The Compendium of Controlled Extensions (CE)
for the
National Imagery Transmission Format (NITFS)

APPENDIX N

Engineering Data (ENGRD) Support Data Extension (SDE)
VERSION 1.0

1 June 2003

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TBD/TBR Listing

Page Number	TBD/TBR	Description

Change Log

Date	Pages Affected	Mechanism
1 June 2003 ENGRDA, Version 1.0	All	Initial publication of the ENGRDA Specification (version 1.0, 31 Mar 06) in the updated STDI-0002, version 3.0, 31 March 2006.
01 August 2007 ENGRDA, Version 1.0	All	Republished without technical change, 01 August 2007

Effectivity Log

Number	Effective	Description

Editors Notes

Date	Change	Rationale
March 2006	- Added a cover sheet, the TBR/TBD and change logs, foreword and table of contents	Consistency

FOREWORD

1.   The National Imagery Transmission Format Standard (NITFS) is the suite of standards for formatting digital imagery and imagery-related products and exchanging them among the Department of Defense (DOD), other Intelligence Community (IC) members, and other United States (US) Government departments and agencies. Resulting from a collaborative US Government and industry effort, it is the common standard used to exchange and store files composed of images, symbols/graphics, text, and associated data.

2.   This appendix to the Controlled Extension (CE) compendium provides one of the approved CE specifications to be used with the National Imagery Transmission Format (NITF) versions 2.0 (NITF2.0) or 2.1 (NITF2.1). Support Data Extension (SDE) implementation criteria are defined in N0105-98, NITFS Standards Compliance and Interoperability Test and Evaluation Program Plan, 25 August 1998.

3.   The NITFS Technical Board (NTB) develops, coordinates, reviews, and plans for the NITFS. It is a consensus-based government/industry forum that responds to the Geospatial Intelligence Standards Working Group (GWG). The GWG manages geospatial and imagery standards for the DOD and IC encompassed by the National System for Geospatial-Intelligence (NSG).

4.   Changes to this appendix are controlled via the GWG, the NTB and the National Geospatial-Intelligence Agency (NGA) Enterprise Standards Working Group (ESWG). Comments, suggestions, or questions should be addressed to the NGA National Center for Geospatial Intelligence Standards (NCGIS), Mail Stop P-106, 12310 Sunrise Valley Drive, Reston, VA 20191-3449, or emailed to ncgis-mail@nga.mil. Since contact information can change, you may want to verify the currency of this address information using the ASSIST Online database at www.dodssp.daps.mil.

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N.1   Background

The Engineering data extension is intended to address the support of specialized system data not supported by the core NITF standard or the collection of support data extensions. Engineering data support is relevant to any real-time sensor system where NITF is the direct output format. The extension has application to both airborne and ground systems for the storage of information specific to the collecting systems.

Engineering data is that information which can provide additional understanding of anomalous behavior of the information source. Engineering data may include built-in-test results, operational status, operational modes, and other information such as temperatures and specialized information for the collecting system. This information may be of use to the system developer during system testing, or during on-going operational monitoring. The information may also be of value through the use of specialized tools at the initial receiving station before the information is disseminated to the next level or placed into an image product library.

If the engineering data is necessary to the basic understanding of the information stored within the NITF file, then the Engineering extension is NOT the location for the information, rather, it belongs in other extensions or directly within NITF. If no location exists supporting the information, then with JITC / NIMA authorization, it may be possible to utilize the Engineering data extension to experiment with the system while producing NITF files readable by fielded systems.

The purpose of this TRE is to provide a mechanism for capturing and reporting data that is not generally supported by other elements of the core NITF standard. Engineering data is defined as that data which is not essential to the mensuration function but may be essential in understanding what happened during the image or data acquisition. Typical usage for "Engineering data" is the reporting of "Health and Wellness" information as well as other System Operational parameters. This information typically includes built-in-test (BIT) status, Operational modes, Status of other system elements and environmental conditions within the system.

