NOAA Technical Memorandum NWS WR-180

STANDARD HYDROLOGIC EXCHANGE FORMAT (SHEF) VERSION I

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STANDARD HYDROLOGIC EXCHANGE FORMAT (SHEF)

ABSTRACT:

The Standard Hydrologic Exchange Format (SHEF) is a standardized system of encoding hydrological data transmissions for both manual and automated processing. Features of SHEF include (a) it is readable by both man and machine, (b) a wide variety of parameters and data types are supported, (c) it has flexible time identification, (d) it uses either SI or English units, and (e) it allows flexible use of spaces and comments within the code text to enhance readability. The SHEF code is now being implemented widely in the United States and has demonstrated a broad base of appeal.

HISTORY OF THIS DOCUMENT:

The SHEF code has been built to a great extent on the foundation of twenty years of experience with the Columbia Basin Teletype (CBTT) code. In efforts to design a multiple-use data system for the Columbia River Operational Hydromet Management System (CROHMS), many requirements of data base structure and data descriptions became evident. A fair level of sophistication is required to handle data which may be telemetered or manually observed, screened or unverified, forecasted, flagged for particular purposes, evenly- or randomly-spaced in time, English or Standard International (SI) units, local or Greenwich time, and so on.

An initial CROHMS data base design to meet many of these needs identified by the National Weather Service and the Corps of Engineers was implemented in 1976. Since that time, the need for further refinements has been seen. Concurrent design of a new data base structure and design of a corresponding external data transmission code were initiated in November 1980 by the National Weather Service (NWS) and Corps of Engineers for applications in the Pacific Northwest.

In November, 1981, and January, 1982, national meetings of NWS personnel resulted in an endorsement of the Standard Hydrologic Exchange Format for use on the AFOS (Automation of Field Operations and Services) system. AFOS is a nationwide network of minicomputers and telecommunications installed at approximately 200 NWS sites in the continental United States. The NWS commitment to use SHEF on AFOS provided the focus, the impetus, and the polishing to complete coordination and documentation.

A working draft of the code was prepared in early 1982, and NWS offices in several parts of the United States began participation in a "shakedown" of the code for use on AFOS. The "Standard Hydrologic Exchange Format (SHEF), Version I: Working Draft for Use in SHEF I Prototype Test" was finalized and about 300 copies distributed on November 18, 1982. These 300 copies were printed by the U.S. Army Corps of Engineers North Pacific Division. Also, software has been prepared by the NWS Missouri Basin River Forecast Center in Kansas City, Missouri, to decode the SHEF format data and post it into the DATACOL data base (Bonnin Cox, NOAA Technical Memorandum NWS CR-67, CR-68).

It has become evident that the version given distribution in November, 1982, should be included in some referenceable publication series. This document, therefore, provides that framework and what follows is an exact reproduction of the November 18, 1982 document.

For operational applications within the National Weather Service, the official SHEF code will be updated, maintained and published by NWS headquarters and referenced by WSOM Chapter E-11.

STANDARD HYDROLOGIC EXCHANGE FORMAT (SHEF)

VERSION I

WORKING DRAFT

FOR USE IN SHEF I PROTOTYPE TEST

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL WEATHER SERVICE
NORTHWEST RIVER FORECAST CENTER
PORTLAND, OREGON

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STANDARD HYDROLOGIC EXCHANGE FORMAT

(SHEF)

TABLE OF CONTENTS

I. INTRODUCTION

II. FUNCTIONAL FEATURES OF IDENTIFICATION AND TRANSMISSION OF HYDROLOGIC DATA

III. ELEMENTS OF DATA IDENTIFICATION

IV. ANALYSIS OF PARAMETRIC FIELDS IN SHEF MESSAGES

- A. Positional Fields
- B. Data String
- C. Parameter Control String
- D. Analysis of Elements Within the Data String
- E. Analysis of Elements Within the .B Format Body

V. RULES FOR CODING SHEF MESSAGES

- A. Missing Data Codes
- B. Trace Code for Precipitation Increment
- C. Changes in Observation Time
- D. Use of the Date Relative 'DRx' Character Code
- E. The Null Field
- F. Standard Record Lengths and Coding Continuation Lines
- G. Revision of a Missing Data Value
- H. Comment Field Definition Character
- I. Syntax Errors in SHEF Messages
- J. Repetition of Parameter Code with Same Date/Time Stamp
- K. Use of a Filler Character in the Parameter Code
- L. Coding the Ice Report 'IR'
- M. Coding the Snow Report 'SR'
- N. Coding SHEF Messages Involving Semi-Annual Time Changes

VI. CONCLUSION

VII. PLANNED ENHANCEMENTS

VIII. ACKNOWLEDGMENTS

IX. BIBLIOGRAPHY

STANDARD HYDROLOGIC EXCHANGE FORMAT
(SHEF)

List of Tables

1 - Physical Element Codes

2 - Send Codes

3 - Duration Codes

4 - Standard Parameter Code Default Keys and Exceptions

5 - Type and Source Codes

6 - Extrema Codes

7 - Probability Codes

8 - Time Zone Designators

9a - Date/Data Type Elements

9b - Date/Data Time Unit Definitions

10 - Data Qualifier Codes

11a - Duration Code Variable Specifier

11b - Duration Code Variable Specifier Units

12a - Time Interval Specifier for .E Format

12b - Time Interval Specifier Units

13a - Date Relative Code

13b - Date Relative Time Unit Definitions

14 - Ice Codes for Ice Report

15 - Snow Codes for Snow Report

16 - Frost Codes for Ground Frost Report

17 - Precipitation Type Codes

18 - State of Ground Code

19 - River Tendency Code

20 - Surface Frost Intensity

21 - Surface Dew Intensity

STANDARD HYDROLOGIC EXCHANGE FORMAT
(SHEF)

List of Figures

1 - .A Format Message (Generalized)

2 - .B Format Message (Generalized)

3 - .E Format Message (Generalized)

4 - .A Format Message Examples

5 - .B Format Message Examples

6 - .E Format Message Examples

Appendices

A - NWS Synoptic Codes for Present Weather

B - NWS Synoptic Codes for Past Weather

C - Terminology -- Ice Structure and Type, Structure of Frozen Ground

D - Daylight/Standard Time Change Dates (1976-2007)

STANDARD HYDROLOGIC EXCHANGE FORMAT (SHEF)

FORMAT SPECIFICATIONS

I. INTRODUCTION

Several SHEF formats may be used to build messages for data exchange. These message formats are:

1. '.A' Single station, multiple parameter
2. '.B' Multi-station, multiple parameter, header driven
3. '.E' Single station, single parameter, evenly-spaced time series

Through the use of Parameter Code (PC) characters to identify the data, these three basic message formats have the flexibility to transmit a wide range of hydrologic information. The formats possess the following characteristics.

The .A format is designed for the transmission of one or more hydrologic parameters observed at various times for a single station. As shown in Figure 1, the .A format consists of Positional Fields and the Data String. The format works well for stations that report several different types of hydrologic data or report data with uneven time spacing. The .A format lines may be continued if required.

The .B format is designed for the transmission of one or more hydrologic parameters from several stations for which many or all of the parameters are the same and are observed at corresponding times. As shown in Figure 2, the .B format consists of three basic parts -- the Header, Body and Terminator. The Header consists of the Positional Fields and the Parameter Control String. The Body contains station identifier(s) and data with optional date/data overrides. The Terminator ends the entire .B format message. The format lends itself exceptionally well to a routine morning roundup of precipitation and river data for a group of stations. The .B format Header provides all pertinent date/time and parameter code information needed to decode the data contained in the Body of the message. The order of the parameter list is completely flexible and may vary from message to message. The data values in the Body are associated with the order of the parameter codes supplied in the Header line. Any parameter that can be reported in a .A format can be reported in the .B format; however, if more than three stations are to be transmitted routinely, the .B format should be more convenient.

The .E format (E for <u>e</u>venly-spaced) is designed for the transmission of several values of a single hydrologic parameter at an evenly-spaced time interval for a single station. As shown in Figure 3, the .E format consists of Positional Fields and the Data String. This format is useful in the transmission of any evenly-spaced time series of observational, processed, or forecasted data (GOES platform data, for example). The .E format is very similar to the .A format in structure except for two minor differences. First, in order to avoid ambiguity, the .E format will accommodate only one hydrologic parameter while the .A can handle several. Second, the .E format requires the explicit specification of a time interval between data values.

II. FUNCTIONAL FEATURES OF IDENTIFICATION AND TRANSMISSION OF HYDROLOGIC DATA.

In order to transmit hydrologic data an external system of data identification is required. This system should have the following features:

A. Visually recognizable.
B. Provide internal identification to a database while minimizing or eliminating translation between external and internal database identification schemes for a wide variety of data.
C. Completely identify hydrologic data collected at nonstandard reporting times and nonstandard locations.
D. Allow for a 'minimum key' of 2 characters to identify most routine hydrologic parameters.
E. Transmit data using the 'enter' function on AFOS, eliminating manual intervention at other NWS AFOS offices.
F. Structure of the hydrologic code should be flexible enough to allow limited use for public (NOAA Weather Wire for example) messages to eliminate "public" and "coded" versions of the same information.

III. ELEMENTS OF DATA IDENTIFICATION.

Data identification systems vary widely from simple text for visual consumption to cryptic coding for computer use. The SHEF data identification system has been designed both for visual recognition as well as for automated handling. The fundamental elements of data identification in SHEF and the receiving database are:

(1) Station Identifier (or 'Location Identifier').

The station name is generally reduced to a unique ID using one of several methods. The National Weather Service in Communications Handbook No. 5, and the Federal Aviation Administration have established station ID's for a large number of stations in the United States. The SHEF format will accept from three to eight alphanumeric characters to support more exotic names for synthetic flow points, 'local' basins, flow 'balances', and other elements required for river modelling.

Different station identifiers should not be used to internally represent different types of data from the same reporting station. On the other hand, areal values such as mean basin precipitation above a flow point should be discriminated from point precipitation values by a separate station identifier since in the former case the 'station' is an area while the latter case refers to a true reporting station. In some areas of the country long-standing three-character identifiers are used to represent a dam or project. One naming convention is to add the state designator character(s) to the project identifier to identify a USGS station downstream of the project.

(2) Time.

In the SHEF messages, every data value is associated with a time of observation, thus permitting observations at non-standard times to be handled in a general way. For mean or period values, the observation time by convention would be the end of the period. For example, a mean daily flow for the 24-hour period ending at midnight would have an observation time of midnight ending that day. A Maximum instantaneous temperature for the 24-hour period ending at 12Z would have an observation time of 12Z ending that day.

The time at which a data value is created may also be carried in the SHEF messages. This allows one to associate a creation time with a particular data element value and, in the case of forecasted values, judge the applicability of the latest forecast available.

(3) Parameter Codes.

In the SHEF messages, different types of data are keyed by a seven-character parameter code PEDTSEP, broken down as follows:

PE = Physical Element (gage height, precipitation, etc...)
D = Duration Code (instantaneous, hourly, daily, etc...)
T = Type Code (observed, forecast, etc...)
S = Source Code (a further refinement of Type Code which may indicate how data was created or transmitted)
E = Extremum Code (maximum, minimum, etc...)
P = Probability Code (90%, 10%, etc...)

This parameter code, when fully specified, will contain six 'keys' for database identification. In order to reduce manual entry and communications requirements, standard defaults for each key (except PE) reduce identification of most hydrologic data to a 'minimum key' of two characters. The 'full key' is used primarily in the transmission of unique hydrologic data.

The descriptor characters have been selected to permit the greatest possible visual recognition for each key.

PE: Physical Element -- This is always specified by a two-character code. Typical physical elements are discharge, river stage, reservoir elevation, or precipitation increment as shown in Table 1. The first character of the code usually defines the basic category of the data while the second character provides additional detail. Certain characters within the table have special meaning. No physical element codes begin with 'D' since 'Dx' codes are reserved for date/data elements.

Send Codes: Some routinely transmitted hydrologic data require up to the full seven parameter code characters to identify the data. To facilitate manual entry for these data, several 2-character 'send codes' have been developed. The send codes are identified with an (S) in Table 1 and are listed separately in Table 2. The 2-character send codes are used only in the transmission of data and represent the 7-character expanded parameter codes for storage in a database. The send codes deal mainly with maxima and minima since the extremum 'E' is the sixth character in the parameter code PEDTSEP and would prove somewhat awkward to code routinely.

Vector Physical Elements: Certain physical elements such as temperature at various depths in the ground or in a reservoir are best described as a vector of information. These physical elements are identified with a (V) in Table 1 and are currently decoded as scalar quantities at an assumed location or value. A format for transmission of these physical elements will be developed later.

D: Duration -- The duration character combined with physical element (PE) describes the vast majority of observed hydrologic data. The most common period durations are listed in Table 3. In external transmission of data, default keys may be associated with most common 'PE' codes to create a 'minimum key' and reduce manual entry requirements. The default assignments and exceptions for several physical elements and parameter code keys are shown in Table 4. The duration code describes the period to which an observed or computed increment applies, such as mean discharge or precipitation increment. It does not define the period to which an extremum applies (which is included in the extremum code itself).

Duration Variable: A provision exists in the SHEF format for the explicit specification of non-standard durations, i.e. 2-monthly. The exact coding of the Duration Code Variable is addressed later in this document under "Analysis of Elements Within the Data String" (Section IV.D.5.).

T: Type -- The type character is used to describe the basic category of the hydrologic data being transmitted. These types include observed, forecast, processed, contingency and historical as shown in Table 5. Observed and forecast type codes are relatively self-explanatory. The processed type code is intended for non-forecast derived values from the observed database such as mean areal precipitation or mean areal temperature. In most applications, the processed parameters would not be used for external transmission of data. Contingency types deal with possible results gained for various hydrologic input scenarios. Historical values (such as peaks of record) are not normally sent via external transmission, but the code is designed to accommodate consistent descriptions of "live" and "historical" information in user databases.

S: Source -- The source character is a further refinement of the type code which may indicate how the hydrologic data was created or transmitted. The source code is always associated with a type code as shown in Table 5. The source codes are structured to allow one to distinguish multiply-automated data values transmitted over differing paths from a single sensor through use of the proper 2-character type/source combination. Several basic data paths have been assigned source characters to accomplish this identification. For retrieval of observed data from a database, if a user is not concerned with the specific data path but wants a 'best' value, the source codes allow a ranking of data such that RA would imply 'best', RB 'second best', etc. This would guarantee the user a data value independent of data path. Source code characters (A-D) are reserved for this purpose and are not used for external transmission of data.

E: Extremum -- This single-character descriptor allows identification of maxima and minima such as crest or minimum stages. As shown in Table 6, each extremum code carries an explicit definition of the period to which the extremum applies. Thus a daily minimum temperature would be coded TAIRZN and a maximum hourly mean discharge for a day would be coded as QRHRZX.

It should be noted that several commonly reported parameters, such as maximum and minimum temperatures, have been given 2-character 'send codes' in order to reduce manual entry and data transmission requirements.

P: Probability -- The probability character descriptor is a key element in identifying both input and products of forecast procedures. Probability descriptors are listed in Table 7. An example would be designation of probable maximum (90%) and probable minimum (10%) water supply volume forecasts. Probability can also be used to describe the expected range of crest stage for spring snowmelt.

IV. ANALYSIS OF PARAMETRIC FIELDS IN SHEF MESSAGES

The following is a rigorous examination of the component fields that comprise the SHEF messages. In order to examine the SHEF messages each field has been given a name as shown in Figures 1, 2, and 3. Several of the fields are optional and are appropriately marked. The use of the caret '^' denotes the need for at least 1 mandatory blank field. The lower case characters identify fields that will be replaced by numbers or characters when actual data is transmitted. The upper case characters are keys to the decode program and are coded in the actual data transmission.

A. Positional Fields (Figures 1, 2, and 3)

1. <u>Format Specifier:</u> '.A, .B, .E' Formats (mandatory)

'.' Dot in Column 1.....
- Triggers computer decoding process
- Distinguishes text lines from SHEF coded data (text lines outside SHEF messages are passed and not decoded).

