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ANSI C12.19-2012

American National Standard for Utility Industry End Device Data Tables

National Electrical Manufacturers Association

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Foreword (This Foreword is not part of American National Standard C12.19-2012.)

The ANSI C12.19 Standard provides a common data structure and descriptors for use in transferring data to and from utility End Devices, typically meters and head-ends. It has been developed with consideration of input from utilities, meter vendors, automated meter reading service companies, ANSI, Measurement Canada (for Industry Canada), NEMA, IEEE, Utilimetrics, NIST, SGIP, AEIC, and other interested parties nationally and internationally. This release of the Standard accommodates the concept of an advanced metering infrastructure (AMI), such as that identified by the Office of Electricity Delivery and Energy Reliability of the U.S. Department of Energy; the Smart Metering Initiative of the Ontario Ministry of Energy (Canada); and the stated requirements of Measurement Canada for the approval of a metering device for use in Canada.

ANSI C12.19 Tables are organized into functional groups known as Decades (nominally ten Tables per Decade). The ANSI C12.19 Standard contains up to 2040 “Standard Tables” that are fully described in the Standard. In addition, provisions were made for an additional 2040 “Manufacturers’ Tables” so that future innovations can be implemented utilizing the extension framework and mechanisms specified by the semantic model of this ANSI C12.19 Standard. These mechanisms facilitate the possibility of future inclusion of Manufacturer-defined Tables into future publications of the Standard. The Standard provides the means for the inclusion of Manufacturer-defined Tables into End Devices through designation of new Device Classes.

Another set of 2040 “Extended User-defined Tables” is available for End Devices that have a need for extremely low communications overhead and a high need for compaction of data. The User-defined Tables and the Extended User-defined Tables aggregate Elements of information from other Tables (Standard Tables Elements or Manufacturer Table Elements). These “Formal Elements” can be bundled into “virtual” Tables for transmission.

The Standard defines “Pending” attributes for Standard Tables, Manufacturer Tables, Standard Procedures, Manufacturer Procedures, and Extended User-defined Tables for use in applications such as End Device deferred programming and End Device firmware upgrades with activation and roll-back capabilities. The Pending Tables also facilitate Event-driven and synchronized actionable communication for use by enterprise systems (such as head-end systems) that communicate with a multitude of C12.19 devices in an AMI network of a Smart Grid.

The Standard’s flexibility presents a challenge to system developers, equipment vendors, utilities, and customers alike. System developers must continue to provide the capability of processing multiple data formats from the End Devices. The obvious advantage of ANSI C12.19 is that the semantic rules and semantic model of the Table structures can be published using machine-readable TDL/XML (structure) and EDL/XML (enterprise exchange data) Forms, in addition to the human readable (Standard Document) Forms. TDL/XML and EDL/XML, together with their derivative products (such as the human readable forms), are expected to be accessible through accredited registries via the Internet or other readily available means.

All registration authorities that recognize registrars are governed by ANSI C12 and IEEE SCC31. To be recognized, any registration authority is expected to adhere to the requirements specified in this Standard. See 0 (normative) “Universal Identifier.”

The ANSI C12.19 Standard provides mechanisms and identifies means to access the Table data. For this reason, it is expected that data acquisition AMI products should be capable of processing data from any End Device that follows the access rules defined by ANSI C12.19 and associated communication protocols (such as ANSI C12.18, ANSI C12.21, and ANSI C12.22) and services. The End Device’s Table of Contents is provisioned by ANSI C12.19 Table 0, “General Configuration Table.” Access to Standard Table 0, function limiting Tables (of the Decades), and information found in device control Tables can be combined with ANSI C12.19 Device Class information to gain the necessary information about “End Devices” for improved efficiency and interoperability.

Although this Standard covers a broad range of functionality, it does not follow that implementations of the Standard need to be large or complex. Implementers and users are encouraged to choose an appropriate functionality subset that is suitable for their needs. Therefore, it is very unlikely for any one End Device to embed all Tables or even the majority of the Tables described herein. Implementers and users are encouraged to deploy their desired functionalities using complete and consistent suites of Standard Tables from Standard Decades to the largest extent practical for the desired functionality of the device.

The third release of this Standard is a minor release in that it establishes a new baseline document that includes all of the corrections that were applied in Annex N, "Listing of Editorial Errors and Errors of Omission in ANSI C12.19-2008" of IEEE Std 1377™-2012.