N.2   Overview

The nature of "Engineering data" is different between systems. This TRE is to provide a single method to record Engineering information in a self-defining format. This format allows down-stream users to view the information with no prior knowledge of the producing system if desired. Additional functionality or over-all "image understanding" may be achieved through the review of this information should anomalies be found in the imagery data. This "additional" understanding will usually be limited to those with special additional system level knowledge of the collecting system and typically would be limited to evaluation phases of programs or at the initial receive location. Due to the flexibility of this TRE, it is possible to utilize it as a method to support testing of concepts prior to developing a new TRE or proposing a change to an existing TRE/SDE with prior NTB/JITC approval.

N.3   Self Defining Format

The basis of the ENGRD TRE is a self-defining format consisting of a TRE header identifying the total data size and number of Engineering Elements included. This is followed by an entry describing each type of data element recorded. This construct is similar to the Abstract Syntax Notation One (ASN.1) ISO standard. A significant simplification of the ASN.1 basic profile is implemented to address the minimal requirements of this TRE. Table N-1 defines the TRE header format.

This implementation of a self-defining format allows COTS Readers the ability to display and potentially utilize the Engineering information without having to update their code for each systems specific data implementation. A Reader can provide either a BCS or hexadecimal string

representation of the data with limited code. The user can then review this display for their specialized requirements. For specific user requirements, Readers could be customized to pass the native information (binary data form) to custom processing modules or user-generated functions.

N.4   Bit and Byte Ordering Within TRE Data

The method of recording numeric data on interchange media shall adhere to the "big endian" convention. In big endian format, the most significant byte in each numeric field shall be recorded and read first, and successive byte/octet recorded and read in order of decreasing significance. That is, if an n-byte field F is stored in memory beginning at address A, then the most significant byte of F shall be stored at A, the next at A+ 1, and so on. The least significant byte shall be stored at address A + n-1.

The most significant bit in each byte of every field, regardless of data type, shall be recorded and read first, and successive bits shall be recorded and read in order of decreasing significance.

Engineering data shall be stored in the big endian format for both bits and bytes/octets. The units and data type shall be defined within the TRE fields.

BCS character strings shall be recorded in the order in which the data is generated.

Table N-1. ENGRDA - Engineering Data Extension - Header
R = Required, C = Conditional, < > = BCS Spaces Allowed for Entire Field

FIELD	NAME	SIZE	VALUE RANGE	TYPE
RETAG	Unique extension type ID. This field shall contain the BCS-A character string uniquely denoting the presence of Engineering Data. Length of RETAG not included in TRE length count by definition.	6	BCS-A "ENGRDA"	R
REL	Length of TRE. This field shall contain a byte count of the TRE including all Engineering Data Elements. Length of REL not included in TRE length count by definition.	5	BCS-N 00047 – 99985	R
RESRC	Unique Source System Name. This field shall be utilized to indicate the Unique System name that has generated this *Engineering Data.* It is preferred that this field be populated with the same *System Identifier* as used in the ACFT SDE, "SENSOR_ID" field, left justified within the field. If unavailable, or considered "non-unique", additional user defined characters should be added to the right of the "SENSOR_ID" within the field or replacing it entirely. A BCS "space" (0x20) shall be utilized to separate additional characters from the "SENSOR_ID" if incorporated. The entire *name* shall be left justified within the field and BCS space filled to the field size.	20	BCS-A	R
RECNT	Record Entry Count. Count of the number of Engineering Data Elements included in the TRE. *The length of this field shall not cause any other NITF field length limits to be exceeded, but is otherwise fully user-defined.*	3	BCS-N 001 – 999	R
REDATA	User Defined Data. Each element of Engineering data is represented by a set of data.	N. A.	See Table Below.	R

N.5   Engineering Data Elements

Engineering data elements are stored within the ENGRD TRE as sets of information (datum) describing the data, the number of data elements, the data size, units, data length and the datum. Each data element, datum set is preceded by a text string describing the data. Table N-2 describes in detail the field order and contents for each datum incorporated in the ENGRD TRE. As an example, a temperature reading entry would have an *ENGLN*, *ENGLBL*, *ENGMTXC, ENGMTXR, ENGTYP*, *ENGDTS, ENGDATU, ENGDATC*, and *ENGDATA*. Each additional Engineering data item would repeat this sequence through the nth item. Examples of TRE implementation are presented in paragraph N.6.

