Designation: E1708 – 14

Standard Practice for Electronic Interchange of Color and Appearance Data[1]

This standard is issued under the fixed designation E1708; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This practice covers procedures to be used in the electronic exchange of color and appearance data between users, by either modem or the physical transfer of electronic media. It is intended for use by manufacturers of color-measuring instruments and developers of software so that any instrument may acquire data for its use that may have been measured on an instrument of another manufacturer, at another place, or at another time.

1.2 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]
E284 Terminology of Appearance

3. Terminology

3.1 Definitions of terms in Terminology E284 are applicable to this practice.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *data value identifier, n*—a keyword that identifies the contents of a data field and, by definition, signals the data type of the field as string, integer, or floating point.

3.2.2 *keyword, n—in electronic interchange*, an alphanumeric designator that defines the nature or number of following data fields.

3.2.2.1 *Discussion*—The word is used in its ordinary dictionary sense in Section 7.

3.2.3 *white space, n*—a valid character representation that does not generate a printable character in a file.

3.2.3.1 *Discussion*—Valid ASCII white space characters are *space* (decimal 32), *carriage return* (decimal 13), *form feed* (decimal 12), *vertical tab* (decimal 11), *newline* (decimal 10), and *horizontal tab* (decimal 9).

4. Summary of Practice

4.1 Users of this practice are given a mandatory list of keywords. The user fills out the list with the data values associated with each keyword. The user may then select from an optional list of keywords. The user then associates with these keywords the data values required to be transmitted.

4.2 The keywords are used at the receiving end of the transmission to decode the format and number of data values present in the transmission.

5. Significance and Use

5.1 This practice should be used by manufacturers of color-measuring instruments and developers of software when the transmission of color and appearance data is desired between instruments or computers and where ASCII files are the desired method of transfer.

5.2 The method of transmission may be via direct connection, modem, or the transfer of electronic media, for example, by floppy disk transfer.

5.3 The practice lends itself to the transmission of either a single record of data or multiple record files.

5.4 Examples of files generated in this practice are contained in Fig. X1.1 and Fig. X2.1 of Appendix X1 and Appendix X2.

6. Procedure

6.1 Prepare a file using ASCII code that consists of the mandatory keyword list followed by the associated data values. Each keyword and each data value is delimited by white space. The record may be organized into logical units associated with each keyword by using the carriage return character for the white space delimiter at the end of the data values associated with any keyword.

6.1.1 Every keyword in the record must be followed by at least one character of white space as a delimiter. Do not precede keywords on a line by other than white space. The exception to this recommendation, which is made to assist

[1] This practice is under the jurisdiction of ASTM Committee E12 on Color and Appearance and is the direct responsibility of Subcommittee E12.04 on Color and Appearance Analysis.

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

human readability, is the use of keywords as data value identifiers, which are listed in order on one line, if possible, so that they may be interpreted by the human reader as column headings.

6.1.2 The specification of data value identifiers is entirely optional regarding the choice and number of identifiers. Data value identifiers are placed between the BEGIN_ DATA_ FORMAT keyword and the END_DATA_ FORMAT keyword. Each data value identifier must be separated by at least one character of white space.

6.2 *Mandatory Keywords*—The following keywords are mandatory in a record:

6.2.1 *E1708YY*—The first seven characters in the file must be this keyword, where the digits YY are numeric for the year of revision of this practice that was used to formulate the record.

6.2.2 ORIGINATOR—The alphanumeric data value associated with this keyword is the specific system, organization, or individual originating the record.

6.2.3 DESCRIPTOR—The alphanumeric data value associated with this keyword contains a description of the purpose or content of the record.

6.2.4 CREATED—The alphanumeric data value associated with this keyword contains the date on which the record was created or the data measured.

6.2.5 NUMBER_OF_FIELDS—The integer data value associated with this keyword contains the number of data format identifiers prescribed in the data format definition that follows.

6.2.6 BEGIN_DATA_FORMAT—No data value is associated with this keyword. The keyword identifies the beginning of the list of data value identifiers.

6.2.7 END_DATA_FORMAT—No data value is associated with this keyword. The keyword identifies the end of the list of data value identifiers.

6.2.8 NUMBER_OF_SETS—The integer data value associated with this keyword denotes the number of data sets with the format described by the list of data value identifiers.

6.2.9 BEGIN_DATA—No data value is associated with this keyword. The keyword marks the beginning of the data value list defined by the data value identifier list and the NUMBER _OF_SETS of data keyword.

6.2.10 END_DATA—No data value is associated with this keyword. The keyword marks the end of the data list.

6.3 *Data Value Identifiers*—The following default data value identifiers are recognized by automated readers. The list contains the data value identifier, followed by its data type, and finally a description of the contents of the data field associated with the descriptor. The alphanumeric data type is indicated by CS. The integer data type is indicated by I. The floating point data type is indicated by F.