The notable differences and corrections that exist in this release of the Standard relative to its predecessor ANSI C12.19-2008 are listed below:

1. Document is formatted according to IEEE Standards Template (Measurement Canada Version only).
2. New clause 1.1, "Purpose" was introduced to clause 1, "Scope."
3. Introduced new references to clause 2, "Normative Reference":
    a. AEICGL : 2010—*Smart Grid/AEIC AMI Interoperability Standard Guidelines for ANSI C12.19 / IEEE 1377 / MC12.19 End Device Communications and Supporting Enterprise Devices, Network and Related Accessories*, The Association of Edison Illuminating Companies (AEIC), v2.0, 2010.
    b. ANSI C12.19, *American National Standard for Utility Industry End Device Data Tables*
    c. ANSI C12.19-1997, *American National Standard for Utility Industry End Device Data Tables*
    d. ANSI C12.19-2008, *American National Standard for Utility Industry End Device Data Tables*
    e. FERC-727-728-2008, Federal Energy Regulatory Commission, *Survey on Demand Response, Time-Based Rate Programs/Tariffs and Advanced Metering Infrastructure Glossary*, FERC-727 and FERC-728, OMB Control Nos. 1902-0214 & 1902-0213
    f. IEEE Std 1377™-1998, *IEEE Standard for Utility Industry End Device Data Tables*
    g. MC S-EG-02-2010, *Measurement Canada Specifications for Approval of Physical Sealing Provisions for Electricity and Gas Meters, S-EG-02 (rev. 1)*
    h. XHTML-2002, *XHTML 1.0 The Extensible HyperText Markup Language (Second Edition), W3C Recommendation 26, 2000, revised 2002*
    i. XML-2006, *Extensible Markup Language (XML) 1.1 (Second Edition), W3C Recommendation 16*
    j. XMLSchema-2012, *W3C XML Schema Definition Language (XSD) 1.1 Part 1: Structures W3C Recommendation 5*
    k. XMLSig-2008, *XML Signature Syntax and Processing (Second Edition), W3C Recommendation 10*
4. Moved references to URLs into page footnotes.
5. Moved clause 2.2, "Other" to Annex M (informative) "Bibliography."
6. Added reference to the "IEEE-SA Standards Definitions Database" in clause 3, "Definitions."
7. Removed numbers from the definitions in clause 3, "Definitions."
8. Replaced Procedure Property "extend" with "type" in clause 4.2.3, "Manufacturer Procedure Properties."
9. Replaced all references to word "byte" with "Octet."
10. Introduced Element-name aliases for backward compatibility with ANSI C12.19-1997, ANSI C12.19-2008, and IEEE Std 1377-1998.
11. Introduced allowance for GEN_CONFIG_TBL.MODEL_SELECT of 1 in clause 6.4.4, "SOURCE_SELECT_RCD".
12. Swapped the terms "target" and "initiating" in clause 8.1.1, "Read Service."