The TRE data definition allows for the receiving system to determine the data size, but not necessarily the data value type through reading the numeric values of the TRE fields. Where the data value type is unknown, various representations could be provided by a reader program, or the data could be displayed as a sequence of N-hexadecimal representations of the data bytes, grouped by the data size specified within the TRE fields. This latter method, provides a system independent method of displaying the engineering data without having to decode the TRE completely or having additional knowledge of the original producing system.

For reference, an Engineering data element (or set of elements) is represented as an occurrence of rows (based on ENGMTXn) and as (ENGDATLn) groupings (based on ENGDTSn) of sequences of bytes (ENGDATAn).

Table N-2. ENGRDA - Engineering Data Extension - Data Elements
R = Required, C = Conditional, < > = BCS Spaces Allowed for Entire Field

FIELD	NAME	SIZE	VALUE RANGE	TYPE
ENGLNn	Engineering Data Label Length. Length in bytes of the label associated with the Engineering data element.	2	BCS-N 01 – 99	R
ENGLBLn	Engineering Data Label. Unique string used to identify the Engineering data incorporated in the record. No terminator characters (0x0A OR 0x0D) shall be incorporated Note: †[1] Field length defined by *ENGLNn*.	†[1]	BCS-A A minimum Label of one character is required	R
ENGMTXCn	Engineering Matrix Data Column Count. Count of the number of elements in each row of the matrix data (C). The value of this field also represents the number of data elements in a one dimensional array or sequence of single values recorded as a simple array. All members of a data row are represented in a single data type (*ENGTYP*) that defines the data. *The length of this field shall not cause any other NITF field length limits to be exceeded, but is otherwise fully user-defined.*	4	BCS-N 0001 –9999	R
ENGMTXRn	Engineering Matrix Data Row Count. Count of the number of rows in the matrix data (R). Members of the (1 to C) x R sized matrix are then represented as a single vector of values in the C x R ordering of elements. *The length of this field shall not cause any other NITF field length limits to be exceeded, but is otherwise fully user-defined.*	4	BCS-N 0001 –9999	R

Table N-2. ENGRDA - Engineering Data Extension - Data Elements (continued)

FIELD	NAME	SIZE	VALUE RANGE	TYPE
ENGTYPn	<u>Value Type of Engineering Data Element.</u> Flag indicating data type: *Binary data representation:* Unsigned Integer data Signed Integer data Real Number (floating point) data Complex data, (pair of real data elements) Complex data should be represented as a set of IEEE floating point numbers. BCS, Alpha numeric character data The type of engineering data *(ENGTYPn)* does not specify implementation size in bits/bytes. The value in the *ENGDTSn* field defines the data precision or element size as a count of bytes representing (8/16/32/64, etc.) bits. Only one *ENGTYP* may be utilized for all members of a matrix/vector data definition. All real data shall be implemented in IEEE floating point format as defined in ANSI/IEEE-754-1985. The minimum size for a binary representation of a float is thus 32 bits, or an ENGDTS value of 4.	1	BCS	R
ENGDTSn	<u>Engineering Data Element Size.</u> The count of bytes utilized to represent the basic data element within the record. The size is defined by the ENGTYPn descriptor, this field allows for direct access to the data without knowing or parsing the ENGTPYn field, allowing for a byte oriented hex print out of the data in "datum sized" groups. In the case of BCS data representation, this field shall be "1".	1	BCS-N Expected values: (1, 2, 4, 8, etc.)	R
ENGDATUn	<u>Engineering Data Units.</u> The units that should be applied to the data presented in this *nth* Engineering data packet. Valid representations are: Feet - "ft", meters - " m", inch - "in", millimeters - "mm", miles - "mi" or "nm", kilometer - "km", Knots - "kt", Not Applicable - "NA", Temperature C/F/K "tC", "tF", or "tK" Voltage AC/DC "Va" or "Vd", Current "mA", "uA", " A" or Undefined "UD". ISO-1000 should be used as a guide in defining other units and representations used in this field.	2	BCS-A (See Name column for defined types)	R

