TAPE REFERENCE MANUAL

"TEST REFERENCE TEAR"

INTRODUCTION

Efficient heating and cooling is largely dependent on building design and on the design of the heating and cooling system. Comparison of heating and air-conditioning systems in a locale requires a consideration of the effects of the weather. This weather information must be in great detail.

The American Society of Heating, Refrigerating, and Air-Conditioning Engineers, (ASHRAE) established a task group on energy requirements for heating and cooling large structures. Simultaneously, in the interest of energy conservation, the National Bureau of Standards(NBS) and the National Oceanic and Atmospheric Administration (NOAA) were attempting to develop climatological data packaging most useful for building design applications. Joining forces, the three groups established a working group to develop the concept of a Test Reference Year (TRY). TRY would consist of hourly weather data values for a selected reference year to be used by engineers in a given area to compare different heating and air-conditioning systems in the same building or in different buildings.

At the same time, the Federal Energy Administration (FEA)--as a member of the Steering Group on Climatic Conditions and Reference Year of the NATO Committee on Challenges of Modern Society--was also working on the problem. Consolidation of both efforts resulted in the development of a selection process for the Test Reference Year, an international format for presentation of the TRY data, and TRY calculations for 60 cities within the United States.

The ASHRAE approved procedure was chosen for selecting a Test Reference Year. The principle of selection is to eliminate years in the period of record containing months with extremely high or low mean temperatures until only one year remains. The period of record examined for 59 United States stations is 1948-1975. The 60th station, Portland, Oregon, has a period of record of 1949-1975.

Extreme months are arranged in order of importance for energy comparisons. Hot Julys and cold Januarys are assumed to be the most important. All months are ranked by alternating between the warm half (May to October) and the cold half (November to April) of the year, with the months closest to late July or late January given priority. The resulting order is given in the center column below. If, in addition, it is assumed that hot summer months or cold winter months are more important than cool summer or mild winter months then the order of extreme months will be down the first column below from "Hottest July" to "Coolest April" and then down the last column from "Coolest July" to "Warmest April".

Hottest	July	Coolest
Coldest	January	Mildest
Hottest	August	Coolest
Coldest	February	Mildest
Hottest	June	Coolest
Coldest	December	Mildest
Hottest	September	Coolest
Coldest	March	Mildest
Warmest	May	Coolest
Coolest	November	Warmest
Warmest	October	Coolest
Coolest	April	Warmest

The first step in the selection process is to mark all 24 extreme months. For the years remaining without any marked month, continue marking months starting with next-to-the-hottest July, then next-to-the-coldest January and so on down the first column and then down the second column above until only one year remains without any marked month. If two or more years remain without any marked months, the process is repeated with the third, fourth, etc. hottest or coldest extremes until only one year remains without any marked month. The remaining year is the Test Reference Year.

The weather in the test year is a standard for comparison of heating and cooling systems. It is not considered sufficiently typical to yield reliable estimates of average energy requirements over several years.

SOURCE

Weather observations, in support of aircraft operations, have been taken at airports since the earliest days of aviation. The rapid growth of the industry during the 1940's made it evident that some mechanical means of summarizing the data must be developed. How was a site to be selected or an airport designed without adequate statistical information on which to base decisions? The first efforts toward this end caused the WBAN No. 1 card to come into being. For archiving purposes these observations, mostly from military stations, were designated as Card Deck-141. The period of record is generally 1941-1944. A change of format necessitated a new card deck designation (Card Deck-142) to be instituted in 1945. This deck remained in force into 1948. During 1948 additional major changes were made in observing and recording practises. These led to the development of Card Deck-144. Although the usual beginning date of digital information in this form is June 1948 the changeover was made station by station on varying dates. Then too, some stations have had observations back-punched in this format to much earlier dates.

In the early 1960's the FAA undertook a major airport study. To facilitate the handling of large masses of data necessary for this effort the Climatological Services of the Weather Bureau, Air

Force and Navy along with the FAA devised the tape format. This format was called Tape Data Family-14 (TDF-14) to retain some continuity with the card decks. Within this family of similar observations there are several Tape Decks - each one uniquely identified at the beginning of each physical record on tape.

QUALITY CONTROL AND CONVERSIONS

All observations have been subjected to some form of quality control. During the earlier years this was almost entirely a manual effort. As more sophisticated techniques of processing were introduced the quality control procedures were also improved. Today, the quality control effort is a blend of several computer programs and manual review. Observations are checked for conformance to established observing and coding practises, for internal consistency, for serial, or time oriented consistency, and against defined limits for various meteorological parameters.