'A', 'B', or 'E' in Column 2.....
- .A, .B, or .E for original data transmission
- .AR, .BR, or .ER on the first line of a revised data transmission. Subsequent continuation lines do not require the 'R' to be explicitly specified. When using the .ER format, only the corresponding data values are replaced in the database.

- .A1, .A2, .E1, .E2, etc., for the continuation of data strings (.B data element strings may not be continued).
- .B1, .B2, etc., for the continuation of a .B format header line.

2. Station ID: 'ssss' .A, .B, .E Formats (mandatory)

- Station ID length (3-8 characters)
- Station ID characters permitted (A-Z) (Ø-9)
- Station ID field must be delimited by a leading and trailing blank in the .A and .E Formats
- Data from NWS stations will be coordinated 5-character NWS ID's from NWS Communications Handbook No. 5
- Non-Weather Service stations with well-established station ID's can be used as long as no ambiguity results in station identification with the RFC-coordinated area of responsibility.
- "Stranger stations" (stations without established ID's not in the regular reporting network) will be transmitted by a 'W', 'X', 'Y' or 'Z' followed by 7 digits containing a 3-digit latitude and 4-digit longitude to the nearest tenth of a degree. The characters represent the following latitudes and longitudes:

Code	
W	South Latitude, West Longitude
X	North Latitude, West Longitude (includes North America)
Y	North Latitude, East Longitude
Z	South Latitude, East Longitude

For example, 'X3Ø8Ø995' would translate to latitude 30.8 degrees north and 99.5 degrees west. The plain language name of the station may be transmitted following the data and after the colon ':' comment delimiter.

3. Message Sources: 'msgsource' .B Format (mandatory)

- This is the office/agency which is the source of the .B Format message
- Msgsource name length (3-8 characters)
- Msgsource characters permitted (A-Z) (Ø-9)
- NWS originating offices will be 3-character station ID's
- Msgsource field must be delimited by a leading and trailing blank

4. Date: 'yymmdd' ('yy' optional; 'mmdd' mandatory) -- All Formats

yy - Year 2 digits (ØØ-99) - optional. When not explicitly coded, a 6-month window is used to assign year that causes the data code to be nearest the current date. For example, if the current date is January 11, 1982, and revised data was entered for month/day DM1212 (December 12) without a year explicitly specified, the date/time stamp of the data would be December 12, 1981.

Caution -- outside the 6-month centered default window, a year other than the default year must be explicitly specified.
- One must also exercise caution when choosing not to explicitly code year in SHEF messages. If these messages are archived in raw form, header records must be added in the archive function to make future determination of correct year possible for retrieval software.

mm - Month, 2 digits (Ø1-12) - mandatory.
dd - Day, 2 digits (Ø1-31) - mandatory.
- Date must be delimited by a leading and trailing blank.
- Date can be redefined within data string by the observation time element.

5. <u>Time Zone</u>:

- Time Zone is an optional field; the default is Zulu (GMT) time.
- Time Zone must be delimited by a leading and trailing blank.
- Time Zone character codes are defined in Table 8.
- Coding a single character local time zone requires the decoding program to determine proper database storage. Appendix D contains the daylight/standard change dates for years 1976-2007.
- Areas which do not follow time change conventions must use 2-character time codes.
- 'tz' can not be redefined within data string.

B. Data String: (.A and .E Formats, Figures 1 and 3)

1. <u>Basic Concepts</u>:

- The Data String must be separated from the Positional Fields by a blank and terminated by a carriage return or colon ':'.
- Within the .A or .E Data String, Observation Time, Creation Date, Units Code, Data String Qualifier, Duration Code Variable, and Time Interval (.E only) apply only to all subsequent data value elements on that line or its continuation.
- Within the .A Data String, the following parameters may be specified or respecified: Observation Time, Creation Date, Units Code, Data String Qualifier, Duration Code Variable, and Parameter Code.
- Within the .E Data String, the following parameters may be specified or respecified: Observation Time, Creation Date, Units Code, Data String Qualifier, Duration Code Variable, and Time Interval. Parameter Code may not be respecified in the .E format message in order to avoid confusion in the assignment of Parameter Code, Time and Value(s).
- All elements within the Data String must be separated by a single slash '/'.
- In order to preserve readability, an individual Data String Data Element cannot be split between continuation lines.

2. <u>Use of 'D' Date/Data Type Codes:</u>

- As shown in Table 1, the 'Dx' character combinations are not allowed for physical elements. These are reserved for the Date/Data type codes. The Date/Data type elements are given in Tables 9a and 9b.

C. Parameter Control String: (.B Format Header, Figure 2)

1. <u>Basic Concepts:</u>

- The Parameter Control String must be separated from the Positional Fields by at least one blank and terminated by a carriage return or a colon ':'.
- Within the .B Parameter Control String certain Date/ Data Type Elements (Observation Time, Creation Date, Units Code, Data String Qualifier, Duration Code Variable, and Parameter Code[s]) apply to all subsequent data value elements in the Body of the .B format message.
- Within the .B Parameter Control String, Observation Time, Creation Date, Units Code, Data String Qualifier, Duration Code Variable, and Parameter Code(s) may be specified or respecified.
- All elements within the Parameter Control String must be separated by a slash '/'.
- There is no limit to the number of parameter codes which may be specified in the .B header.

D. Analysis of Elements Within the Data String: (.A and .E Formats). and Parameter Code String (.B Format) - (Figures 1, 2, and 3)

1. <u>Observation Time Element:</u> (Optional Field) - Tables 9a and 9b)

- If Observation Time is not specified, the hour and minute (hhnn) default to 24ØØ if a local time zone is specified, 12ØØ if Zulu time is specified.
- If hour (DHnn) is specified without minute (nn), nn defaults to ØØ.
- If minute (DNnn) is specified without an explicit specification of hour (DHhh), the default hour will be 24 if local time is specified and 12 if Zulu time is specified.
- When specifying an observation time element, you can expand the time definition to finer detail without respecifying the Date/Data type code. For example, one can specify month, day and hour by coding DMØ9Ø1/DHØ6 or DMØ9Ø1Ø6. To code hour and minute one can code DHØ6/DN3Ø or DHØ63Ø. One restriction here is that if Julian date is specified, time of day must be specified with a separate Date/Data code.
  Table 9a lists all possible observation time specifications for each date/data code. Table 9b lists the Time Unit definitions for each time code.

- Time controls can be redefined within all three message formats. In the .A and .E formats the observation time can be redefined (including new month, day, or year) within the data string. In the .B format, the observation time can be redefined in the parameter control string and on a line-by-line basis in the .B format Body.
- If the data value is for a period rather than instantaneous, the time stamp is always by convention associated with the end of that period. For example, QRD (mean daily flow) would be coded DH24 and would be considered the mean daily flow associated with the latest 'mmdd' specified in the Data Field or Data String if redefined.

2. Creation Date Element: 'DC' (optional), (mandatory for forecast parameters)

   - This element is used to indicate the time at which the data elements that follow were created. This allows one to associate a creation time with a particular data element value and, in the case of forecasted values, judge the quality of the forecast. 'DC' must be coded in order to transmit forecast data.

   yy - Year, 2 digits (ØØ-99) - optional. The yy defaults in the same manner as a yy in the Date Field. The yy is only coded when 'mmddhhnn' are also specified.
   mm - Month, 2 digits (Ø1-12) - mandatory
   dd - Day, 2 digits (Ø1-31) - mandatory
   hh - Hour, 2 digits (ØØ-24) - optional, defaults as hh in D.1.
   nn - Minute, 2 digits (ØØ-59) - optional
   The nn defaults to ØØ if not specified.

3. Units Code Element: 'DU' (optional) -- defaults to English Units if not specified.

   - 'S' will denote "Standard International" units.
   - 'E' will denote "English" units (used to respecify after use of 'S').
   - The Units scaling will be in accordance with the standard defaults in Tables 1 and 4.

4. Data String Qualifier: 'DQq'

   - An optional external means of explicitly qualifying all subsequent Data Element values in a message. Table 10 lists the 'q' character codes and definitions.
   - The specification of a 'DQZ' will deactivate the qualifier function and allow the parameter code and data value to assume the no qualification default.

5. Duration Code Variable: 'DV'

   - The 'DV' codes in Tables 11a and 11b are used to explicitly define durations not listed in Table 3.

- The DV code triggers the decode program to look at an explicit duration specification 'DVx' within the SHEF message (the 'x' will specify the duration wherever a V appears in a parameter code for duration.
- For example, in order to code 18-hour precipitation amounts one would specify DVH18 followed by PPV XXXX in the data string. To code 5-monthly flow data one would specify DVM5 followed by QPV XXX in the data string of .A format messages. The 'DV' can also be used in .B and .E formats.
- The specification of DVZ will deactivate the process and return the duration to default value for that physical element if not explicitly specified in the parameter code.

6. Data Elements:

- Consists of a Parameter Code and data value (plus a possible qualifier) separated by at least one blank for the .A format or a value 'v' (with an optional qualifier 'q') for the .B and .E formats.

  a. Data Element Parameter Code: 'PC'
     - An external character code of from 2 to 7 characters and 6 'keys' used to identify data. All parameters in the SHEF are fully represented by a 7-character code, although in most external transmission applications only 2 or 3 characters are required with the remaining characters completely specified by default conventions.

  b. Data Element Value: 'v'
     - The hydrologic data being transmitted.
     - Coded as a decimal or integer number using appropriate scaling based on Parameter Code.
     - The '+' and '-' sign characters are supported; however, when coding positive numbers '+' is not necessary.

  c. Data Element Qualifier: 'q'
     - An optional external means of qualifying a particular Data Element value. Table 10 lists the 'q' character codes and definitions. A qualifier attached to a data value within a data element overrides a general data qualifier set by the DQx Date/Data code. Respecification of a qualifier follows the same rules as date value revisions.

7. Time Interval: 'DIx' (mandatory -- .E Format only)

- The 'DIx' codes are used in the .E format data string to designate the time interval between values as shown in Table 12a.
- Table 12b lists the allowable range for each Time Interval code.
- If 'DIN15' were coded in the .E format Data String it would represent a 15-minute interval between data values. Coding 'DIH2' would represent a 2-hour interval, while 'DID1' would indicate a daily interval.

- The Time Interval code does not require the filling of the two-digit field as is required in the Date/Time elements.
- Coding Time Interval, 'End of Month' 'DIE', allows one to transmit end-of-month values in a .E format without concern for the different number of days in the months. The 'End of Month' process is keyed with the latest explicit specification of any hour or minute occurring in the last day of any month. Specification of 'DIE' outside this 'time window' will generate a SHEF error.

E. Analysis of Elements Within the .B Format Body: (Figure 2)

1. Basic Concepts:

- Order of Data Element String corresponds to the order of parameter and time controls in the .B format header.
- More than one grouping of the Station ID, Date/Data Override, and Data Element String may appear on a single line in order to reduce the number of lines in the .B format message. This is done by using a comma to separate fields which normally would be on separate lines. The name given to this variation of the .B format will be the Packed .B Format (see Figure 5, example 6).
- Special care must be taken in coding the Packed .B Format so that data elements in the body correspond directly to the parameter codes specified in the header.
- Special care is required in the use of the ',' delimiter, for any ambiguity will result in the termination of the decoding program for that line and subsequent loss of data in the receiving database.

2. Station ID: 'ssss' (mandatory)

- The ID may begin in column one or may be preceded by a comma in the packed .B format, otherwise rules for the .A and .E Positional Fields apply.

3. Date/Data Override: 'Dtxx' (optional - .B Body only)

- When coded, Dtxx overrides the corresponding Date/Data fields in the .B Format Header for that station line only (or until comma in Packed .B).
- Any Date/Data 'D' code from the .B Format Header can be coded as the Date/Data Override in the .B Body and will apply only to that particular line.
- When the Date/Data Override for a station is not coded, the data transmitted for the station is assigned date and data codes as specified in the .B Format Header. If no date or data elements are specified in the .B Format Header, standard defaults are assigned.

4. Data Element String: 'vvvq/vvv...' (mandatory)

- The Data Element String and Station ID must be separated by at least one blank.
- Data Elements must be separated by a slash.
- Data Element Strings terminate with a colon ':' or a carriage return.

F. .B Format Termination.

- .END in Columns 1-4 is the normal termination of a .B message.

V. RULES FOR CODING SHEF MESSAGES

A. Missing Data Codes:

- The single character codes '+' and 'm' (upper or lower case) coded as a data value.
- -9999 or -9002 decimal or integer.

B. Trace Code for Precipitation Increment: (Physical Elements PC, PP, and PY)

- 'T' character code (upper or lower case) coded as a data value.
- 'T' is decoded as .001 for database storage.

C. Change of Observation Time Element Within the .A and .E Data String or .B Parameter Control String.

- Required changes in date/time information may be accomplished using the Date/Data Type codes as shown in Table 9a.
- All time codes must be padded with zeros to fill the maximum positional size as shown on Table 9b. For example, June 1 should be coded DM0601.
- Smaller time elements down to hours will carry over after redefinition of a larger time element. For example, if one codes DM0207 and DH07, then redefines month, day to DM0208, the hour will stay at DH07 unless explicitly respecified. An explicit respecification of the entire observation time would be coded DM0208/DH07 or DM020807. If the hour is respecified it will apply to the last explicitly-stated DM or DD. Redefinition of hour (DHhh) will force minutes to zero unless explicitly specified using DHhhnn.

D. Use of the Date Relative 'DRx' Character Code:

- The Date Relative Code has the ability to either increment or decrement the latest explicit date/time specified in the SHEF messages. This means that if you give a Date Relative of +6 hours, then a +12 hours, the second is only twelve hours (not 18) from the last explicit time given. The Date Relative code requires the use of signed whole integers corresponding to the Date codes in Table 13a.
- When the 'DRx' code is used to increment or decrement the date/time, the entire field width need not be specified. For example, to increase the date/time stamp by one day greater than the latest explicitly-specified date/time, one would code DRH+24. This can change effective minute, hour, day, month, or year of all data values that follow until next explicitly-stated date/time stamp.
- If a Date/Data Override date/time is specified in the .B Format message, the 'DRx' code will operate on that date/time (the Date/Data Override is the latest explicit date/time specified in the SHEF message).

- Coding Date Relative, 'End of Month', 'DRE', allows one to transmit end-of-month values without concern for the different number of days in the months. The 'End of Month' process is keyed with the latest explicit specification of any hour or minute occurring in the last day of any month. Specification of DRE outside this 'time window' will generate a SHEF error.

E. The Null Field:

- A Null Field occurs whenever a slash is encountered in the data string instead of a data element or missing symbol.
- On occasion it may be easier, when coding a .B Format message, to list in the header all possible parameter codes reported by the stations in the body of the message even though not all stations report every parameter. This would be done in order to avoid making separate SHEF messages for unique station and physical element combinations. Also, if the data element string begins with a slash, that assigns a null field to the first parameter in the .B header. (See Figure 5, Example Number 2). No attempt will be made to put a value into receiving databases for that station parameter.
- If no legitimate data element value 'v' is found between slashes '//', the value will be treated as a null field or no report. No attempt will be made to put a value into receiving databases for that station parameter.

F. Continuation Lines in .A and .E Data Strings and .B Header:

- The standard record length for SHEF messages is 80 characters (bytes).
- Since there is a requirement that a slash separate all elements in a Data String or Header when coding a continuation line, the following rule(s) apply: 1) If no slash is specified at the end of one line or the beginning of the next, an implied slash will be generated by the decoding program; 2) if a coded slash exists at either the end of one line or the beginning of the next, the decode program will not add a slash, thus avoiding the creation of an unintended null field; and 3) if a slash exists at both the end of a line and the beginning of another the null field is implied.

G. Revision of a Missing Data Value:

- Should a missing data value code reside in a database and an actual value be transmitted to the database in a non-revised SHEF, the actual value will overwrite the missing data code in the database. If an actual value resides in the database a transmitted missing code cannot overwrite an actual value without an 'R' revision flag. The explicit revision 'R' will cause any data stored in the database to be overwritten.

