICE OF INTENT TO DO SO.

APPROPRIATIONS. COORDINATING BOARD'S DUTIES, RESPONSIBILITIES, OBLIGATIONS, AND LIABILITIES ARE SUBJECT TO ADEQUATE LEGISLATIVE APPROPRIATIONS. COORDINATING BOARD SHALL NOT BE IN DEFAULT FOR NONPAYMENT UNDER THIS CONTRACT IF SUCH APPROPRIATED FUNDS ARE NOT AVAILABLE TO COORDINATING BOARD FOR PAYMENT OF COORDINATING BOARD'S OBLIGATIONS UNDER THIS CONTRACT IN SUCH EVENT, COORDINATING BOARD WILL PROMPTLY NOTIFY VENDOR, AND THE CONTRACT SHALL TERMINATE SIMULTANEOUS WITH THE TERMINATION OF THE APPROPRIATED FUNDS. UNDER NO CIRCUMSTANCES SHALL THIS CONTRACT OR ANY PROVISIONS HEREIN BE CONSTRUED TO EXTEND THE DUTIES, RESPONSIBILITIES, OBLIGATIONS, OR LIABILITIES OF THE STATE OF TEXAS OR COORDINATING BOARD BEYOND THE THEN EXISTING BIENNIUM.

APPLICABLE TAXES. THIS CONTRACT SHALL NOT BE CONSTRUED SO AS TO SUPERSEDE THE LAWS OF THE UNITED STATES OR THE STATE OF TEXAS THAT ACCORD THE STATE OF TEXAS, THE COORDINATING BOARD, AND ALL DEPARTMENTS, AGENCIES, AND INSTRUMENTALITIES OF THE STATE OF TEXAS EXEMPTIONS FROM THE PAYMENT (S) OF ALL TAXES OF WHATEVER KIND. MORE SPECIFICALLY, COORDINATING BOARD SHALL NOT DIRECTLY OR INDIRECTLY BE LIABLE FOR TAXES OF WHATEVER KIND. TO THE EXTENT ALLOWED BY LAW, COORDINATING BOARD SHALL PROVIDE, UPON THE REQUEST OF VENDOR, ALL APPLICABLE TAX EXEMPTION CERTIFICATES.

CHANGE IN LAW. IF FEDERAL OR STATE LAWS OR REGULATIONS OR OTHER FEDERAL OR STATE REQUIREMENTS ARE AMENDED OR JUDICIALLY INTERPRETED SO THAT EITHER PARTY CANNOT REASONABLY FULFILL THIS CONTRACT AND IF THE PARTIES CANNOT AGREE TO AN AMENDMENT THAT WOULD ENABLE SUBSTANTIAL CONTINUATION OF THE CONTRACT, THE PARTIES SHALL BE DISCHARGED FROM ANY FURTHER OBLIGATIONS UNDER THIS CONTRACT.

NO ACTIONS, SUITS, OR PROCEEDINGS. VENDOR WARRANTS THAT THERE ARE NO ACTIONS, SUITS, OR PROCEEDINGS, PENDING OR THREATENED, THAT WILL HAVE A MATERIAL ADVERSE EFFECT ON VENDOR'S ABILITY TO FULFILL ITS OBLIGATIONS UNDER THIS CONTRACT. VENDOR FURTHER WARRANTS THAT IT WILL NOTIFY COORDINATING BOARD IMMEDIATELY IF VENDOR BECOMES AWARE OF ANY ACTION, SUIT, OR PROCEEDING, PENDING OR THREATENED, THAT WILL HAVE A MATERIAL ADVERSE EFFECT OF VENDOR'S ABILITY TO FULFILL THE OBLIGATIONS UNDER THIS CONTRACT.

SOVEREIGN IMMUNITY. THE PARTIES STIPULATE AND AGREE THAT NO PROVISION OF, OR ANY PART OF THE CONTRACT BETWEEN THE COORDINATING BOARD AND VENDOR, SHALL BE CONSTRUED AS A WAIVER OF THE DOCTRINE OF SOVEREIGN IMMUNITY OR IMMUNITY FROM SUIT AS PROVIDED FOR IN THE TEXAS CONSTITUTION AND THE LAWS OF THE STATE OF TEXAS. THE PARTIES STIPULATE AND AGREE THAT NO PROVISION OF, OR ANY PART OF THE CONTRACT BETWEEN THE COORDINATING BOARD AND VENDOR, SHALL BE CONSTRUED TO EXTEND LIABILITY TO THE COORDINATING BOARD BEYOND SUCH LIABILITY PROVIDED FOR IN THE TEXAS CONSTITUTIONS AND THE LAWS OF THE STATE OF TEXAS. ADDITIONALLY, THE PARTIES STIPULATE AND AGREE THAT NO PROVISION OF, OR ANY PART OF THE CONTRACT BETWEEN THE COORDINATING BOARD AND VENDOR, SHALL BE CONSTRUED AS A WAIVER OF ANY IMMUNITY PROVIDED BY THE 11TH AMENDMENT OR ANY OTHER PROVISION OF THE UNITED STATES CONSTITUTION OR ANY IMMUNITY RECOGNIZED BY THE COURTS AND THE LAWS OF THE UNITED STATES.