The archiving of long term climatological information presents an almost constant dilemma to the archivist, systems analyst and programmer. Refinements of observational instruments, new techniques, changes in user needs and other factors combine to keep the incoming data in an almost perpetual state of change. In some instances the changes are of such significance that individual fields in the tape format must be redefined and the ultimate user must adapt this new information to his needs.

At other times the changes may be of such a nature that they can be incorporated into the existing format by converting units or other measurements. For example, wind speeds were recorded and punched in miles per hour through 1955 and in knots thereafter. All wind speeds on the tape file are in knots, the earlier period having been converted from mph.

Each selected TRY was re-subjected to the computer and hand edit routines, updates being made as necessary.

Some additional conversions were done for the TRY tapes. For the period prior to 1964 wind directions were reported and recorded to 16 points of the compass. These values have been converted to whole degrees. The conversion method used is explained under Tape Field 005. The user is cautioned that for these years wind directions will be biased. Beginning with 1964 wind directions were recorded to whole degrees and these values will appear on the Try tapes if the selected year occurs during this period.

USE OF THE MANUAL

This manual was designed so that recourse to additional reference material should be unnecessary. Occasionally, however the user may wish to obtain copies of original reference manuals or other information. This may be done by writing to the Director, National Climatic Center, Asheville, NC 28801.

Care should be taken to read carefully the general tape notations and coding practises.

MANUAL AND TAPE NOTATIONS

FORMAT

Each logical record (observation) is 80 bytes long. Archive files are blocked 24 logical records (1920 bytes) per physical tape record. Tapes may be ordered with different blocking factors at no additional cost.

The initial file contains TRY data for 60 stations, 20 stations on each reel of tape. An inventory showing stations and selected years is included in this manual.

The manual presents a graphical representation of the tape format indicating Tape Fields, Tape Positions and Element Definition followed by detailed information for each field.

MANUAL AND TAPE

x = any numeric or alphanumeric character

\- = an "11" or zone punch

Δ = blank

NOTE: Missing fields are 9 filled.

SPECIAL NOTE

Space has been designated for the inclusion of Solar Radiation values. At the present time this Tape Field will contain 9's.

At the conclusion of the Solar Radiation rehabilitation project it is expected that these data will be added to the TRY tapes. Enen at that time, however, only a small percentage of the stations will have the Solar Radiation data available.

INVENTORY

WBAN NUMBER	STATION	SELECTED TRY
(Tape 1)		
03927	Fort Worth, TX	1975
03937	Lake Charles, LA	1966
03940	Jackson, MS	1964
12839	Miami, FL	1964
12842	Tampa, FL	1953
12916	New Orleans, LA	1958
12918	Houston, TX	1966
12919	Brownsville, TX	1955
12921	San Antonio, TX	1960
13722	Raleigh, NC	1965
13737	Norfolk, VA	1951
13739	Philadelphia, PA	1969
13740	Richmond, VA	1969
13743	Washington, DC	1957
13874	Atlanta, GA	1975
13876	Birmingham, AL	1965
13880	Charleston, SC	1955
13889	Jacksonville, FL	1965
13893	Memphis, TN	1964
13897	Nashville, TN	1972
(Tape 2)		
13967	Oklahoma City, OK	1951
13968	Tulsa, OK	1973
13983	Columbia, MO	1968
13985	Dodge City, KS	1971
13988	Kansas City, MO	1968
13994	St. Louis, MO	1972
14732	New York, NY	1951
14733	Buffalo, NY	1974
14735	Albany, NY	1969
14739	Boston, MA	1969
14742	Burlington, VT	1966
14764	Portland, ME	1965
14819	Chicago, IL	1974
14820	Cleveland, OH	1969
14837	Madison, WI	1974
14922	Minneapolis, MN	1970
14942	Omaha, NE	1966
23042	Lubbock, TX	1955
23044	El Paso, TX	1967
23047	Amarillo, TX	1968

WBAN NUMBER	STATION	SELECTED TRY
(Tape 3)		
23050	Albuquerque, NM	1959
23174	Los Angeles, CA	1973
23183	Phoenix, AZ	1951
23188	San Diego, CA	1974
23232	Sacramento, CA	1962
23234	San Francisco, CA	1974
24011	Bismarck, ND	1970
24018	Cheyene, WY	1974
24127	Salt Lake City, UT	1948
24131	Boise, ID	1966
24143	Great Falls, MT	1956
24225	Medford, OR	1966
24229	Portland, OR	1960
24233	Seattle-Tacoma, WA	1960
93193	Fresno, CA	1951
93814	Cincinnati, OH	1957
93819	Indianapolis, IN	1972
93821	Louisville, KY	1972
94823	Pittsburgh, PA	1957
94847	Detroit, MI	1968