H. Comment Field Definition Character:

- The colon ':' placed anywhere in the SHEF message will indicate the termination of the decoding process for that line. Any characters which follow will be treated as comments and will not be decoded. The Comment Field will continue until a carriage return is encountered at which time the computer decoding process will be resumed.

I. Syntax Errors in SHEF Messages:

- In order to protect the target database from the indiscriminate posting of data derived from SHEF message keys which may contain Syntax Errors, a rather restrictive set of rules has been adopted to terminate the decoding process.
- In the .A and .E messages, all data will be decoded up to the point of the Syntax Error.
- 15 consecutive blanks terminate the decode process for any line.
- In the .B message, the termination of the decode process is more complex since the Header, Body, and Terminator are all interrelated in the transmission of data values. A Syntax Error in the Header of the message can have damaging effect on the Data Strings contained in the Body of the message. The following rules have been adopted to protect the target databases.

  * If a Syntax Error occurs in the Header line, all parameters correctly specified up to the error will be decoded in the Body of the message.

  * If 2 or more consecutive data lines in the Body have Syntax Errors the decode process will be terminated.

  * If a total of 3 lines located anywhere in the message (Header plus Body) contain Syntax Errors the decode process will be terminated.

  * A blank line within a .B message is not treated as a Syntax Error; however, the use of a colon ':' to denote a comment line is encouraged.

J. Repetition of a Parameter Code Having the Same Date/Time Stamp Within a SHEF Message:

- Both parameter codes will be parsed without a syntax error; however, only the first parameter code will be posted to the target database unless the message has a revision 'R' flag on it.
- Should the second parameter code be the correct value, a separate SHEF 'R' revision format message must be transmitted to the target database.

K. Use of the Filler Character 'Z' in Parameter Code PEDTSEP:

- At times it may be necessary to specify an interior parameter code character in order to explicitly define a data value. If, for example, the sixth character E (Extremum) required explicit definition, but that particular PE (Physical Element), D (Duration), T (Type) and S (Source) could use standard defaults, then a 'Z' filler character could be used to point to the defaults for 'D', 'T', and 'S'. Transmission of parameters 'HGZZZX' and 'HGIRZX' are equivalent, as shown by the following table.

The Code would be translated as follows:

Parameter	Transmission Code	Translation
PE	HG	HG (none)
D	Z	I (instantaneous, default for HG)
T	Z	R (reading, default for type)
S	Z	Z (nonspecific, default for source)
E	X	X (maximum of day)

A 'Z' can be used to define a physical element in character positions 1 and 2. In character positions 3 and 4 the 'Z' is used as a pointer to the default characters for duration and type. Since source, extrema and probability already have default values of Z (except for some send codes), a 'Z' in character positions 5, 6 or 7 will not be translated to some other character.

L. Coding Ice Report 'IR': (Table 14)

- The Ice Report consists of 3 elements: (1) ice structure, (2) ice type, and (3) ice cover.
- The Ice Report is coded as 3 digits in the following order:
  1. Ice structure, 1 digit (1-9); Ø = no report
  2. Ice type, 1 digit (1-9); Ø = no report
  3. Ice cover, 1 digit (Ø-9); Ø = no ice cover
- The report is coded IR XXX. Three digits would indicate a full report; 2 digits would indicate ice type and ice cover; 1 digit would indicate only ice cover.
- In order to code ice structure without coding ice type, one would have to code all 3 characters with a zero 'Ø' in the second position.

M. Coding Snow Report 'SR': (Table 15)

- The Snow Report consists of 4 elements: (1) structure, (2) base of snowcover, (3) surface of snowcover, and (4) area description.
- The Snow Report is coded as 4 digits in the following order:
  1. Structure, 1 digit (1-2); Ø = no report
  2. Base of snowcover, 1 digit (1-3); Ø = no report
  3. Surface of snowcover, 1 digit (1-3); Ø = no report
  4. Area description, 1 digit (1-3); Ø = no report
- The report is coded SR XXXX. Four digits would indicate a full report; 3 digits would indicate base of snowcover, surface of snowcover, and area description; two digits would indicate surface of snowcover and area description, and 1 digit would indicate only an area description.
- In order to code the snow structure and area description, a zero 'Ø' filler would be specified for base and surface of snowcover.

N. Coding SHEF Messages Involving Semi-Annual Time Changes. (Appendix D).

- According to the Uniform Time Act of 1966, Daylight Savings Time begins on the last Sunday of April at Ø2ØØ, therefore Ø2Ø1 local Standard Time would become Ø3Ø1 local Daylight Savings Time. Standard Time begins on the last Sunday in October at Ø2ØØ local Daylight Savings Time, therefore Ø2Ø1 local Daylight Savings Time becomes Ø1Ø1 local Standard Time.
- All SHEF messages are parsed to a Zulu time base for subsequent database posting.
- In all SHEF messages, observation times can be specified either implicitly or explicitly. Implicit time specification refers to the use of the time interval in the .E Format and the use of the Date Relative in all SHEF formats. A time may be specified explicitly through the use of the Date Type elements DN, DH, DD, DM, DJ, DY, and DC.

A. Zulu Time Specification.

1. Explicit Time Specification.
   - No translation to Zulu is required. Times are parsed as transmitted.

2. Implicit Time Specification.
   - Same as A.1.

B. Two-Character Time Zone Specification (Daylight or Standard Specified).

1. Explicit Time Specification.
   - Translation to Zulu is based on the difference in hours between the 'TZ' specified and Zulu. This difference is applied in the calculation of Zulu time for each time specified throughout the SHEF message.

2. Implicit Time Specification.
   - Same as B.1.

C. One-Character Time Zone Specification (Default to Daylight or Standard).

1. Explicit Time Specification.
   - Daylight to Standard
     * The translation to Zulu is based on the difference in hours between Zulu time and the time standard in effect when each explicit time is specified. Times from Ø1Ø1 to Ø2ØØ local time on the day in which the time standard changes from Daylight to Standard time will always be parsed as Daylight Savings Time. Users are urged to use either Zulu time, the two-character time zone specifications, or implicit time specifications during the hour following the change from Daylight to Standard time. (See example below.)

```
.A STNX 1Ø31 C DHØ1/HG 1./DHØ2/HG 2./DRH+1/HG 3./DHØ3/HG 4.
                  ↑           ↑           ↑            ↑
Zulu
  Translation    Ø6Z         Ø7Z         Ø8Z          Ø9Z
```

- Standard to Daylight
  * Translation to Zulu is based on the difference in hours between Zulu time and the time standard in effect when each explicit time is specified.
  * To code a message during this transition, one must remember that times between Ø2Ø1 and Ø3ØØ are invalid. (See example message below.)

```
.A STNY Ø425 C DHØ1/HG 1./DHØ2/HG 2./DHØ3Ø1/HG 3.
                  ↑           ↑           ↑
Zulu
  Translation    Ø7Z         Ø8Z         Ø8Ø1Z
```

2. Implicit Time Specification.
   - When local times are specified implicitly using either minute or hourly date relative codes or time intervals, the absolute time increments will be maintained throughout changes in time standards. The last explicit specification of time will be converted to Zulu time according to the applicable local time standard. All subsequent implicitly-specified times will relate, as coded, to the explicit time specification in Zulu.
   - When local times are specified implicitly using either daily, monthly, or yearly date relative codes or time intervals, translation to Zulu time will occur after the implicit time specifications have been computed from the local explicit specification of time of day.

VI. CONCLUSION.

A Standard Hydrologic Exchange Format (SHEF) consisting of three basic message types has been presented in this paper. SHEF fulfills envisioned functional features required for the identification and transmission of hydrologic data. The national adoption of SHEF will be the basic stepping-stone for the design of functional databases for hydrologic forecasting.

This has been a group effort at local, regional and national levels, allowing a wide spectrum of ideas to be incorporated in the final document.

VII. PLANNED ENHANCEMENTS.

Enhancements to SHEF are to be expected. A future version of SHEF is expected to include:

A. Vector Format capability to transmit physical elements such as temperature at various depths in a reservoir, soil, or atmosphere.

B. Grid Format to transmit gridded field data, as for example from radar or satellite.

Other requirements will almost certainly become evident as the use of SHEF becomes more widespread.

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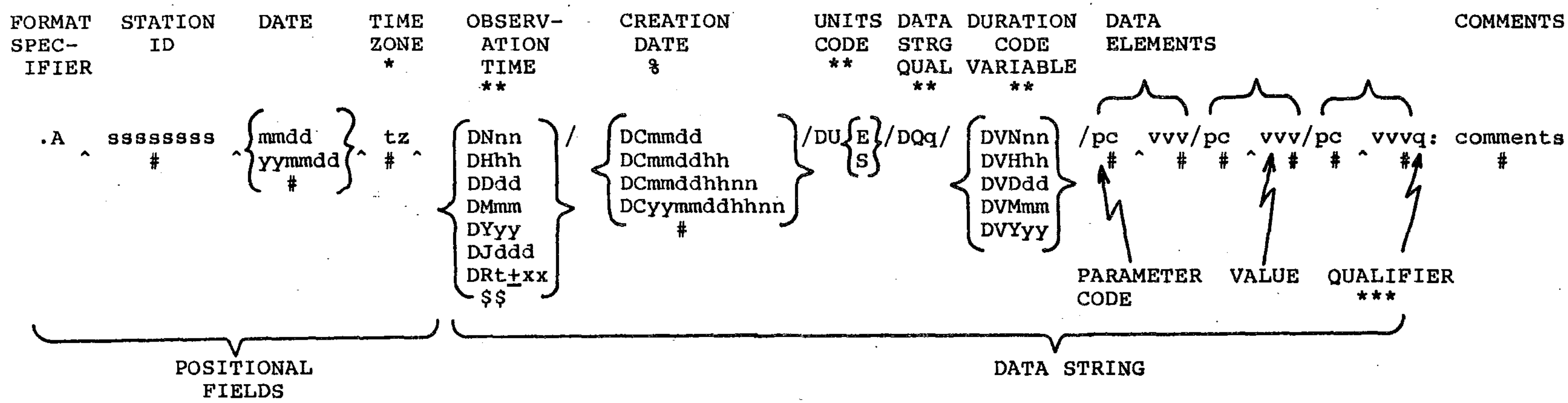


* Denotes optional field which defaults to prespecified value and is fixed positionally in the message

** Denotes optional fields which default to prespecified values and can occur anywhere in the data string

*** Denotes optional field which occurs directly after the data element value 'v'

^ Denotes at least 1 mandatory blank used as a delimiter

\# Denotes variable length fields

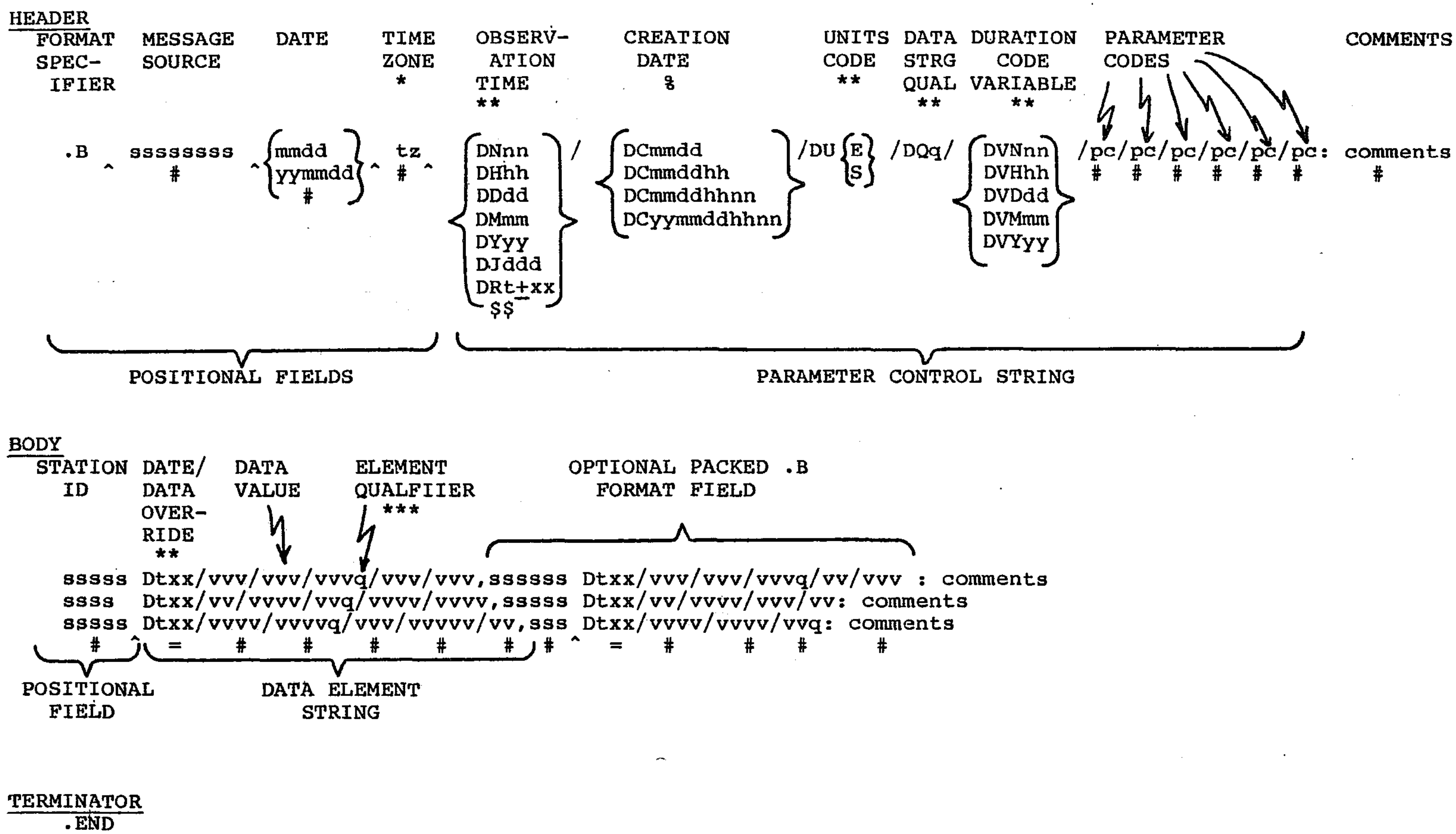
$$ Denotes fields that can be expanded (see table at right)

% Denotes mandatory field for forecast data only.