Table N-2. ENGRDA - Engineering Data Extension - Data Elements (continued)

FIELD	NAME	SIZE	VALUE RANGE	TYPE
ENGDATCn	Engineering Data Count. Count of engineering data symbols in this n^{th} record. All members of a matrix data definition shall have the same number of symbols defined per matrix row. For BCS representations this field shall represent the count of bytes/characters contained within *ENGDATAn*. When data represented requires in excess of 99932 bytes of storage, the data shall be broken into separate TRE or the entire TRE shall be located to the TRE Overflow DES. Under no circumstance shall the length of this field cause any other NITF field length limits to be exceeded, but is otherwise fully user-defined.	8	BCS-N 00000001 – 99999932	R
ENGDATAn	Engineering Data. Engineering data associated with the defined Data Label and Data Value Type. Note: $†^2$ Field length defined by *ENGDATCn*.	$†^2$	Alphanumeric & binary. (0x00-0xFF)	R

N.6   ENGRDA Examples

Three examples of the ENGRDA are presented. The first is a simple recording of three different temperature readings that are represented in different units. The second is a representation of a matrix and array data in the form of two rows or three elements each and a single array. The third example is a simple illustration of a possible implementation storing several data elements as a simple vector.

These examples illustrate that for small amounts of data, the TRE is not very efficient. As the amount of similar data increases, the efficiency improves. In all cases, prior knowledge is not required for the data to be preserved and presented as a sequence of BCS or hex characters if the TRE is present at a receiving station, if desired by the user and supported by the viewer for presentation.

Example 1. Temperature 1 (0x0125) is in degrees C, and represented as a 16 bit signed integer. Temperature 2 (0x03271276) is in degrees K and is represented as a float. A third temperature is illustrated as a simple character representation within the TRE.

Table N-3. ENGRDA - Example 1

FIELD	NAME	SIZE	Value
RETAG	Unique extension type ID.	6	"ENGRDA"
REL	Length of TRE.	5	"00126"
RESRC	Unique Source System Name.	20	"YOUR_SENSOR_ID…."
RECNT	Record Entry Count.	3	"003"
$ENGLN_1$	Engineering Data Label Length.	2	"05"
$ENGLBL_1$	Engineering Data Label.	5	"TEMP1"
$ENGMTXC_1$	Engineering Data Matrix Column.	4	"0001"
$ENGMTXR_1$	Engineering Data Matrix Row.	4	"0001"
$ENGTYP_1$	Value Type of Engineering Data Element.	1	"I"
$ENGDTS_1$	Engineering Data Element Size.	1	"2"
$ENGDATU_1$	Engineering Data Units.	2	"tC"
$ENGDATC_1$	Engineering Data Count.	8	"00000001"
$ENGDATA_1$	Engineering Data.	2	0x0125

Table N-3. ENGRDA - Example 1 (continued)