	STATN NO.	DRY BLB	WET BLB	DEW PT	WIND DIR	WIND SPD	STAT PRES	W X	TOT AMT	CLOUDS LAYER 1 AMT	LAYER 1 TYP	LAYER 1 HGT	LAYER 2 AMT	LAYER 2 TYP	LAYER 2 HGT	LAYER 2 SUM	LAYER 3 AMT	LAYER 3 TYP	LAYER 3 HGT	LAYER 3 SUM	LAYER 4 AMT	LAYER 4 TYP	LAYER 4 HGT
	XXXXX	XXX	XXX	XXX	XXX	XXX	XXXX	X	XX	XX	X	XXX	XX	X	XXX	XX	XX	X	XXX	XX	XX	X	XXX
FIELD NUMBER	001	002	003	004	005	006	007	008	009	010	011	012	013	014	015	016	017	018	019	020	021	022	023

	SLR RAD	BLANK	YEAR	MO	DY	HR	BLNK
	XXXX	XXXXXXXXXX	XXXX	XX	XX	XX	X
FIELD NUMBER	024	025	026	027	028	029	030

TAPE FIELD NUMBER	TAPE POSITIONS	ELEMENT
001	01 - 05	STATION NUMBER
002	06 - 08	DRY BULB TEMPERATURE
003	09 - 11	WET BULB TEMPERATURE
004	12 - 14	DEW POINT TEMPERATURE
005	15 - 17	WIND DIRECTION
006	18 - 20	WIND SPEED
007	21 - 24	STATION PRESSURE
008	25	WEATHER
009	26 - 27	TOTAL SKY COVER
010	28 - 29	AMOUNT OF LOWEST CLOUD LAYER
011	30	TYPE OF LOWEST CLOUD OR OBSCURING PHENOMENA
012	31 - 33	HEIGHT OF BASE OF LOWEST LAYER
013	34 - 35	AMOUNT OF SECOND CLOUD LAYER
014	36	TYPE OF CLOUD - SECOND LAYER
015	37 - 39	HEIGHT OF BASE OF SECOND LAYER
016	40 - 41	SUMMATION AMOUNT OF FIRST TWO LAYERS
017	42 - 43	AMOUNT OF THIRD CLOUD LAYER
018	44	TYPE OF CLOUD - THIRD LAYER
019	45 - 47	HEIGHT OF BASE OF THIRD LAYER
020	48 - 49	SUMMATION AMOUNT OF FIRST THREE LAYERS
021	50 - 51	AMOUNT OF FOURTH CLOUD LAYER
022	52	TYPE OF CLOUD - FOURTH LAYER
023	53 - 55	HEIGHT OF BASE OF FOURTH LAYER
024	56 - 59	SOLAR RADIATION
025	60 - 69	BLANK
026	70 - 73	YEAR
027	74 - 75	MONTH
028	76 - 77	DAY
029	78 - 79	HOUR
030	80	BLANK

TAPE FIELD NUMBER	TAPE POSITIONS	ELEMENT	TAPE CONFIGURATION	CODE DEFINITIONS AND REMARKS
001	01 - 05	STATION NUMBER	01001 - 98999	Unique number used to identify each station. Usually a WBAN number but occasionally a WMO or other number system.
002 003 004	06 - 08 09 - 11 12 - 14	DRY BULB TEMPERATURE WET BULB TEMPERATURE DEW POINT TEMPERATURE	000 - 140 -01 - -80 999	Specified temperature in whole degrees Fahrenheit. 000-140 = 0° - +140°F -01--80 = -1° - -80°F 999 = Missing
005	15 - 17	WIND DIRECTION	000 - 360 999	Direction from which the wind is blowing in whole degrees. 000 = Calm 001-360 = 001°-360° 999 = Missing Note: Prior to 1964 direction was recorded to only 16 intervals (points of the compass). The following scheme was used to convert these values to whole degrees. TAPE ORIGINAL CODE 000 = Calm 360 = North 023 = North Northeast 045 = Northeast 068 = East Northeast 090 = East 113 = East Southeast 135 = Southeast 158 = South Southeast 180 = South 203 = South Southwest 225 = Southwest 248 = West Southwest 270 = West 293 = West Northwest 315 = Northwest 338 = North Northwest
006	18 - 20	WIND SPEED	000 - 230 999	Wind speed in whole knots. 000 = Calm 001-230 = 1-230 knots 999 = Missing
007	21 - 24	STATION PRESSURE	1900 - 3999 9999	Pressure at station in inches and hundredths of Hg. 1900-3999 = 19.00- 39.99 in Hg. 9999 = Missing