EXPANSION TABLE

OBSERVATION TIME	RELATIVE DATE (DRt)
DNnn	DRN±xx
DHhhnn	DRH±xx
DDddhhnn	DRD±xx
DMmmddhhnn	DRM±xx
DYyymmddhhnn	DRY±xx
DJyyddd	DRE±mm

FIGURE 1. GENERALIZED .A FORMAT MESSAGE

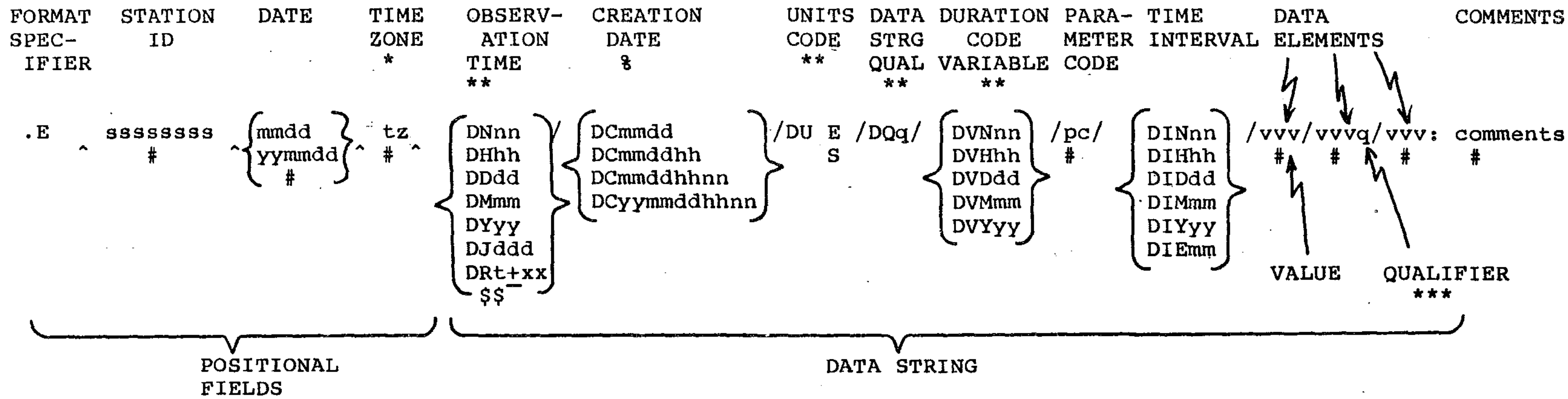


*	Denotes optional field which defaults to prespecified value and is fixed positionally in the message
**	Denotes optional fields which default to prespecified values and can occur anywhere in the data string
***	Denotes optional field which occurs directly after the value
^	Denotes at least 1 mandatory blank used as a delimiter
#	Denotes variable length fields
,	Denotes packed .B FORMAT delimiter
$$	Denotes fields that can be expanded (see table at right)
%	Denotes mandatory field for forecast data only
=	Denotes Date/Data Override 'Dt', t can be any valid 'D' code for this message

EXPANSION TABLE

OBSERVATION TIME	RELATIVE DATE (DRt)
DNnn	DRN±xx
DHhhnn	DRH±xx
DDddhhnn	DRD±xx
DMmmddhhnn	DRM±xx
DYyymmddhhnn	DRY±xx
DJyyddd	DRE±mm

FIGURE 2. GENERALIZED .B FORMAT MESSAGE



* Denotes optional field which defaults to prespecified value and is fixed positionally in the message

** Denotes optional fields which default to prespecified values and can occur anywhere in the data string

*** Denotes optional field which occurs directly after the value

^ Denotes at least 1 mandatory blank used as a delimiter

\# Denotes variable length fields

$$ Denotes fields that can be expanded (see table at right)

% Denotes mandatory field for forecast data only

EXPANSION TABLE

OBSERVATION TIME	RELATIVE DATE (DRt)
DNnn	DRN±xx
DHhhnn	DRH±xx
DDddhhnn	DRD±xx
DMmmddhhnn	DRM±xx
DYyymmddhhnn	DRY±xx
DJyyddd	DRE±mm

FIGURE 3. GENERALIZED .E FORMAT MESSAGE

STANDARD HYDROLOGIC EXCHANGE FORMAT (SHEF)

'.A FORMAT EXAMPLES'

EXAMPLE #1 (ROUTINE TRANSMISSION)

```
.A EGTM7 1120 C DH08/HG 5.75/QR 5.97/PP 2.15

.A        :.A FORMAT MESSAGE
EGTM7     :EDGERTON, MO
1120      :NOVEMBER 20 (CURRENT YEAR ASSUMED)
C         :CENTRAL LOCAL TIME (COMPUTER DETERMINES DAYLIGHT OR STANDARD)
DH08      :HOUR 8 A.M.
HG 5.75   :HEIGHT, RIVER 5.75 FEET (INSTANTANEOUS)  (HG=HGIRZZZ)
QR 5.97   :DISCHARGE, RIVER 5970 CFS (INSTANTANEOUS) (QR=QRIRZZZ)
PP 2.15   :PRECIPITATION, 24 HR ENDING AT 8 A.M. 2.15 INCHES
```

EXAMPLE #2 (ROUTINE TRANSMISSION)

```
.A CSAT2 0309 DH12/HG 10.25

.A        :.A FORMAT MESSAGE
CSAT2     :CORSICANA, TX
0309      :MARCH 9 (CURRENT YEAR ASSUMED)
DH12      :HOUR 1200 ZULU  (DEFAULT, SINCE NO TIME ZONE WAS SPECIFIED)
HG 10.25  :HEIGHT, RIVER 10.25 FEET (INSTANTANEOUS) (HG=HGIRZZZ)
```

EXAMPLE #3 (CHANGE MONTH/DAY CODE IN THE DATA STRING)

```
.A MASO1 0907 C DH22/QR .12/DM0908/DH09/QR 5.0

.A        :.A FORMAT MESSAGE
MASO1     :MASSILLON, OH
0907      :SEPTEMBER 7 (CURRENT YEAR ASSUMED)
C         :CENTRAL LOCAL TIME (COMPUTER DETERMINES DAYLIGHT OR STANDARD)
DH22      :HOUR 10 P.M. (LOCAL TIME ASSUMED)
QR .12    :DISCHARGE, RIVER 120 CFS (INSTANTANEOUS) (QR=QRIRZZZ)
DM0908    :SEPTEMBER 8 (CURRENT YEAR ASSUMED)
DH09      :HOUR 9 A.M.
QR 5.0    :DISCHARGE, RIVER 5000 CFS (INSTANTANEOUS) (QR=QRIRZZZ)
```

EXAMPLE #4 (CHANGE MONTH/DAY CODE, USE OF 3 CHARACTER 'PC')

```
.A BON 810907 P DH24/QID 250./DM090806/QIQ 300./QIQ 310.

.A        :.A FORMAT MESSAGE
BON       :BONNEVILLE DAM, OR
810907    :SEPTEMBER 7, 1981
P         :PACIFIC LOCAL TIME (COMPUTER DETERMINES DAYLIGHT OR STANDARD)
DH24      :MIDNIGHT
QID 250.  :DISCHARGE, INFLOW 250000 CFS (MEAN DAILY) (QID=QIDRZZZ)
DM090806  :SEPTEMBER 8 (CURRENT YEAR ASSUMED) 6 A.M.
QIQ 300.  :DISCHARGE, INFLOW 300000 CFS (MEAN FOR SIX HOURS ENDING AT 6 A.M.)
QIQ 310.  :DISCHARGE, SAME TIME, PARSED BUT NOT STORED IN DATABASE, NO 'R' FLAG.
           (QIQ=QIQRZZZ)
```

FIGURE 4. .A FORMAT EXAMPLES

EXAMPLE #5 (REVISION OF DATA)

```
.AR SNGT2 1212 C DH08/HG 37.5/HG 37.7

.AR          :.AR FORMAT MESSAGE FOR DATA REVISION
SNGT2        :SPRING BRANCH, TX
1212         :DECEMBER 12 (CURRENT YEAR ASSUMED)
C            :CENTRAL LOCAL TIME (COMPUTER DETERMINES DAYLIGHT OR STANDARD)
DH08         :HOUR 8 A.M.
HG 37.5      :HEIGHT, RIVER REVISED 37.5 FEET (INSTANTANEOUS) (HG=HGIRZZZ)
HG 37.7      :HEIGHT, RIVER REVISED 37.7 FEET (INSTANTANEOUS)
             :*** NOTE *** THE FIRST READING 37.5 SHOULD OVERRIDE ANY VALUE STORED
             :AT THAT TIME IN THE RECEIVING DATABASE.  THE SECOND READING OVER-
             :RIDES THE FIRST SINCE THE REVISION FLAG 'AR' WAS TURNED ON.
```

EXAMPLE #6 (CONTINUATION LINE)

```
.A SERT2 1209 C DH1015/HG 12.7/PP .17
.A1 TX 107/TN 55

.A           :.A FORMAT MESSAGE
SERT2        :SEYMOUR, TX
1209         :DECEMBER 9 (CURRENT YEAR ASSUMED)
             :CENTRAL LOCAL TIME (COMPUTER DETERMINES DAYLIGHT OR STANDARD)
DH1015       :HOUR 1015 A.M.
HG 12.7      :HEIGHT, RIVER 12.7 FEET (INSTANTANEOUS)  (HG=HGIRZZZ)
PP .17       :24 HOUR PRECIPITATION ENDING AT 1015 A.M. .17 INCHES
.A1          :FIRST CONTINUATION OF .A FORMAT MESSAGE
TX 107       :24 HR MAX TEMPERATURE 107 DEGREES F (PERIOD ENDING 1015 A.M.)
TN 55        :24 HR MIN TEMPERATURE 55 DEGREES F  (PERIOD ENDING 1015 A.M.)
             :(TX=TAIRXZZ), (TN=TAIRNZZ)
```

EXAMPLE #7 (ICE AND SNOW REPORT)

```
.A MONO3 1231 P DH09/IR 128/SR 2033

.A           :.A FORMAT MESSAGE
MONO3        :MONUMENT, OR
1231         :DECEMBER, 31 (CURRENT YEAR ASSUMED)
P            :PACIFIC LOCAL TIME (COMPUTER DETERMINES DAYLIGHT OR STANDARD)
DH09         :HOUR 0900 A.M.
IR 1209      :ICE REPORT
             :STRUCTURE=  1 (BREAKING)
             :TYPE     =  2 (CAKE)
             :COVER    =  8 (8/10 - 9/10 COVERED)
SR 2033      :SNOW REPORT
             :STRUCTURE             =  2 (DENSELY PACKED)
             :BASE OF SNOWCOVER     =  0 (NO OBSERVATION)
             :SURFACE OF SNOWCOVER=  3 (ICE)
             :AREA DESCRIPTION      =  3 (DRIFTED)
```

FIGURE 4. .A FORMAT EXAMPLES (CONTINUED)

'.B FORMAT EXAMPLES'

EXAMPLE #1 (ROUTINE ROUNDUP OF STAGE AND PRECIPITATION)

```
.B TOP 1Ø1Ø C DHØ8/HG/PP    : FIRST DATA ROUNDUP FROM TOPEKA
:
: ID  STAGE, PRECIPITATION, STATION NAME
:
MRYK1 2.75/.5Ø   :MARYSVILLE, KS
NLSK1 1Ø.3/.55   :NILES, KS
LVNK1 5.7/+      :LEAVENWORTH, KS
MTTK1 +/2.75     :MANHATTEN, KS
.END
```

```
.B          :.B FORMAT MESSAGE
TOP         :MESSAGE SOURCE, TOPEKA, KS WSFO
1Ø1Ø        :OCTOBER 1Ø (CURRENT YEAR ASSUMED)
C           :CENTRAL LOCAL TIME (COMPUTER DETERMINES DAYLIGHT OR STANDARD)
DHØ8        :HOUR 8 A.M.
HG          :HEIGHT, RIVER (INSTANTANEOUS)
PP          :PP PRECIPITATION, INCREMENT (24 HOUR AMOUNT)

MRYK1 2.75/.5Ø   :MARYSVILLE, KS; STAGE 2.75 FT; 24HR PRECIP .5Ø INCHES.
NLSK1 1Ø.3/.55   :NILES, KS; STAGE 1Ø.3 FT; 24HR PRECIP .55 INCHES.
LVNK1 5.7/+      :LEAVENWORTH, KS; STAGE 5.7 FT; 24HR PRECIP MISSING.
MTTK1 +/2.75     :MANHATTEN, KS; STAGE MISSING; 24HR PRECIP 2.75 INCHES.
.END             :NORMAL TERMINATION OF .B MESSAGE.
```

EXAMPLE #2 (USE OF THE NULL RECORD TO POSITION DATA STRING)

```
.B GEG Ø1Ø7 P DHØ83Ø/SD/SF/TX/XW : SNOWFALL MESSAGE FROM SPOKANE
SQAW1 Ø/Ø/+/Ø4
BPAW1 6/2/3Ø/Ø2
SPAW1 //38/Ø2
.END
```

```
.B          :.B FORMAT MESSAGE
GEG         :MESSAGE SOURCE, SPOKANE,WA WSO
Ø1Ø7        :JANUARY 7 (CURRENT YEAR ASSUMED)
P           :PACIFIC LOCAL TIME (COMPUTER DETERMINES DAYLIGHT OR STANDARD)
DHØ83Ø      :HOUR 8:3Ø A.M.
SD          :SNOW, DEPTH (INCHES)
SF          :SNOW, NEW (INCHES)
TX          :TEMPERATURE, AIR (MAX) 24 HR
XW          :WEATHER, CURRENT (2 CHARACTER SYNOPTIC CODE)

SQUAW1      :SNOQUALMIE FALLS, WA
Ø/Ø/+/Ø4    :SNOW DEPTH Ø;SNOW NEW Ø;MAX TEMP. MISSING; FOG
BPAW1       :BLEWETT PASS NO. 2, WA
6/2/3Ø/Ø2:SNOW DEPTH 6;SNOW NEW 2;MAX TEMP. 3ØF;CLOUDY
SPAW1       :SATUS PASS, WA
//38/Ø2     :DOES NOT REPORT SNOW DEPTH OR NEW SNOW; MAX TEMP. 38F;CLOUDY
.END        :NORMAL TERMINATION OF .B MESSAGE.
```

FIGURE 5. .B FORMAT EXAMPLES

AMPLE #3 (USE OF RELATIVE DATE CONTROL FEATURE AND DATA ELEMENT QUALIFIER)

```
.B PDX 1Ø11 P DHØ6/HG/DRH-12/HG
:
: ID  6 AM STAGE THIS MORNING, 6 PM STAGE LAST NIGHT, STATION NAME
:
PHIO3 9.7/6.2E  :PHILOMATH, OR
JFFO3 4.5/7.2   :JEFFERSON, OR
.END

.B        :.B FORMAT MESSAGE
PDX       :MESSAGE SOURCE, PORTLAND, OR.  WSFO
1Ø11      :OCTOBER 11 (CURRENT YEAR ASSUMED)
P         :PACIFIC LOCAL TIME (COMPUTER DETERMINES DAYLIGHT OR STANDARD)
DHØ6      :HOUR 6 A.M.
HG        :HEIGHT, RIVER STAGE (INSTANTANEOUS)  (HG=HGIRZZZ)
DRH-12    :DATE, RELATIVE CONTROL. SUBTRACT 12 HOURS FROM LAST EXPLICITLY
          :SPECIFIED DATE/TIME STAMP. DATE WILL BE 6 P.M. OCTOBER 1Ø.
HG        :HEIGHT, RIVER STAGE (INSTANTANEOUS)
PHIO3     :PHILOMATH, OR
9.7/6.2E  :RIVER STAGE 9.7 FEET; RIVER STAGE 6.2 FEET (ESTIMATED)
JFFO3     :JEFFERSON, OR
4.5/7.2   :RIVER STAGE 4.5 FEET; RIVER STAGE 7.2 FEET
.END      :NORMAL TERMINATION OF .B MESSAGE
```

XAMPLE #4 (USE OF DATE/TIME OVERRIDE)

```
.B PDR Ø8Ø7 P DHØ5/SW/PC/DUS/TA
: THIS IS SELECTED SNOTEL DATA
ANRO3 DHØ523/Ø.1/ 72.4/ 7.2         :ANEROID LAKE
BCDO3 DHØ456/Ø.2/ 68.5/13.7         :BIGELOW CAMP
BLAO3 DHØ5Ø8/Ø.Ø/122.9/22.6         :BLAZED ALDER
.END

.B                 :.B FORMAT MESSAGE
PDR                :MESSAGE SOURCE, NWRFC, PORTLAND, OR.
Ø8Ø7               :AUGUST 7 (CURRENT YEAR ASSUMED)
P                  :PACIFIC LOCAL TIME (COMPUTER DETERMINES DAYLIGHT OR STANDARD)
DHØ5               :HOUR Ø5ØØ
SW                 :SNOW WATER EQUIVALENT (IN) (SW=SWIRZZZ)
PC                 :ACCUMULATED PRECIPITATION (IN) (PC=PCIRZZZ)
DUS                :UNITS CODE DEFINITION (STANDARD INTERNATIONAL UNITS) (DC)
TA                 :TEMPERATURE (DEG C) (TA=TAIRZZZ)
ANRO3              :ANEROID LAKE, OR
DHØ523/            :DATE/TIME OVERRIDE, Ø523 PACIFIC LOCAL
Ø.1/ 72.4/ 7.2     :SW=Ø.1 (IN), PC=72.4 (IN), TA=7.2 (DEG C)
BCDO3              :BIGELOW CAMP, OR
DHØ456/            :DATE/TIME OVERRIDE, Ø456 PACIFIC LOCAL
Ø.2/ 68.5/13.7     :SW=Ø.2 (IN), PC=68.5 (IN), TA=13.7 (DEG C)
LAO3               :BLAZED ALDER, OR
HØ5Ø8/             :DATE/TIME OVERRIDE, Ø5Ø8 PACIFIC LOCAL
Ø.Ø/122.9/22.6     :SW=Ø.Ø (IN), PC=122.9 (IN), TA=22.6 (DEG C)
.END               :NORMAL TERMINATION .B FORMAT MESSAGE
```