FIELD	NAME	SIZE	Value
ENGLN$_2$	Engineering Data Label Length.	2	"05"
ENGLBL$_2$	Engineering Data Label.	5	"TEMP2"
ENGMTXC$_2$	Engineering Data Matrix Column.	4	"0001"
ENGMTXR$_2$	Engineering Data Matrix Row.	4	"0001"
ENGTYP$_2$	Value Type of Engineering Data Element.	1	"R"
ENGDTS$_2$	Engineering Data Element Size.	1	"4"
ENGDATU$_2$	Engineering Data Units.	2	"tK"
ENGDATC$_2$	Engineering Data Count.	8	"00000001"
ENGDATA$_2$	Engineering Data.	4	0x03271276
ENGLN$_3$	Engineering Data Label Length.	2	"10"
ENGLBL$_3$	Engineering Data Label.	10	"TEMP3 Wall"
ENGMTXC$_3$	Engineering Data Matrix Column.	4	"0010"
ENGMTXR$_3$	Engineering Data Matrix Row.	4	"0001"
ENGTYP$_3$	Value Type of Engineering Data Element.	1	"A"
ENGDTS$_3$	Engineering Data Element Size.	1	"1"
ENGDATU$_3$	Engineering Data Units.	2	"NA"
ENGDATC$_3$	Engineering Data Count.	8	"00000010"
ENGDATA$_3$	Engineering Data.	10	"10.7 DEG C"

Example 2. Matrix data. In 2 rows by 3 elements with no applicable units.

Table N-4. ENGRDA - Example 2

FIELD	NAME	SIZE	Value
RETAG	Unique extension type ID.	6	"ENGRDA"
REL	Length of TRE.	5	"00098"
RESRC	Unique Source System Name.	20	"YOUR_SENSOR_ID…"
RECNT	Record Entry Count.	3	"002"
$ENGLN_1$	Engineering Data Label Length.	2	"11"
$ENGLBL_1$	Engineering Data Label.	11	"STB MTX 3x2"
$ENGMTXC_1$	Engineering Data Matrix Column.	4	"0003"
$ENGMTXR_1$	Engineering Data Matrix Row.	4	"0002"
$ENGTYP_1$	Value Type of Engineering Data Element.	1	"I"
$ENGDTS_1$	Engineering Data Element Size.	1	"1"
$ENGDATU_1$	Engineering Data Units.	2	"NA"
$ENGDATC_1$	Engineering Data Count.	8	"00000006"
$ENGDATA_1$	Engineering Data.	6	0x01, 0x25, 0x37, 0x27, 0x12, 0x76
$ENGLN_2$	Engineering Data Label Length.	2	"11"
$ENGLBL_2$	Engineering Data Label.	11	"temps a b c"
$ENGMTXC_2$	Engineering Data Matrix Column.	4	"0003"
$ENGMTXR_2$	Engineering Data Matrix Row.	4	"0001"
$ENGTYP_2$	Value Type of Engineering Data Element.	1	"I"
$ENGDTS_2$	Engineering Data Element Size.	1	"1"
$ENGDATU_2$	Engineering Data Units.	2	"tC"
$ENGDATC_2$	Engineering Data Count.	5	"00000003"
$ENGDATA_2$	Engineering Data.	3	0x37, 0x28, 0x26

Example 3. Temperature data represented as a Vector of 3 BCS data elements.

Table N-5. ENGRDA - Example 3

FIELD	NAME	SIZE	Value
RETAG	Unique extension type ID.	6	"ENGRDA"
REL	Length of TRE.	5	"00079"
RESRC	Unique Source System Name.	20	"YOUR_SENSOR_ID"….
RECNT	Record Entry Count.	3	"001"
$ENGLN_1$	Engineering Data Label Length.	2	"12"
$ENGLBL_1$	Engineering Data Label.	12	"Sta Temp 1-3"
$ENGMTXC_1$	Engineering Data Matrix Column.	4	"0022"
$ENGMTXR_1$	Engineering Data Matrix Row.	4	"0001"
$ENGTYP_1$	Value Type of Engineering Data Element.	1	"A"
$ENGDTS_1$	Engineering Data Element Size.	1	"1"
$ENGDATU_1$	Engineering Data Units.	2	"tC"
$ENGDATC_1$	Engineering Data Count.	8	"00000022"
$ENGDATA_1$	Engineering Data.	22	"274.6, 327.65, 300.53©" Where © represents a 0x0D line termination as supported in NITF.