6.3.1 SPECIMEN_ID, CS—This identifies the specimen that the data represent.

6.3.2 STRING, CS—This indicates that the field contains any alphanumeric value it may be necessary to transmit. This keyword is used to identify label information, lot number information, or other string values associated with the record.

6.3.3 SPECTRAL_NM, I—This identifies the wavelength, in nm, of an associated data value.

6.3.4 SPECTRAL_PC, F—This indicates that the associated data value is in units of percent reflectance or percent transmittance.

6.3.5 SPECTRAL_RT, F—This indicates that the associated data value is a spectral reflectance factor or spectral transmittance factor.

6.3.6 SPECTRAL_RM, F—This indicates that the associated value is a spectroradiometric quantity.

6.3.7 XYZ_X, F—This indicates that the associated data value is a CIE X tristimulus value.

6.3.8 XYZ_Y, F—This is a CIE Y tristimulus value.

6.3.9 XYZ_Z, F—This is a CIE Z tristimulus value.

6.3.10 XYY_CAPY, F—This is a CIE Y tristimulus value. This keyword is used as an alternative to XYZ_Y when the data are furnished in chromaticity coordinates and luminance format.

6.3.11 XYY_X, F—This is a CIE x chromaticity coordinate.

6.3.12 XYY_Y, F—This is a CIE y chromaticity coordinate.

6.3.13 LAB_L, F—This is a CIE 1976 metric lightness value, L^*.

6.3.14 LAB_A, F—This is a CIE 1976 redness-greenness value, a^*.

6.3.15 LAB_B, F—This is a CIE 1976 yellowness-blueness value, b^*.

6.3.16 LAB_U, F—This is a CIE 1976 redness-greenness value, u^*.

6.3.17 LAB_V, F—This is a CIE 1976 yellowness-blueness value, v^*.

6.3.18 LAB_C, F—This is a CIE 1976 metric chroma value, C^*.

6.3.19 LAB_H, F—This is a CIE 1976 *a, b* hue angle, h_{ab}.

6.3.20 LAB_DE, F—This is a CIE 1976 metric color difference value, ΔE^*_{ab}.

6.4 *Data Values*—Data values must be formatted to correspond to the type of data called for by the keyword definition.

6.4.1 Alphanumeric data must be enclosed by the character "double-quote" (decimal 34) at beginning and ending. The double-quote character embedded in a string is designated by two double-quotes ("") in a row, as is required by C language syntax. In this syntax, one double-quote is an element of the data, and the other is an indicator to the automated reader that the occurrence of the character *double-quote* does not terminate the string in which the double-quote is embedded.

6.4.2 It is not mandatory that the data value associated with the keyword SPECIMEN_ID be enclosed by double-quotes unless the specimen data value contains white space.

6.4.3 The integer data type is formed by combinations of the characters 0 through 9 inclusive, without decimal point or alphanumeric characters.

6.4.4 The floating point data type should contain a decimal point. A decimal point will be assumed at the end of the number represented if a floating point number fails to contain an explicit decimal point.

6.4.5 Data values must be followed by at least one character of white space.

6.4.6 In order to enhance human readability, data values may be placed on one line in order to form a table with the data value identifiers as implied headings.

6.4.7 The carriage-return or newline should break the data stream into similarly formatted logical segments in order to enhance human readability.

6.5 *Optional Keywords and Data Format Identifiers* —The following keywords are optional for use.

6.5.1 # (decimal 35)—This character is used as the comment designator. It indicates to the automated reader that all characters between it and the end of the line should be ignored. Its effect is terminated by a carriage-return or newline.

6.5.2 KEYWORD—The use of this word as a keyword designates that the associated data value is to be treated as a user-defined keyword, or data value identifier, for the rest of the file. The definition is not effective until encountered in the file and is operative until the end of the file.

6.5.2.1 The data value associated with this keyword will itself become a defined keyword for the remainder of the file. Keywords must all be capital letters without white space. Consequently, the data values associated with this keyword must be so capitalized.

6.5.2.2 The data value associated with this keyword must declare the data type to be associated with its data from among the list for alphanumeric (CS), integer (I), or floating-point (F). These type declarations must be the terminal characters of the keyword.

6.5.3 The following optional keywords are data type CS.

MANUFACTURER	PROD_DATE	SERIAL
MATERIAL	INSTRUMENTATION	MEASUREMENT_SOURCE
PRINT_CONDITIONS		

6.5.4 The following data value identifiers are optional for use. All are data type F.

CMYK_C	D_RED	RGB_R	STDEV_X	STDEV_A
CMYK_M	D_GREEN	RGB_G	STDEV_Y	STDEV_B
CMYK_Y	D_BLUE	RGB_B	STDEV_Z	STDEV_DE
CMYK_K	D_VIS		STDEV_L	

6.5.5 The following data value identifiers are extensions and are optional for use.

6.5.5.1 DDMMYY, CS—Date in day, month, year format.

6.5.5.2 MMDDYY, CS—Date in month, day, year format.

6.5.5.3 DTSC, CS—Date time stamp for the latest calibration. The date is in DDMMYY format, followed by the time in 24 h four-digit format.