FIGURE 5. .B FORMAT EXAMPLES (CONTINUED)

EXAMPLE #5 (USE OF PY,PPP SEND CODE AND PRECIPITATION INCREMENT)

```
.B FTW 0107 C DH13/PY/PPP
SNGT2 .25/1.75
SERT2 .30/2.33
.END

.B                  :.B FORMAT MESSAGE
FTW                 :MESSAGE SOURCE, FORT WORTH, TX
0107                :JANUARY 7 (CURRENT YEAR ASSUMED)
C                   :CENTRAL LOCAL TIME (COMPUTER DETERMINES DAYLIGHT OR STANDARD)
DH13                :HOUR 1:00 P.M.
PY                  :SEND CODE, 24 HOUR PRECIPITATION INCREMENT ENDING AT 7:00 A.M.
                    :LOCAL TIME JANUARY 7.
PPP                 :PRECIPITATION INCREMENT BEGINNING AT 7:00 A.M. LOCAL AND
                    :ENDING AT 1:00 P.M. LOCAL TIME.
SNGT2               :SPRING BRANCH, TX
.25/1.75            :24 HOUR PRECIP. ENDING AT 7:00 A.M. .25 INCHES
                    :6 HOUR PRECIP. ENDING AT 1:00 P.M. 1.75 INCHES
SERT2               :SEYMOUR, TX
.30/2.33            :24 HOUR PRECIP. ENDING AT 7:00 A.M. .30 INCHES
                    :6 HOUR PRECIP. ENDING AT 1:00 P.M. 2.33 INCHES
.END                :NORMAL TERMINATION OF .B MESSAGE
```

EXAMPLE #6 (USE OF PACKED .B FORMAT MESSAGE FOR STAGE AND PRECIPITATION DATA)

```
.B CHI 1020 /HG/PP
GUNI2  1.9/ .20, RVRI2  3.5/ .35, MORI2  5.6/ 1.25 :GURNEE/RIVERSIDE/MORRIS
WMTW3   M /  M , ALGI2  1.37/.19, PNTI2  2.30/ .57 :WILMOT/ALGONQUIN/PONTIAC
LSLI2 11.0//                                       :LA SALLE
.END

.B                  :.B FORMAT MESSAGE
CHI                 :MESSAGE SOURCE, CHICAGO, IL
1020                :OCTOBER 20 (CURRENT YEAR ASSUMED) 1200 ZULU DEFAULT TIME
HG                  :HEIGHT, RIVER STAGE (INSTANTANEOUS)
PP                  :PRECIPITATION INCREMENT (24 HOUR DURATION ENDING AT 1200 ZULU)
GUNI2 1.9/ .20      :HG 1.9 FEET, PP  .20 INCHES, GURNEE, IL
RVRI2 3.5/ .35      :HG 3.5 FEET, PP  .35 INCHES, RIVERSIDE, IL
MORI2 5.6/1.25      :HG 5.6 FEET, PP 1.25 INCHES, MORRIS, IL
WMTW3  M / M        :HG REPORTED MISSING, PP REPORTED MISSING, WILMOT, WI
ALGI2 1.37/.19      :HG 1.37 FEET, PP .19 INCHES, ALGONQUIN, IL
PNTI2 2.30/.57      :HG 2.30 FEET, PP .57 INCHES, PONTIAC, IL
LSLI2 11.0//        :HG 11.0 FEET, NO REPORT, NO PRECIP. COLLECTED AT LA SALLE, IL
.END                :NORMAL TERMINATION OF .B MESSAGE
```

FIGURE 5. .B FORMAT EXAMPLES (CONTINUED)

EXAMPLE #7 (USE OF DATE/DATA OVERRIDE IN .B FORMAT BODY)

```
.B CHI 1010 DH08/HG/DRH+12/HG
STN1 1.0/2.0
STN2 DH0832/3.0/4.0
.END
```

```
.B                  :.B FORMAT MESSAGE
CHI                 :MESSAGE SOURCE, CHICAGO, IL.
1010                :OCTOBER 10 (CURRENT YEAR ASSUMED)
DH08                :0800 ZULU (.B HEADER TIME)
HG                  :HEIGHT, RIVER STAGE (INSTANTANEOUS)
DRH+12              :DATE RELATIVE CONTROL; ADD 12 HOURS TO LAST EXPLICIT
                    :TIME STAMP
HG                  :HEIGHT, RIVER SATAGE (INSTANTANEOUS)
STN1                :SAMPLE STATION 1
1.0/2.0             :STAGE 1.0 FEET, 0800 ZULU; STAGE 2.0 FEET, 2000 ZULU
STN2                :SAMPLE STATION 2
DH0832/3.0/4.0      :DATE/DATA OVERRIDE TO TIME IN .B HEADER
                    :THE DATE/DATA OVERRIDE APPLIES TO THIS DATA LINE ONLY
                    :STAGE 3.0 FEET, 0832 ZULU; STAGE 4.0 FEET, 2032 ZULU
.END                :NORMAL TERMINATION OF .B MESSAGE
```

FIGURE 5. .B FORMAT EXAMPLES (CONTINUED)

STANDARD HYDROLOGIC EXCHANGE FORMAT
(SHEF)

'.E FORMAT EXAMPLES'

EXAMPLE #1 (ROUTINE TRANSMISSION OF GOES DATA)

```
.E KIDW1 1012 Z DH0300/HGIRG/DIH1/17.2/17.4/17.6/17.8/17.6/17.4

.E         :.E FORMAT MESSAGE
KIDW1      :KID VALLEY, WA (GOES PLATFORM)
1012       :OCTOBER 12 (CURRENT YEAR ASSUMED)
Z          :ZULU TIME (LEAVING OUT Z IS EQUIVALENT TO Z)
DH0300     :HOUR TIME STAMP OF 1ST DATA VALUE 0300Z
HGIRG      :HEIGHT, RIVER (FEET, INSTANTANEOUS) GOES
DIH1       :TIME INTERVAL BETWEEN OBSERVATIONS, 1 HOUR.

17.2       :17.2 FT AT 0300Z
17.4       :17.4 FT AT 0400Z
17.6       :17.6 FT AT 0500Z
17.8       :17.8 FT AT 0600Z
17.6       :17.6 FT AT 0700Z
17.4       :17.4 FT AT 0800Z
```

EXAMPLE #2 (TRANSMISSION OF DAILY PRECIPITATION AMOUNTS)

```
.E WGLM8 1201 M DH06/PP/DID1/1.20/+/3.00/+/.55

.E         :.E FORMAT
WGLM8      :WEST GLACIER PARK, MT.
1201       :DECEMBER 1 (CURRENT YEAR ASSUMED)
M          :MOUNTAIN LOCAL TIME (COMPUTER DETERMINES DAYLIGHT OR STANDARD)
DH06       :HOUR 6 A.M.
PP         :24 HOUR PRECIPITATION
DID1       :TIME INTERVAL BETWEEN OBSERVATIONS; 1 DAY

1.20       :1.20 INCHES ENDING 12/01 0600
 +         :MISSING     ENDING 12/02 0600
3.00       :3.00 INCHES ENDING 12/03 0600
 +         :MISSING     ENDING 12/04 0600
.55        :.55 INCHES  ENDING 12/05 0600
```

FIGURE 6. .E FORMAT EXAMPLES

.E FORMAT EXAMPLES (CONTINUED)

EXAMPLE #3 (TRANSMISSION OF END-OF-MONTH PRECIPITATION DATA)

```
.E PDX Ø331 P DHØ7/PPM/DIEØ1/5.71/6.21/3.73/1.2Ø

.E                :.E FORMAT
PDX               :PORTLAND, OREGON
Ø331              :MARCH 31 (CURRENT YEAR ASSUMED)
P                 :PACIFIC LOCAL TIME (COMPUTER DETERMINES DAYLIGHT OR STANDARD)
DHØ7              :Ø7ØØ A.M.
PPM               :PRECIPITATION INCREMENT, MONTHLY
DIEØ1             :END-OF-MONTH INDICATOR, 1 MONTH INTERVAL
5.71              :5.71 INCHES, MONTHLY TOTAL ENDING MARCH 31
6.21              :6.21   "        "      "     "   APRIL 3Ø
3.73              :3.73   "        "      "     "   MAY 31
1.2Ø              :1.2Ø   "        "      "     "   JUNE 3Ø
```

FIGURE 6. .E FORMAT EXAMPLES (CONTINUED)

STANDARD HYDROLOGICAL EXCHANGE FORMAT
PHYSICAL ELEMENTS
PE DTSEP

CODE EXPLANATION (UNITS)

A AGRICULTURAL DATA (COMPATIBLE WITH ROSA SYSTEM)
AD RESERVED
AF SURFACE FROST INTENSITY (CODED, SEE TABLE 20)
AM SURFACE DEW INTENSITY (CODED, SEE TABLE 21)
AT TIME BELOW CRITICAL TEMPERATURE (25 DF, -3.9 DC) (HOURS AND MINUTES)
AU TIME BELOW CRITICAL TEMPERATURE (32 DF, 0 DC) (HOURS AND MINUTES)
AW LEAF WETNESS (HOURS AND MINUTES)

B RESERVED
C RESERVED

D RESERVED FOR DATE/DATA TYPE NON PHYSICAL ELEMENTS (SEE TABLE 9a & 9b)

E EVAPORATION
EA EVAPOTRANSPIRATION POTENTIAL (AMOUNT) (IN,MM)
ED EVAPORATION, PAN DEPTH (IN,MM)
EM EVAPOTRANSPIRATION AMOUNT (IN,MM)
EP EVAPORATION, PAN INCREMENT (IN,MM)
ER EVAPORATION RATE (IN/DAY,MM/DAY)
ET EVAPOTRANSPIRATION TOTAL (IN,MM)
EV EVAPORATION, LAKE (COMPUTED) (IN,MM)

F FISH COUNT DATA
FA FISH - SHAD
FB FISH - SOCKEYE
FC FISH - CHINOOK
FE FISH - CHUM
FK FISH - COHO
FL (V) FISH - LADDER(1-LEFT, 2-RIGHT, 3-TOTAL)
FP FISH - PINK
FS FISH - STEELHEAD
FT (V) FISH TYPE - TYPE(1-ADULT, 2-JACKS, 3-FINGERLINGS)
FZ FISH - COUNT OF ALL TYPES COMBINED

G GROUND FROST AND GROUND STATE
GD FROST DEPTH, DEPTH OF FROST PENETRATION (NON PERMAFROST) (IN,CM)
GR FROST REPORT, STRUCTURE (CODED, SEE TABLE 16)
GS GROUND STATE (CODED, SEE TABLE 18)
GT FROST, DEPTH OF SURFACE FROST THAWED (IN,CM)

H HEIGHT
HA (V) HEIGHT OF READING (ALTITUDE ABOVE SURFACE) (FT,M)
HB (V) DEPTH OF READING BELOW SURFACE (FT,M)
HC HEIGHT, CEILING (FT,M)
HD HEIGHT, HEAD (FT,M)
HE (V) HEIGHT, REGULATING GATE (FT,M)
HF ELEVATION, PROJECT POWERHOUSE FOREBAY (FT,M)
HG HEIGHT, RIVER STAGE (FT,M)
HH (V) HEIGHT, OF READING(ELEVATION - MSL) (FT,M)
HI STAGE TREND INDICATOR (CODED, SEE TABLE 19)
HJ (V) HEIGHT, SPILLWAY GATE (FT,M)
HK HEIGHT, LAKE ABOVE A SPECIFIED DATUM (FT,M)
HL ELEVATION, NATURAL LAKE (FT,M)

TABLE 1. PHYSICAL ELEMENTS

CODE EXPLANATION (UNITS)

H HEIGHT (CONTINUED)
HM HEIGHT OF TIDE (MLLW) (FT,M)
HN (S) HEIGHT, RIVER STAGE (MIN) (FT,M) (....TRAN TO HGIRZNZ)
HP ELEVATION, POOL (FT,M)
HR ELEVATION, LAKE OR RESERVOIR RULE CURVE (FT,M)
HS ELEVATION, SPILLWAY FOREBAY (FT,M)
HT ELEVATION, PROJECT TAILWATER STAGE (FT,M)
HW HEIGHT, SPILLWAY TAILWATER (FT,M)
HX (S) HEIGHT, RIVER STAGE (MAX) (FT,M) (....TRAN TO HGIRZXZ)
HY (S) HEIGHT, RIVER STAGE AT 7AM LOCAL JUST PRIOR TO DATE/TIME STAMP (FT,M)
HY.....(TRAN TO HGIRZZZ AT 7AM LOCAL TIME, SEE TABLE 2)
HZ ELEVATION, FREEZING LEVEL (KFT,KM)

I ICE
IC ICE COVER, RIVER (%)
IE EXTENT OF ICE FROM REPORTING AREA (MI,KM) +=UPSTREAM -=DOWNSTREAM
IO EXTENT OF OPEN WATER FROM REPORTING AREA (FT,M) +=DOWN,-UPSTREAM
IR ICE REPORT (STRUCTURE, TYPE, COVER) (CODED, SEE TABLE 14)
IT ICE THICKNESS (IN,CM)

J RESERVED
K RESERVED

L LAKE DATA
LA LAKE SURFACE AREA (KAC,KM2)
LC LAKE STORAGE VOLUME CHANGE (KAF,MCM)
LS LAKE STORAGE (VOLUME) (KAF,MCM)

M MOISTURE AND FIRE/FUEL PARAMETERS
MI MOISTURE, SOIL INDEX OR API (IN)
ML MOISTURE, LOWER ZONE STORAGE (IN,CM)
MM FUEL MOISTURE, WOOD (%)
MS (V) MOISTURE, SOIL (AMOUNT) (IN,MM)
MT FUEL TEMPERATURE, WOOD PROBE (DF,DC)
MU MOISTURE, UPPER ZONE STORAGE (IN,CM)
MW MOISTURE, SOIL, PERCENT BY WEIGHT (%)

N GATE AND DAM DATA
NG TOTAL OF GATE OPENINGS (FT,M)
NN (V) NUMBER OF THE SPILLWAY GATE REPORTED (USED WITH HP,QS)

O DO NOT USE FOR EXTERNAL RECOGNITION. CONFUSED WITH ZERO.