TAPE FIELD NUMBER	TAPE POSITIONS	ELEMENT	TAPE CONFIGURATION	CODE DEFINITIONS AND REMARKS
008	25	WEATHER	0 - 9	Occurrence of weather at the time of observation. 0 = No weather or obstructions to vision. 1 = Fog 2 = Haze 3 = Smoke 4 = Haze and smoke 5 = Thunderstorm 6 = Tornado 7 = Liquid precipitation (rain, rain showers, freezing rain, drizzle, freezing drizzle) 8 = Frozen precipitation (snow, snow showers, snow pellets, snow grains, sleet, ice pellets, hail) 9 = Blowing dust, blowing sand, blowing spray, dust Note: Original observations may contain combinations of these elements. Whenever this occurred a priority was assigned for the purpose of indicating weather in this Tape Deck. (1) - Liquid precip -7 (2) - Frozen precip -8 (3) - Obstructions to vision - 1, 2, 3, 4, 9 (4) - Thunderstorm (no precip) - 5 (5) - Tornado (no precip) - 6
009	26 - 27	TOTAL SKY COVER	00 - 10 99	Amount of the celestial dome covered by clouds or obscuring phenomena in tenths. 00-10 = 0-10 tenths 99 = Missing
010	28 - 29	AMOUNT OF LOWEST CLOUD LAYER		
013	34 - 35	AMOUNT OF SECOND CLOUD LAYER		
016	40 - 41	SUMMATION OF FIRST TWO LAYERS		
017	42 - 43	AMOUNT OF THIRD CLOUD LAYER		
020	48 - 49	SUMMATION OF FIRST THREE LAYERS		
021	50 - 51	AMOUNT OF FOURTH CLOUD LAYER		

TAPE FORMAT DOCUMENTATION

TAPE DECK		PAGE NO.
9706	TEST REFERENCE YEAR (TRY)	4

TAPE FIELD NUMBER	TAPE POSITIONS	ELEMENT	TAPE CONFIGURATION	CODE DEFINITIONS AND REMARKS
011	30	TYPE OF LOWEST CLOUD OR OBSCURING PHENOMENA	0 - 9	Generic cloud type or obscuring phenomena. 0 = Clear 1 = Fog or other obscuring phenomena 2 = Stratus or Fractus Stratus 3 = Stratocumulus 4 = Cumulus or Cumulus Fractus 5 = Cumulonimbus or Mammatus 6 = Altostratus or Nimbostratus 7 = Altocumulus 8 = Cirrus 9 = Cirrostratus or Cirrocumulus 9 = Unknown if the amount of cloud is 99
014	36	TYPE OF CLOUD - SECOND LAYER		
018	44	TYPE OF CLOUD - THIRD LAYER		
022	52	TYPE OF CLOUD - FOURTH LAYER		
012	31 - 33	HEIGHT OF BASE OF LOWEST LAYER	000 - 760 777 888 999	Height of base of clouds or obscurring phenomena in hundreds of feet. 000-760 = 0-76,000 feet 777 = Unlimited - clear 888 = Cirroform clouds of unknown height 999 = Missing
015	37 - 39	HEIGHT OF BASE OF SECOND LAYER		
019	45 - 47	HEIGHT OF BASE OF THIRD LAYER		
023	53 - 55	HEIGHT OF BASE OF FOURTH LAYER		
024	56 - 59	SOLAR RADIATION	0000 - 1999 9999	Total solar radiation in Langleys to tenths. Values are for the hour ending at time indicated in Field 029. 0000-1999 = 0-199.9 Langleys 9999 = Missing
025	60 - 69	BLANK	ΔΔΔΔΔΔΔΔΔΔ	Blank field - reserved for future use.
026	70 - 73	YEAR	1948 - 1980	Year
027	74 - 75	MONTH	01 - 12	Month of year 01 = Jan 02 = Feb etc.
028	76 - 77	DAY	01 - 31	Day of month
029	78 - 79	HOUR	00 - 23	Hour of observation in Local Standard Time 00-23 = 0000-2300 LST
030	80	BLANK	Δ	Blank field - reserved for future use.