6.5.5.4 DTSR, CS—Date time stamp for reading. The date and time are formatted as in 6.5.5.3.

6.5.5.5 SPECTRAL_FR, F—Kubelka-Munk K/S values for single-constant colorant formulation.

6.5.5.6 SPECTRAL_KA, F—Kubelka-Munk absorption coefficients K for two-constant colorant formulation, or Beer-Lambert Law absorbance values A for use in transmission spectrophotometry.

6.5.5.7 SPECTRAL_SC, F—Kubelka-Munk scattering coefficients for a two-constant colorant formulation.

6.5.5.8 LAB_LUV, F—A CIE 1976 metric color difference value, ΔE^*_{uv}.

6.5.5.9 LAB_CMC, F—A CMC-formula color difference value.

7. Keywords

7.1 data interchange; data transmission; spectral data interchange; spectral data transmission

APPENDIXES

(Nonmandatory Information)

X1. EXAMPLE OF A SINGLE-RECORD FILE

X1.1 An example of a single-record file, which transfers a set of tristimulus weighting factors, is shown in Fig. X1.1.

```
E170895
ORIGINATOR "ASTM, 1916 Race Street, Philadelphia, PA 19103"
DESCRIPTOR "Tristimulus Weighting Factors for Illuminant A, CIE 1931
Observer, 20 nm interval between 380 nm and 780 nm extracted from E 308
Table 5.2"
CREATED "12/31/93"
NUMBER_OF_FIELDS 4
BEGIN_DATA_FORMAT
   SPECTRAL_NM   XYZ_X   XYZ_Y   XYZ_Z
END_DATA_FORMAT
NUMBER_OF_SETS 22
BEGIN_DATA
360        0.000      0.000     −0.001
380       −0.002      0.000     −0.008
400        0.020      0.000      0.088
420        0.614      0.017      2.944
440        1.812      0.118      9.121
460        1.982      0.410     11.430
480        0.889      1.204      7.444
500        0.023      3.720      3.035
    .  .  .  .  .  .  .
760        0.007      0.002      0.000
780        0.002      0.001      0.000
END_DATA
NUMBER_OF_FIELDS 4
BEGIN_DATA_FORMAT
   STRING            XYZ_X      XYZ_Y      XYZ_Z
END_DATA_FORMAT
NUMBER_OF_SETS 2
BEGIN_DATA
"Check Sum"          109.852    100.003    35.586
"White Point"        109.850    100.000    35.585
END_DATA
```

FIG. X1.1 Single-Record File

X2. EXAMPLE OF A FILE CONTAINING TWO RECORDS

X2.1 An example of a file containing two records, which transfer spectral reflectance data associated with two measurements, is shown in Fig. X2.1.

```
E170895
ORIGINATOR "XYZ Laboratories, Inc."
DESCRIPTOR "Red Ceramic Tile Thermochromism Study - Readings at
18° C - Measured GE-Hardy Serial #95783 on December 21, 1993"
CREATED "December 31, 1993"
KEYWORD "PHOTOMETRIC_ZERO(F)"
KEYWORD "PHOTOMETRIC_100(F)"
NUMBER_OF_FIELDS 4
BEGIN_DATA_FORMAT
   SPECTRAL_NM   SPECTRAL_PC   PHOTOMETRIC_ZERO   PHOTOMETRIC_100
END_DATA_FORMAT
NUMBER_OF_SETS 31
BEGIN_DATA
400       4.404       0.000       99.998
410       4.421       0.001      100.002
420       4.521       0.002      100.001
430       4.651       0.003      100.000
440       4.786      −0.001       99.997
    .  .  .  .  .  .  .
690      89.367       0.000      100.000
700      90.204       0.001       99.999
END_DATA
ORIGINATOR "XYZ Laboratories, Inc."
DESCRIPTOR "Red Ceramic Tile Thermochromism Study - Readings at
25° C - Measured GE-Hardy Serial #95783 on December 22, 1993"
CREATED "December 31, 1993"
NUMBER_OF_FIELDS 4
BEGIN_DATA_FORMAT
   SPECTRAL_NM   SPECTRAL_PC   PHOTOMETRIC_ZERO   PHOTOMETRIC_100
END_DATA_FORMAT
NUMBER_OF_SETS 31
BEGIN_DATA
400       4.406       0.000       99.998
410       4.418       0.001      100.002
420       4.520       0.002      100.001
430       4.653       0.003      100.000
440       4.781      −0.001       99.997
    .  .  .  .  .  .  .
690      90.549       0.000      100.000
700      91.328       0.001       99.999
END_DATA
```

FIG. X2.1 File Containing Two Records