P PRESSURE AND PRECIPITATION
PA PRESSURE, ATMOSPHERIC (IN-HG,KPA)
PC PRECIPITATION, ACCUMULATOR (IN,MM)
PP PRECIPITATION, ACTUAL INCREMENT (IN,MM)
PR PRECIPITATION RATE (IN/DAY,MM/DAY)
PT PRECIPITATION, TYPE (CODED, SEE TABLE 17)

TABLE 1. PHYSICAL ELEMENTS (CONTINUED)

CODE EXPLANATION (UNITS)

P PRESSURE AND PRECIPITATION (CONTINUED)
PY (S) PRECIP, INCREMENT ENDING AT 7AM LOCAL JUST PRIOR TO DATE/TIME STAMP(IN,MM)
PY.....(TRAN TO PPDRZZZ AT 7AM LOCAL TIME, SEE TABLE 2)

Q DISCHARGE
QA DISCHARGE, ADJUSTED FOR STORAGE AT PROJECT ONLY(KCFS,CMS)
QC RUNOFF VOLUME (KAF,MCM)
QD DISCHARGE, CANAL DIVERSION (KCFS,CMS)
QG DISCHARGE FROM POWER GENERATION (KCFS,CMS)
QI DISCHARGE, INFLOW (KCFS,CMS)
QL DISCHARGE, RULE CURVE (KCFS,CMS)
QM DISCHARGE, PREPROJECT CONDITIONS IN BASIN (KCFS,CMS)
QN (S) DISCHARGE, MINIMUM FLOW (KCFS,CMS) (....TRAN TO QRIRZNZ)
QP DISCHARGE, PUMPING (KCFS,CMS)
QR DISCHARGE, RIVER (KCFS,CMS)
QS DISCHARGE, SPILLWAY (KCFS,CMS)
QT DISCHARGE, COMPUTED TOTAL PROJECT OUTFLOW (KCFS,CMS)
QU DISCHARGE, CONTROLLED BY REGULATING OUTLET (KCFS,CMS)
QV CUMULATIVE VOLUME INCREMENT (KAF,MCM)
QX (S) DISCHARGE, MAXIMUM FLOW (KCFS,CMS) (....TRAN TO QRIRZXZ)
QY (S) DISCHARGE, RIVER AT 7AM LOCAL JUST PRIOR TO DATE/TIME STAMP (KCFS,CMS)
QY.....(TRAN TO QRIRZZZ AT 7AM LOCAL TIME, SEE TABLE 2)

R RADIATION
RA RADIATION, ALBEDO (%)
RC RADIATION, TOTAL SKY COVER (TENTHS)
RI RADIATION, ACCUMULATED INCOMING SOLAR OVER SPECIFIED DURATION IN LANGLEYS (LY)
RP RADIATION, SUNSHINE PERCENT OF POSSIBLE (%)
RT RADIATION, SUNSHINE HOURS (HOURS)

S SNOW DATA
SA SNOW, AREAL EXTENT OF BASIN SNOW COVER (%)
SD SNOW, DEPTH (IN,CM)
SF SNOW, DEPTH (NEW SNOWFALL) (IN,CM)
SL SNOW, ELEVATION OF SNOW LINE (KFT,M)
SR SNOW REPORT (STRUCTURE, TYPE, SURFACE, BOTTOM) (CODED, SEE TABLE 15)
SS SNOW DENSITY (IN SWE/IN SNOW, CM SWE/CM SNOW)
SW SNOW, WATER EQUIVALENT (IN,MM)

T TEMPERATURE DATA
TA TEMPERATURE, AIR (DRY BULB) (DF,DC)
TC TEMPERATURE, DEGREE DAYS OF COOLING (ABOVE 65DF, 18.3DC) (DF,DC)
TD TEMPERATURE, DEW POINT (DF,DC)
TF TEMPERATURE, DEGREE DAYS OF FREEZING (BELOW 32DF, ØDC) (DF,DC)
TH TEMPERATURE, DEGREE DAYS OF HEATING (BELOW 65DF, 18.3DC) (DF,DC)
TM TEMPERATURE, AIR (WET BULB) (DF,DC)
TN (S) TEMPERATURE, AIR (MIN) (DF,DC) (....TRAN TO TAIRZNZ)
TP TEMPERATURE, PAN WATER (DF,DC)
TS TEMPERATURE, SOIL (DF,DC)
TW TEMPERATURE, WATER (DF,DC)
TX (S) TEMPERATURE, AIR (MAX) (DF,DC) (....TRAN TO TAIRZXZ)

TABLE 1. PHYSICAL ELEMENTS (CONTINUED)

CODE EXPLANATION (UNITS)

U WIND
UC WIND, ACCUMULATED WIND TRAVEL (MI,KM)
UD WIND, DIRECTION (TENS OF DEGREES)
UL WIND, TRAVEL LENGTH ACCUMULATED OVER SPECIFIED DURATION (MI,KM)
US WIND, SPEED (MI/HR,M/SEC)

V GENERATION AND GENERATOR DATA
VB VOLTAGE - BATTERY (VOLT)
VC GENERATION, SURPLUS CAPACITY OF UNITS ON LINE (MEGAWATTS)
VE GENERATION, ENERGY TOTAL (MEGAWATT HOURS)
VG GENERATION, PUMPED WATER, POWER PRODUCED (MEGAWATTS)
VH GENERATION TIME (HOURS)
VJ GENERATION, ENERGY PRODUCED FROM PUMPED WATER (MEGAWATT HOURS)
VK GENERATION, ENERGY STORED IN RESERVOIR ONLY (MEGAWATT * 'DURATION')
VL GENERATION, STORAGE DUE TO NATURAL FLOW ONLY (MEGAWATT * 'DURATION')
VM GENERATION, LOSSES DUE TO SPILL AND OTHER WATER LOSSES (MEGAWATT * 'DURATION')
VP GENERATION, PUMPING USE, POWER USED (MEGAWATTS)
VQ GENERATION, PUMPING USE, TOTAL ENERGY USED (MEGAWATT HOURS)
VR GENERATION, STORED IN RESERVOIR PLUS NATURAL FLOW (ENERGY POTENTIAL) (MEGAWATT * 'DURATION')
VS GENERATION, STATION LOAD, ENERGY USED (MEGAWATT HOURS)
VT GENERATION, POWER TOTAL (MEGAWATTS)
VU GENERATOR, STATUS (ENCODED)
VW GENERATION, STATION LOAD, POWER USED (MEGAWATTS)

W WATER QUALITY
WA WATER, DISSOLVED NITROGEN & ARGON (PPM,MG/L)
WC WATER, CONDUCTANCE (uMHOS/CM)
WG WATER, DISSOLVED TOTAL GASES, PRESSURE (IN-HG,MM-HG)
WH WATER, DISSOLVED HYDROGEN SULFIDE (,MG/L)
WL WATER, SUSPENDED SEDIMENT (,MG/L)
WO WATER, DISSOLVED OXYGEN (PPM,MG/L)
WP WATER, PH (PH VALUE)
WT WATER, TURBIDITY (JTU)
WV WATER, VELOCITY (FT/SEC,M/SEC)

X WEATHER CODES
XG LIGHTNING, NUMBER OF STRIKES PER GRID BOX
XL LIGHTNING, POINT STRIKE (ASSUMED ONE STRIKE AT TRANSMITTED LAT AND LONG)
XP WEATHER, PAST; NWS SYNOPTIC CODE (SEE APPENDIX B)
XR HUMIDITY, RELATIVE (%,%)
XU HUMIDITY, ABSOLUTE (GRAINS/FT3,GRAMS/M3)
XV WEATHER, VISIBILITY (MI,KM)
XW WEATHER, PRESENT; NWS SYNOPTIC CODE (SEE APPENDIX A)

Y RESERVED FOR UNIQUE, STATION SPECIFIC TYPE CODES WITHIN LOCAL AREA
YA THRU YZ TO ASSIGNED ON AN INDIVIDUAL BASIS FOR UNIQUE DATA

Z RESERVED

TABLE 1. PHYSICAL ELEMENTS (CONTINUED)

UNITS ABBREVIATIONS DEFINITIONS FOR PHYSICAL ELEMENTS TABLE 1.

UNIT DEFINITION

IN = INCHES
FT = FEET
KFT= THOUSANDS OF FEET
FT2= SQUARE FEET
FT3= CUBIC FEET
KAC= THOUSANDS OF ACRES
KAF= THOUSANDS OF ACRE-FEET
CFS= CUBIC FEET PER SECOND
KCFS= THOUSANDS OF CUBIC FEET PER SECOND

MM = MILLIMETERS
CM = CENTIMETERS
M = METERS
KM = KILOMETERS
KM2= SQUARE KILOMETERS
KM3= CUBIC KILOMETERS
MCM= MILLIONS OF CUBIC METERS
CMS= CUBIC METERS PER SECOND

DF = DEGREES FAHRENHEIT
DC = DEGREES CENTIGRADE

IN-HG = INCHES OF MERCURY
MM-HG = MILLIMETERS OF MERCURY
KPA = KILOPASCALS

PPM = PARTS PER MILLION
JTU = JACKSON TURBIDITY UNITS
% = PERCENT
LY = LANGLEYS
MG/L= MILLIGRAMS PER LITER
uMHOS/CM = MICRO-MILLIOHMS PER CENTIMETER
SWE = SNOW WATER EQUIVALENT
MLLW = MEAN OF LOWER OF THE LOW WATERS (TIDES)

SEC = SECOND
HR = HOUR

UNITS CONVERSION FOR TABLE 1.

STANDARD INTERNATIONAL TO ENGLISH

ENGLISH = SI * FACTOR

SI	FACTOR	ENGLISH
MM	.0393701	IN
CM	.393701	IN
M	3.2808399	FT
M	.00328084	KFT
KM	3.2808399	KFT
KM	.6213712	MI
KM2	247.10541	KAC
MCM	.8107131	KAF
CMS	.0353147	KCFS
DC	(DC*1.8)+32	DF
KPA	.296134	IN-HG
GRAMS/FT3	2.2883564	GRAINS/FT3
M/SEC	2.2369363	MI/HR
M/SEC	3.2808399	FT/SEC

TABLE 1. PHYSICAL ELEMENTS (CONTINUED) UNITS CONVERSIONS

STANDARD HYDROLOGIC EXCHANGE FORMAT
(SHEF)

SEND CODES

SEND CODE	EXPLANATION (UNITS)
HN	HEIGHT, RIVER STAGE (FT,M) MINIMUM OF THE DAY TRANSLATED TO 'HGIRZNZ'
HX	HEIGHT, RIVER STAGE (FT,M) MAXIMUM OF THE DAY TRANSLATED TO 'HGIRZXZ'
* HY	HEIGHT, RIVER STAGE AT 7AM LOCAL PRIOR TO THE DATE/TIME STAMP (FT,M) TRANSLATED TO 'HGIRZZZ'
* PY	PRECIPITATION INCREMENT ENDING AT 7AM LOCAL PRIOR TO DATE/TIME STAMP (IN,MM) TRANSLATED TO 'PPDRZZZ'
QN	DISCHARGE, RIVER (KCFS,CMS) MINIMUM OF THE DAY TRANSLATED TO 'QRIRZNZ'
QX	DISCHARGE, RIVER (KCFS,CMS) MAXIMUM OF THE DAY TRANSLATED TO 'QRIRZXZ'
* QY	DISCHARGE, RIVER AT 7AM LOCAL PRIOR TO THE DATE/TIME STAMP (KCFS,CMS) TRANSLATED TO 'QRIRZZZ'
TN	TEMPERATURE, AIR (DF,DC) MINIMUM OF DAY TRANSLATED TO 'TAIRZNZ'
TX	TEMPERATURE, AIR (DF,DC) MAXIMUM OF DAY TRANSLATED TO 'TAIRZXZ'

* THE FOLLOWING RULES APPLY TO THE USE OF HY,PY, AND QY.

1. CANNOT BE USED WITH A ZULU TIME ZONE
2. CANNOT BE USED WITH A .E MESSAGE
3. CANNOT BE USED WITH A RELATIVE DATE CODE 'DRt'

TABLE 2. SEND CODES

STANDARD HYDROLOGIC EXCHANGE FORMAT
DURATION CODES
PE D TSEP

CODE	EXPLANATION
I	INSTANTANEOUS
U	1 MINUTE
C	15 MINUTE
J	30 MINUTE
H	ONE HOURLY
B	TWO HOURLY
T	THREE HOURLY
Q	SIX HOURLY
A	EIGHT HOURLY
K	TWELVE HOURLY
L	EIGHTEEN HOURLY
D	DAILY (TWENTY FOUR HOURLY)
W	WEEKLY
M	ONE MONTH (MONTHLY)
Y	YEARLY
P	DURATION FOR A PERIOD BEGINNING AT PREVIOUS 7AM LOCAL AND ENDING AT TIME OF OBSERVATION
* V	VARIABLE PERIOD, DURATION DEFINED SEPERATELY (SEE TABLE 11a and 11b)
S	PERIOD OF SEASONAL DURATION (NORMALLY USED TO DESIGNATE A PARTIAL PERIOD, FOR EXAMPLE 1 JANUARY TO CURRENT DATE)
R	ENTIRE PERIOD OF RECORD
X	UNKNOWN DURATION
Z	FILLER CHARACTER, POINTER TO DEFAULT DURATION FOR THAT PHYSICAL ELEMENT AS SHOWN IN TABLE 4.

* USE THE 'DVx' CODE (TABLE 11) TO SPECIFY DURATIONS NOT LISTED ABOVE

TABLE 3. DURATION CODES

STANDARD HYDROLOGIC EXCHANGE FORMAT
(SHEF)

STANDARD DEFAULTS FOR EACH PARAMETER CODE KEY
PEDTSEP

PARAMETER	KEY	CODE	DEFAULT DEFINITION
PHYSCIAL ELEMENT	PE :		NO DEFAULT, MUST BE SPECIFIED
DURATION	D :	'I'	INSTANTANEOUS
TYPE	T :	'R'	READING, OBSERVED
SOURCE	S :	'Z'	NON-SPECIFIED SOURCE
EXTREMA	E :	'Z'	NULL CHARACTER, NO VALUE ASSIGNED
PROBABILITY	P :	'Z'	NULL CHARACTER, NO VALUE ASSIGNED

EXCEPTIONS TO STANDARD DURATION DEFAULT KEY

PE	D	UNITS (ENG,SI)	PHYSICAL ELEMENT
AT	D	(HRS & MINS)	TIME BELOW CRITICAL TEMPERATURE (25 DF, -3.9 DC)
AU	D	(HRS & MINS)	TIME BELOW CRITICAL TEMPERATURE (32 DF, Ø DC)
AW	D	(HRS & MINS)	LEAF WETNESS
EA	D	(IN,MM)	EVAPOTRANSPIRATION POTENTIAL (AMOUNT)
EM	D	(IN,MM)	EVAPOTRANSPIRATION AMOUNT
EP	D	(IN,MM)	EVAPORATION, PAN INCREMENT
ER	D	(IN/DAY,MM/DAY)	EVAPORATION RATE
ET	D	(IN,MM)	EVAPOTRANSPIRATION TOTAL
EV	D	(IN,MM)	EVAPORATION, LAKE (COMPUTED)
LC	D	(KAF,MCM)	LAKE STORAGE CHANGE
PP	D	(IN,MM)	PRECIPITATION, ACTUAL INCREMENT
PR	D	(IN/DAY,MM/DAY)	PRECIPITATION RATE
QC	D	(KAF,MCM)	RUNOFF VOLUME
QV	Z	(KAF,MCM)	CUMULATIVE VOLUME INCREMENT
RI	D	(LY)	RADIATION, ACCUMULATED INCOMING SOLAR
RP	D	(%)	RADIATION, SUNSHINE PERCENT OF POSSIBLE
RT	D	(HOURS)	RADIATION, SUNSHINE HOURS
TC	S	(DEG F, DEG C)	DEGREE DAYS OF COOLING (ABOVE 65 DF, 18.3 DC)
TF	S	(DEG F, DEG C)	DEGREE DAYS OF FREEZING (BELOW 32 DF, Ø DC)
TH	S	(DEG F, DEG C)	DEGREE DAYS OF HEATING (BELOW 65 DF, 18.3 DC)
UC	D	(MI,KM)	ACCUMULATED WIND TRAVEL
UL	D	(MI,KM)	TRAVEL LENGTH ACCUMULATED OVER SPECIFIED DURATION
XG	J		LIGHTNING, NUMBER OF STRIKES PER GRID BOX
XP	Q		WEATHER, PAST; NWS SYNOPTIC CODE (APPENDIX B)

TABLE 4. STANDARD PARAMETER CODE DEFAULT KEYS AND EXCEPTIONS

STANDARD HYDROLOGICAL EXCHANGE FORMAT
TYPE AND SOURCE CODES
PED TS EP

CODE	EXPLANATION
C	CONTINGENCY DATA
C1	CONTINGENCY 1
C2	CONTINGENCY 2
C3 THRU C9	CONTINGENCY 3 THRU 9
CA THRU CY	CONTINGENCY A THRU Y
CZ	NONSPECIFIC CONTINGENCY (DEFAULT FOR THIS TYPE CATEGORY)
F	FORECAST
FA	ADJUSTED MODEL 1
FB	ADJUSTED MODEL 2
FC	ADJUSTED MODEL 3
FD	ADJUSTED MODEL 4
FE	PUBLIC VERSION, EXTERNAL
FM	MANUAL METHOD NUMBER 1
FN	MANUAL METHOD NUMBER 2
FP	MANUAL METHOD NUMBER 3
FQ	MANUAL METHOD NUMBER 4
FU	UNADJUSTED MODEL 1
FV	UNADJUSTED MODEL 2
FW	UNADJUSTED MODEL 3
FX	UNADJUSTED MODEL 4
FZ	NONSPECIFIC FORECASTED DATA (DEFAULT FOR THIS TYPE CATEGORY)
H	RESERVED FOR HISTORICAL DATA USES
P	PROCESSED DATA (NON FORECAST) (PROCESSES DEFINED LOCALLY OR BY CONVENTION AMONG INTERRELATED USERS)
PA	PROCESS #1
PB	PROCESS #2
PC	PROCESS #3
PD	PROCESS #4
PE-PY	PROCESS #5 THRU #25
PZ	NONSPECIFIC PROCESSED DATA (DEFAULT FOR THIS TYPE CATEGORY)
R	READING (OBSERVED) DATA
RA	BEST QUALITY (RETRIEVE CODE, NOT FOR TRANSMISSION)
RB	2ND BEST (RETRIEVE CODE, NOT FOR TRANSMISSION)
RC	3RD BEST (RETRIEVE CODE, NOT FOR TRANSMISSION)
RD	4TH BEST (RETRIEVE CODE, NOT FOR TRANSMISSION)
RG	GOES
RM	METEOR BURST
RP	PHONE ASCII (DARDC)
RR	RADIO #1
RS	RADIO #2
RT	TELEMARK/BDT (PHONE AUDIO)
RV	VISUAL/MANUAL #1
RW	VISUAL/MANUAL #2
RX	VISUAL/MANUAL #3
RZ	NONSPECIFIC OBSERVED READING (DEFAULT FOR THIS CATEGORY, AND UNIVERSAL DEFAULT FOR TYPE/SOURCE)

TABLE 5. TYPE AND SOURCE CODES

STANDARD HYDROLOGICAL EXCHANGE FORMAT
EXTREMA CODES
PEDTS E P

CODE	EXPLANATION
J	MINIMUM OF RECORD
K	MINIMUM OF YEAR (CALENDER)
L	MINIMUM OF MONTH
M	MINIMUM OF WEEK
N	MINIMUM OF DAY
P	MINIMUM OF 12 HOURS
T	MAXIMUM OF RECORD
U	MAXIMUM OF YEAR (CALENDER)
V	MAXIMUM OF MONTH
W	MAXIMUM OF WEEK
X	MAXIMUM OF DAY
Y	MAXIMUM OF 12 HOURS
Z	NULL CHARACTER (FILLER)

TABLE 6. EXTREMA CODES

STANDARD HYDROLOGICAL EXCHANGE FORMAT
PROBABILITY CODES
PEDTSE P

CODE		EXPLANATION
A	.002	CHANCE VALUE IS AT OR BELOW THE SPECIFIED VALUE
B	.004	" " " " " " " " "
C	.01	" " " " " " " " "
D	.02	" " " " " " " " "
E	.04	" " " " " " " " "
F	.05	" " " " " " " " "
1	.1	" " " " " " " " "
2	.2	" " " " " " " " "
G	.25	" " " " " " " " "
3	.3	" " " " " " " " "
4	.4	" " " " " " " " "
5	.5	" " " " " " " " "
6	.6	" " " " " " " " "
7	.7	" " " " " " " " "
H	.75	" " " " " " " " "
8	.8	" " " " " " " " "
9	.9	" " " " " " " " "
T	.95	" " " " " " " " "
U	.96	" " " " " " " " "
V	.98	" " " " " " " " "
W	.99	" " " " " " " " "
X	.996	" " " " " " " " "
Y	.998	" " " " " " " " "
J	.0013	CHANCE VALUE BELOW SPECIFIED: -3 STANDARD DEVIATIONS
K	.0228	" " " " -2 " "
L	.1587	" " " " -1 " "
M	MEAN (EXPECTED VALUE)	
N	.8413	CHANCE VALUE BELOW SPECIFIED: +1 STANDARD DEVIATIONS
P	.9772	" " " " +2 " "
Q	.9987	" " " " +3 " "
Z	NULL CHARACTER (FILLER)	

TABLE 7. PROBABILITY CODES

STANDARD HYDROLOGICAL EXCHANGE FORMAT
TIME ZONE DESIGNATORS
'tz'

CODE	EXPLANATION
N	NEWFOUNDLAND LOCAL TIME
NS	NEWFOUNDLAND STANDARD TIME
A	ATLANTIC LOCAL TIME
AD	ATLANTIC DAYLIGHT TIME
AS	ATLANTIC STANDARD TIME
E	EASTERN LOCAL TIME
ED	EASTERN DAYLIGHT TIME
ES	EASTERN STANDARD TIME
C	CENTRAL LOCAL TIME
CD	CENTRAL DAYLIGHT TIME
CS	CENTRAL STANDARD TIME
M	MOUNTAIN LOCAL TIME
MD	MOUNTAIN DAYLIGHT TIME
MS	MOUNTAIN STANDARD TIME
P	PACIFIC LOCAL TIME
PD	PACIFIC DAYLIGHT TIME
PS	PACIFIC STANDARD TIME
Y	YUKON LOCAL TIME
YD	YUKON DAYLIGHT TIME
YS	YUKON STANDARD TIME
H	HAWAIIAN LOCAL TIME
HS	HAWAIIAN STANDARD TIME
L	ALASKAN LOCAL TIME
LD	ALASKAN DAYLIGHT TIME
LS	ALASKAN STANDARD TIME
B	BERING LOCAL TIME
BD	BERING DAYLIGHT TIME
BS	BERING STANDARD TIME
Z	ZULU TIME (GMT) (DEFAULT TIME ZONE IF 'tz' NOT SPECIFIED)

TABLE 8. TIME ZONE DESIGNATORS

D DATE/DATA TYPE ELEMENTS

CODE	EXPLANATION
DN	MINUTE OF HOUR (nn)
DH	HOUR OF DAY (hh);(hhnn)
DD	DAY OF MONTH (dd);(ddhh);(ddhhnn)
DM	MONTH OF YEAR (mm);(mmdd);(mmddhh);(mmddhhnn)
DJ	JULIAN DATE (ddd);(yyddd)
DY	YEAR (yy);(yymm);(yymmdd);(yymmddhh);(yymmddhhnn)
DC	FORECAST CREATION DATE (mmddhh);(yymmddhh);(yymmddhhnn)
* DI	TIME INTERVAL SPECIFIER FOR .E FORMAT (SEE TABLE 12)
* DQ	DATA QUALIFIER FOR REST OF LINE (SEE TABLE 10)
* DR	DATE RELATIVE INCREMENT (SEE TABLE 13)
* DU	UNIT TYPE CHANGE (E=ENGLISH, S=STANDARD INTERNATIONAL)
* DV	DURATION VARIABLE CODE (SEE TABLE 11a & 11b)

* THESE CODES HAVE SPECIAL APPLICATIONS SEE APPROPRIATE TABLES

TABLE 9a. DATE/DATA TYPE ELEMENTS

*****

DATE/DATA TIME UNIT DEFINITIONS

* CODE	DEFINITION
nn -	MINUTE (00 - 59)
hh -	HOUR (00 - 24)
dd -	DAY (01 - 31)
mm -	MONTH (01 - 12)
ddd-	JULIAN DAY (001 - 366)
yy -	YEAR (00 - 99)

* WHEN USED IN AN OBSERVATION TIME ELEMENT,
THESE CODES REQUIRE PADDING TO FULL POSITIONAL FIELD SIZE

TABLE 9b. DATE/DATA TIME UNIT DEFINITIONS

STANDARD HYDROLOGICAL EXCHANGE FORMAT
(SHEF)

DATA QUALIFIER CODES

CODE	EXPLANATION
E	ESTIMATED
F	FLAGGED BY SENSOR OR TELEMETRY (PARITY ERRORS FOR EXAMPLE)
R	REJECTED
Q	QUESTIONED
T	TRIGGERED (TELLS DATABASE TO START SOME ADDITIONAL FUNCTION)
S	SCREENED LEVEL 1 (DATA VALUE TESTED USING PRELIMINARY CRITERIA)
V	SCREENED LEVEL 2 (DATA VALUE VERIFIED USING A MORE RIGOROUS METHOD THAN LEVEL 1)
Z	FILLER (NULL CHARACTER, NO QUALIFICATION)

NOTE: ALL OTHER LETTERS, EXCEPT O AND I, ARE RESERVED FOR FUTURE USE. SOFTWARE SHOULD NOT ASSUME THAT THE ABOVE LIST IS ALL THAT WILL EVER BE USED.

TABLE 10. DATA QUALIFIER CODES

DURATION CODE VARIABLE SPECIFIER
'DVx'

CODE UNITS	DEFINITION
DVNnn	MINUTES
DVHhh	HOURS
DVDdd	DAYS
DVMmm	MONTHS
DVYyy	YEARS
DVZ	DEFAULT FOR PARTICULAR PHYSICAL ELEMENT

TABLE 11a. DURATION CODE VARIABLE SPECIFIER

*****

DURATION CODE VARIABLE SPECFIER UNITS

CODE	UNITS	RANGE
nn-	MINUTES	(Ø-99)
hh-	HOURS	(Ø-99)
dd-	DAYS	(Ø-99)
mm-	MONTHS	(Ø-99)
yy-	YEARS	(Ø-99)

TABLE 11b. DURATION CODE VARIABLE SPECIFIER UNITS

TIME INTERVAL SPECIFIER FOR .E FORMAT
'DIx'

CODE UNITS	DEFINITION
DINnn	MINUTES
DIHhh	HOURS
DIDdd	DAYS
DIMmm	MONTHS
* DIEmm	MONTHS
DIYyy	YEARS

* FOR USE FOR END OF MONTH DATA ONLY

TABLE 12a. TIME INTERVAL SPECIFIER FOR .E FORMAT

*****

TIME UNIT INTERVAL SPECIFIER UNITS

CODE	UNITS	RANGE
nn-	MINUTES	(Ø-99)
hh-	HOURS	(Ø-99)
dd-	DAYS	(Ø-99)
mm-	MONTHS	(Ø-99)
yy-	YEARS	(Ø-99)

TABLE 12b. TIME UNIT INTERVAL SPECIFIER UNITS

DATE RELATIVE CODE
'DRx'

CODE UNITS	DEFINITION
DRN±nn	MINUTES
DRH±hh	HOURS
DRD±dd	DAYS
DRM±mm	MONTHS
* DRE±mm	MONTHS
DRY±yy	YEARS

* FOR USE WITH END OF MONTH DATA ONLY

TABLE 13a. DATE RELATIVE CODE

*****

DATE RELATIVE TIME UNITS DEFINITIONS

CODE	UNITS	RANGE
nn-	MINUTES	(Ø-99)
hh-	HOURS	(Ø-99)
dd-	DAYS	(Ø-99)
mm-	MONTHS	(Ø-99)
yy-	YEARS	(Ø-99)

TABLE 13b. DATE RELATIVE TIME UNIT DEFINITIONS

STANDARD HYDROLOGIC EXCHANGE FORMAT
(SHEF)

ICE CODES
FOR ICE REPORT 'IR'

ICE, STRUCTURE	CODE	ICE, TYPE	CODE	
NO REPORT	0	NO REPORT	0	
BREAKING ICE	1	ANCHOR	1	(ALSO BOTTOM ICE)
FLOATING (RUNNING)	2	CAKE	2	
HANGING	3	CLEAR	3	
HONEYCOMB	4	FRAZIL	4	
LAYERED	5	ICE GORGE	5	(ALSO JAMMED ICE)
ROTTEN	6	LOCALLY FORMED	6	
STATIONARY	7	SHEET ICE	7	
STOPPED	8	SHELL ICE	8	(ALSO ICE BRIDGE)
SLUSH	9	SHORE ICE	9	

ICE, COVER	CODE
NO ICE	0
1/10 COVER	1
2/10 ""	2
3/10 ""	3
4/10 ""	4
5/10 ""	5
6/10 ""	6
7/10 ""	7
8/10 - 9/10	8
FULLY COVERED	9

****

THE ICE REPORT CONSISTS OF A 3 DIGIT CODE

IR $x^1x^2x^3$
IR x^2x^3
IR x^3

x^1 =ICE STRUCTURE
x^2 =ICE TYPE
x^3 =ICE COVER

TABLE 14. ICE CODES FOR ICE REPORT 'IR'

SNOW CODES
FOR SNOW REPORT 'SR'

SNOW STRUCTURE	
NO REPORT	Ø
LOOSELY PACKED	1
DENSELY PACKED	2

BASE OF SNOWCOVER	
NO REPORT	Ø
WET SNOW	1
DRY SNOW	2
ICE LAYER	3

SURFACE OF SNOWCOVER	
NO REPORT	Ø
SNOW CRUST	1
LOOSE	2
ICE	3

AREA DESCRIPTION	
NO REPORT	Ø
UNIFORM	1
SOME DRIFTS	2
DRIFTED	3

THE SNOW REPORT CONSISTS OF A 4 DIGIT CODE

SR $x^1x^2x^3x^4$
SR $x^2x^3x^4$
SR x^3x^4
SR x^4

x^1 =SNOW STRUCTURE
x^2 =BASE OF SNOWCOVER
x^3 =SURFACE OF SNOWCOVER
x^4 =AREA DESCRIPTION

TABLE 15. SNOW REPORT CODES 'SR'

STANDARD HYDROLOGIC EXCHANGE FORMAT
(SHEF)

GROUND FROST REPORT
FOR GROUND FROST STRUCTURE 'GR'

FROST, STRUCTURE OF FROZEN GROUND	
CONCRETE	1
GRANULAR	2
HONEYCOMB	3
STALACTITE	4

TABLE 16. GROUND FROST REPORT FOR GROUND FROST STRUCTURE 'GR'

RIVER TREND INDICATOR CODE
'HI'

CODE	DEFINITION
Ø	STATIONARY
1	RISING
2	FALLING
3	UNKNOWN
4	STATIONARY *
5	RISING *
6	FALLING *
7	FROZEN

* CODE FIGURES 4,5, OR 6 AS APPROPRIATE ONLY WHEN STAGE IS AT OR ABOVE FLOOD STAGE

TABLE 19. RIVER TREND CODE

SURFACE FROST INTENSITY CODES
'AF'

CODE	DEFINITION
Ø	NO FROST
1	LIGHT FROST: (SURFACE OBJECTS,VEGETATION, ETC., COVERED WITH A THIN DEPOSIT OF FROST, WHICH MAY BE MORE OR LESS PATCHY)
2	MODERATE FROST: (SURFACE OBJECTS, VEGETATION, ETC., COVERED WITH A THICKER, BUT PATCHY DEPOSIT OF FROST)
3	HEAVY FROST: (SURFACE OBJECTS, VEGETATION, ETC., COVERED WITH COPIOUS DEPOSIT OF FROST)

TABLE 2Ø. SURFACE FROST INTENSITY CODES

SURFACE DEW INTENSITY CODES
'AM'

CODE	DEFINITION
Ø	NONE
1	LIGHT DEW: (DEW DROPLETS NOT CONNECTED, NO DEW UNDER TREES OR SHELTERED AREAS)
2	MODERATED DEW: (DEW DROPLETS MOSTLY CONNECTED, BUT SURFACES NOT SATURATED AND NO DRIPPING OCCURRING)
3	HEAVY DEW: (NEARLY SATURATED SURFACES AND DRIPPING, SOME MOISTURE UNDER TREES AND SHELTERED AREAS)

TABLE 21. SURFACE DEW INTENSITY CODES

PRECIPITATION TYPE CODES
'PT'

CODE	DEFINITION
0	ICE PRISM
1	RAIN
2	FREEZING RAIN
3	DRIZZLE
4	FREEZING DRIZZLE
5	SNOW
6	SNOW PELLETS
7	SNOW GRAINS
8	ICE PELLETS
9	HAIL

TABLE 17. PRECIPITATION TYPE CODES

STATE OF GROUND
'GS'

(WMO TABLES 901 AND 945)

0-9 WITHOUT SNOW OR MEASUREABLE ICE COVER
10-19 WITH SNOW OR MEASUREABLE ICE COVER

CODE	EXPLANATION
0	SURFACE OF GROUND DRY (WITHOUT CRACKS AND NO APPRECIABLE AMOUNT OF LOOSE SAND)
1	SURFACE OF GROUND MOIST
2	SURFACE OF GROUND WET (STANDING WATER IN SMALL OR LARGE POOLS ON SURFACE)
3	FLOODED
4	SURFACE OF GROUND FROZEN
5	GLAZE ON GROUND
6	LOOSE DRY DUST OR SAND NOT COVERING GROUND COMPLETELY
7	THIN COVER OF LOOSE DRY DUST OR SAND COVERING GROUND COMPLETELY
8	MODERATE OR THICK COVER OF LOOSE DRY DUST OR SAND COVERING GROUND COMPLETELY
9	EXTREMELY DRY WITH CRACKS
10	GROUND PREDOMINANTLY COVERED BY ICE
11	COMPACT OR WET SNOW (WITH OR WITHOUT ICE) COVERING LESS THAN ONE-HALF OF THE GROUND
12	COMPACT OR WET SNOW (WITH OR WITHOUT ICE) COVERING AT LEAST ONE-HALF OF THE GROUND BUT GROUND NOT COMPLETELY COVERED
13	EVEN LAYER OF COMPACT OR WET SNOW COVERING GROUND COMPLETELY
14	UNEVEN LAYER OF COMPACT OR WET SNOW COVERING GROUND COMPLETELY
15	LOOSE DRY SNOW COVERING LESS THAN ONE-HALF OF THE GROUND
16	LOOSE DRY SNOW COVERING AT LEAST ONE-HALF OF THE GROUND (BUT NOT COMPLETELY)
17	EVEN LAYER OF LOOSE DRY SNOW COVERING GROUND COMPLETELY
18	UNEVEN LAYER OF LOOSE DRY SNOW COVERING GROUND COMPLETELY
19	SNOW COVERING GROUND COMPLETELY; DEEP DRIFTS

TABLE 18. STATE OF GROUND

NWS SYNOPTIC CODES

Code Table 4

[WMO Code 4677]

Symbol ww=Present Weather

00—49: No precipitation at the station at the time of observation.

00—19: No precipitation, fog, ice fog (except for 11 and 12), duststorm, drifting or blowing snow at the station at the time of observation or, except for 09 and 17, during the preceding hour.

No meteors except photometeors:

- 00 Cloud development not observed or not observable.
- 01 Clouds generally dissolving or becoming less developed.
- 02 State of sky on the whole unchanged.
- 03 Clouds generally forming or developing.

(00–03: Characteristic change of the state of sky during past hour.)

Haze, dust, sand or smoke:

- 04 Visibility reduced by smoke, e.g., veldt or forest fires, industrial smoke or volcanic ashes.
- 05 Haze.
- 06 Widespread dust in suspension in the air, not raised by wind at or near the station at the time of observation.
- 07 Dust or sand raised by wind at or near the station at the time of observation, but no well developed dust whirl(s) or sand whirl(s), and no duststorm or sandstorm seen: or, in the case of ships, blowing spray at the station.
- 08 Well developed dust whirl(s) or sand whirl(s) seen at or near the station during the preceding hour, or at the time of observation, but no duststorm or sandstorm.
- 09 Duststorm or sandstorm within sight at the time of observation or at station during the preceding hour.

- 10 Light fog.[1] (Vis. 1,100 yds. or more.)
- 11 Patches of
- 12 More or less continuous

(11–12: shallow fog or ice fog at the station, whether on land or sea, not deeper than about 6 feet on land or 33 feet at sea. (Apparent vis. less than 1,100 yds.))

- 13 Lightning visible, no thunder heard.
- 14 Precipitation within sight, but not reaching the ground or the surface of the sea.
- 15 Precipitation within sight, reaching the ground or the surface of the sea, but distant (i.e., estimated to be more than 3.1 miles) from the station.
- 16 Precipitation within sight, reaching the ground or the surface of the sea near to but not at the station.
- 17 Thunderstorm, but no precipitation at the time of observation.
- 18 Squalls at or within sight of the station during the preceding hour or at the time of observation.
- 19 Funnel cloud(s) (i.e., tornado cloud or waterspout) at or within sight of the station during the preceding hour or at the time of observation.

20—29: Precipitation, fog, ice fog or thunderstorm at the station during the preceding hour but not at the time of observation.

- 20 Drizzle (not freezing) or snow grains
- 21 Rain (not freezing)
- 22 Snow
- 23 Rain and snow or ice pellets (type a)
- 24 Freezing drizzle or freezing rain

(20–24: Not falling as shower(s).)

- 25 Shower(s) of rain.
- 26 Shower(s) of snow, or of rain and snow.
- 27 Shower(s) of hail,[2] or of rain and hail.[2]
- 28 Fog or ice fog. (Vis. less than 1,100 yds.).
- 29 Thunderstorm (with or without precipitation).

30—39: Duststorm, sandstorm, drifting or blowing snow.

Slight or moderate duststorm or sandstorm:

- 30 Has decreased during the preceding hour.
- 31 No appreciable change during the preceding hour.
- 32 Has begun or has increased during the preceding hour.

Severe duststorm or sandstorm:

- 33 Has decreased during the preceding hour.
- 34 No appreciable change during the preceding hour.
- 35 Has begun or has increased during the preceding hour.

- 36 Slight or moderate drifting snow, generally low. (Less than 6 ft.)
- 37 Heavy drifting snow, generally low. (Less than 6 ft.)
- 38 Slight or moderate blowing snow, generally high. (6 ft. or more)
- 39 Heavy blowing snow, generally high. (6 ft. or more)

40—49: Fog or ice fog at the time of observation. (Vis. less than 1,100 yds.)

- 40 Fog or ice fog at a distance at the time of observation, but not at the station during the preceding hour, the fog or ice fog extending to a level above that of the observer.
- 41 Fog or ice fog in patches
- 42 Fog or ice fog, sky discernible
- 43 Fog or ice fog, sky not discernible

(42–43: Has become thinner during the preceding hour.)

- 44 Fog or ice fog, sky discernible
- 45 Fog or ice fog, sky not discernible

(44–45: No appreciable change during the preceding hour.)

Code Table 4—Continued

46	Fog or ice fog, sky discernible	Has begun or has become thicker during the preceding hour.
47	Fog or ice fog, sky not discernible	

48 Fog, depositing rime, sky discernible.
49 Fog, depositing rime, sky not discernible.

50—99: Precipitation at the station at the time of observation

50—59: Drizzle.

50	Drizzle, not freezing, intermittent	Slight at time of observation.
51	Drizzle, not freezing, continuous	
52	Drizzle, not freezing, intermittent	Moderate at time of observation.
53	Drizzle, not freezing, continuous	
54	Drizzle, not freezing, intermittent	Heavy (dense) at time of observation.
55	Drizzle, not freezing, continuous	

56 Drizzle, freezing, slight.
57 Drizzle, freezing, moderate or heavy (dense).
58 Drizzle and rain, slight.
59 Drizzle and rain, moderate or heavy.

60—69: Rain.

60	Rain, not freezing, intermittent	Slight at time of observation.
61	Rain, not freezing, continuous	
62	Rain, not freezing, intermittent	Moderate at time of observation.
63	Rain, not freezing, continuous	
64	Rain, not freezing, intermittent	Heavy at time of observation.
65	Rain, not freezing, continuous	

66 Rain, freezing, slight.
67 Rain, freezing, moderate or heavy.
68 Rain or drizzle and snow, slight.
69 Rain or drizzle and snow, moderate or heavy.

70—79: Solid precipitation not in showers

70	Intermittent fall of snow flakes	Slight at time of observation.
71	Continuous fall of snow flakes	
72	Intermittent fall of snow flakes	Moderate at time of observation.
73	Continuous fall of snow flakes	
74	Intermittent fall of snow flakes	Heavy at time of observation.
75	Continuous fall of snow flakes	

76 Ice prisms (with or without fog).
77 Snow grains (with or without fog).
78 Isolated starlike snow crystals (with or without fog).
79 Ice pellets (type a) (sleet, U.S. definition).

80—99: Showery precipitation, or precipitation with current or recent thunderstorm

80 Rain shower(s), slight.
81 Rain shower(s), moderate or heavy.
82 Rain shower(s), violent.
83 Shower(s) of rain and snow mixed, slight.
84 Shower(s) of rain and snow mixed, moderate or heavy.
85 Snow shower(s), slight.
86 Snow shower(s), moderate or heavy.

87	Shower(s) of snow pellets, or ice pellets (type b) with or without rain or rain and snow mixed.	Slight.
88		Moderate or heavy.
89	Shower(s) of hail,[2] with or without rain or rain and snow mixed, not associated with thunder.	Slight.
90		Moderate or heavy.
91	Slight rain at time of observation.	Thunderstorm during the preceding hour but not at time of observation.
92	Moderate or heavy rain at time of observation.	
93	Slight snow or rain and snow mixed or hail [3] at time of observation.	
94	Moderate or heavy snow, or rain and snow mixed or hail [3] at time of observation.	
95	Thunderstorm, slight or moderate, without hail [3] but with rain and/or snow at time of observation.	Thunderstorm at time of observation.
96	Thunderstorm, slight or moderate, with hail [3] at time of observation.	
97	Thunderstorm, heavy, without hail, [3] but with rain and/or snow at time of observation.	
98	Thunderstorm combined with duststorm or sandstorm at time of observation.	Thunderstorm at time of observation.
99	Thunderstorm, heavy with hail [3] at time of observation.	

[1] The U.S. term, "light fog" is synonymous with the European term "mist."
[2] Refers to "hail" only.
[3] Refers to snow pellets, ice pellets (type b), and hail.

NOTE.—With respect to precipitation, "at the station" means "at the point where the observation is normally taken."

PAST WEATHER CODE
(MOST SIGNIFICANT IN LAST 6 HOURS)
'XP'

(WMO TABLE 456)

CODE	DEFINITION
Ø	CLOUD COVERING ONE-HALF OR LESS OF THE SKY THROUGHOUT PERIOD
1	CLOUD COVERING MORE THAN ONE-HALF OF THE SKY PART OF THE APPROPRIATE PERIOD AND COVERING ONE-HALF OR LESS DURING PART OF THE PERIOD
2	CLOUD COVERING MORE THAN ONE-HALF OF THE SKY THROUGHOUT THE APPROPRIATE PERIOD
3	SANDSTORM, DUSTSTORM OR BLOWING SNOW
4	FOG OR ICE FOG OR THICK HAZE
5	DRIZZLE
6	RAIN
7	SNOW, OR RAIN AND SNOW MIXED
8	SHOWER(S)
9	THUNDERSTORM(S) WITH OR WITHOUT PRECIPITATION

STANDARD HYDROLOGIC EXCHANGE FORMAT (SHEF)

ICE AND FROST TERMINOLOGY

Terminology - ICE Type

Running Ice	- moving with current
Stationary Ice	- not in motion because of no current
Stopped Ice	- not in motion in spite of current
Jammed Ice	- jammed or gorged. An accumulation of broken river ice caught against an obstruction or construction.
Formed locally	- not brought in by current
Shore Ice	- formed along and fastened to shore, does not extend the entire width across.
Anchor Ice	- Ice that forms on the bottom of a stream in the form of a cap or layer.
Cake Ice	- Surface ice or an ice gorge having broken at some point upstream.
Shell Ice	- Ice, on a body of water that remains as an unbroken surface when the water lowers so that a space occurs between the water surface and the ice (also called cat ice and ice bridge).

Terminology - ICE Structure

Breaking Ice	- When stopped, jammed or frozen ice shows signs of weakening or cracking. Usually accompanied by cracking noises.
Honeycombed	- contains numerous small air bubbles or spaces
Rotten	- has been weakened by warm temperatures
Layered	- ice formed in distinct layers, similar to plywood
Clear	- clear ice, also called blade ice
Hanging	- An agglomeration of slush ice attached, or in the process of attaching to the bottom of sheet ice.
Frazil	- suspended ice composed of small crystals (also called needle ice)
Slush	- an accumulation of ice crystals which remain separate or only slightly frozen together
Sheet	- smooth thin layer of ice on a quiet water surface

Terminology - FROST, Structure of Frozen Ground

Concrete	- saturated or supersaturated ground that is completely frozen, extremely dense
Granualar	- small ice crystals intermixed with soil particles and aggregated around them. Loose, porous, easily broken into pieces
Honeycomb	- similar to granular, but with a higher degree of connection among ice crystals and a lower porosity
Stalactite	- small needle like ice crystals aligned vertically and extending downward into the soil from a heaved surface. Often formed from a refreeze period.

DAYLIGHT/STANDARD TIME CHANGE DATES
1976-2007

YEAR	DAY IN APRIL	DAY IN OCTOBER
1976	26	31
1977	24	30
1978	30	29
1979	29	28
1980	27	26
1981	26	25
1982	25	31
1983	24	30
1984	29	28
1985	28	27
1986	27	26
1987	26	25
1988	24	30
1989	30	29
1990	29	28
1991	28	27
1992	26	25
1993	25	31
1994	24	30
1995	30	29
1996	28	27
1997	27	26
1998	26	25
1999	25	31
2000	30	29
2001	29	28
2002	28	27
2003	27	26
2004	25	31
2005	24	30
2006	30	29
2007	29	28

SEE TEXT, SECTION V.14, RULES FOR CODING DATA DURING TIME CHANGES

121 Climatological Prediction of Cumulonimbus Clouds in the Vicinity of the Yucca Flat Weather Station. R. F. Quiring, June 1977. (PB-271-704/AS)
122 A Method for Transforming Temperature Distribution to Normality. Morris S. Webb, Jr., June 1977. (PB-271-742/AS)
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131 Automated Fire-Weather Forecasts. Mark A. Mollner and David E. Olsen, September 1978. (PB-289-916/AS)
132 Estimates of the Effects of Terrain Blocking on the Los Angeles WSR-74C Weather Radar. R. G. Pappas, R. Y. Lee, B. W. Finke, October 1978. (PB289767/AS)
133 Spectral Techniques in Ocean Wave Forecasting. John A. Jannuzzi, October 1978. (PB291317/AS)
134 Solar Radiation. John A. Jannuzzi, November 1978. (PB291195/AS)
135 Application of a Spectrum Analyzer in Forecasting Ocean Swell in Southern California Coastal Waters. Lawrence P. Kierulff, January 1979. (PB292716/AS)
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144 Arizona Cool Season Climatological Surface Wind and Pressure Gradient Study. Ira S. Brenner, May 1979. (PB298900/AS)
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146 The BART Experiment. Morris S. Webb, October 1979. (PB80-155112)
147 Occurrence and Distribution of Flash Floods in the Western Region. Thomas L. Dietrich, December 1979. (PB80-160344)
149 Misinterpretations of Precipitation Probability Forecasts. Allan H. Murphy, Sarah Lichtenstein, Baruch Fischhoff, and Robert L. Winkler, February 1980. (PB80-174576)
150 Annual Data and Verification Tabulation - Eastern and Central North Pacific Tropical Storms and Hurricanes 1979. Emil B. Gunther and Staff, EPHC, April 1980. (PB80-220486)
151 NMC Model Performance in the Northeast Pacific. James E. Overland, PMEL-ERL, April 1980. (PB80-196033)
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168 Forecasting the Onset of Coastal Gales Off Washington-Oregon. John R. Zimmerman and William D. Burton, August 1981. (PB82-127051)
169 A Statistical-Dynamical Model for Prediction of Tropical Cyclone Motion in the Eastern North Pacific Ocean. Preston W. Leftwich, Jr., October 1981.
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179 Stratified Maximum Temperature Relationships Between Sixteen Zone Stations in Arizona and Respective Key Stations. Ira S. Brenner, June 1983.

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