13. Corrected the description of Offset/Octet-count Method in clause 8.1.1, “Read Service.”
14. Corrected the description of Offset/Octet-count Method in clause 8.1.2, “Write Service.”
15. Corrected the TDL Type Definitions syntax in clause 8.2, “Pending Event Description.”
16. Added missing descriptions to TDL Element Descriptions in clause 8.2, “Pending Event Description.”
17. Corrected the TDL Element Descriptions true/false and high/low sense in clause 8.2, “List Management Description.”
18. Updated MODEL_SELECT in clause 9.1.1, “Table 00 General Configuration Table” to provide reference to the AEIC Guidelines Version 2 [AEICGL : 2010].
19. Updated the description of DEVICE_CLASS in clause 9.1.1, “Table 00 General Configuration Table” to indicate that the last arc tracks the value of MODEL_SELECT.
20. Updated the descriptions of STD_VERSION_NO and STD_REVISION_NO in clause 9.1.1, “Table 00 General Configuration Table.”
21. Corrected duplication in syntax of Table 04 Type Definitions in clause 9.1.5, “Table 04 Pending Status Table.”
22. Recast and updated descriptions of GPS COORDINATE_1, COORDINATE_2, and COORDINATE_3 in terms of definitely structured STRINGs in clause 9.1.7, “Table 06 Utility Information Table.”
23. Corrected and replaced the terms “off/on” with “disconnect/connect” in the definition of NEW_LEVEL in clause 9.1.10.22, “Procedure 21 Direct Load Control.”
24. Updated Decade 1 Data Description in clause 9.2, “Decade 1: Data Source Tables” to correctly reflect changes in MODEL_SELECT values.
25. Corrected UOM values above 220 in clause 9.2.3, “Table 12 Units of Measure Entry Table.”
26. Corrected ID_RESOURCE values above 23 in clause 9.2.3, “Table 12 Units of Measure Entry Table.”
27. Added security best practice recommendation to note in clause 9.5.3, “Table 42 Security Table.”
28. Added security best practice recommendation to note in clause 9.5.6, “Table 45 Key Table.”
29. Corrected description of TIME_ZONE_OFFSET in clause 9.6.4, “Table 53 Time Offset Table.”
30. Introduced SIG_ALGORITHM Element to facilitate the introduction of hash functions that comply with FIPS PUB 180-2 in clause 9.8.1, “Table 70 Log Dimension Limits Table.”
31. Introduced SIG_ALGORITHM Element to facilitate the introduction of hash functions that comply with FIPS PUB 180-2 in clause 9.8.2, “Table 70 Actual Log Limiting Table.”
32. Revised hash function algorithm descriptions in clause 9.8.9, “Table 78 End Device Program State Table” to reflect the changes made to ACT_LOG_TBL and ACT_LOG_TBL Elements SIG_ALGORITHM.
33. Corrected description of Element LEVEL_SUPPORTED_FLAG in clause 9.12.3, “Table 112 Load Control Status.”
34. Added citations IEEE Std 1159-1995 (R2001) and IEEE Std 519-1992 description section of clause 9.16, “Decade 15: Quality-of-service.”
35. Corrected Table role and accessibility properties and reorganized descriptions in clause 9.16.4, “Table 153 Quality-of-service Incidents Table.”
36. Corrected Table role and accessibility properties in clause 9.16.5, “Table 154 Quality-of-service Log Table.”
37. Corrected Table role and accessibility properties in clause 9.17.4, “Table 163 One-way Data Table.”
38. Modified unit of measures in COMMODITY_OUTAGE_DUTY_BFLD from seconds to minutes in clause 9.17.4, “Table 163 One-way Data Table.”
39. Updated the algorithm description of Element READ_VALUE in clause B.2, “Logger Arguments Implementation Details.”
40. Revised BNF definition of constIdentifier in clause G.4, “Identifiers.”
41. Corrected BNF definition of Element in clause G.6.1.2, “Container Scopes.”
42. Deleted BNF definitions of constType and constMember and associated example from clause G.12, “Constants” to reflect revisions to constIdentifier to clause G.4, “Identifiers.”
43. Revised BNF definitions of syntax from clause G.17, “Document Form Starting Production Rule” to reflect revisions to constIdentifier to clause G.4, “Identifiers.”

44. Corrected DTD definitions for object and Table in clause I.2.1.7, “<description> Child DTDs.”
45. Inserted missing description for object in clause I.2.1.15, “<object> Attributes.”
46. Inserted missing description for Table in clause I.2.1.16, “<table> Attributes.”
47. Inserted missing descriptions for Table members in clause I.2.1.17, “<caption>, <col>, <thead>, <tfoot> and <tbody> Subelement usage of <table>.”
48. Updated examples in clause I.2.1.18, “<description> Document Form.”
49. Revised DTD definition of enumerator in clause I.2.1.25, “<enumerator> DTD (named)” to reflect revisions to constIdentifier to clause G.4, “Identifiers.”
50. Deleted definition of <positional> in clause I.2.1.27, “<enumerator> DTD (named)” to reflect revisions to constIdentifier to clause G.4, “Identifiers.”
51. Revised clause I.2.1.28, “Constant Enumerated Values DTD.”
52. Revised clause, I.2.1.29, “<enumerator> DTD (Un-named).”
53. Revised clause I.2.1.30, “<enum> DTD.”
54. Revised clause I.2.1.3,1 “<enum> Attributes.”
55. Updated example in clause I.2.1.32, “<enum> Document Form.”
56. Corrected definition of Element in clause I.2.1.39, “<element> DTD.”
57. Corrected definition of else in clause I.2.1.55, “<else> DTD.”
58. Corrected definition of switch in clause I.2.1.58, “<switch> DTD.”
59. Corrected definition of case in clause I.2.1.62, “<case> DTD.”
60. Corrected definitions in clause I.2.1.69, “<bitField> DTD.”
61. Corrected definition of switch in clause I.2.1.84, “<switch> DTD.”
62. Corrected definition of Table in clause I.2.1.108, “<table> DTD definition.”
63. Corrected definition of packedRecord in clause I.2.1.114, “< packedRecord > DTD.”
64. Corrected definition of bitField in clause I.2.1.116, “<bitField> DTD.”
65. Corrected definition of tableName in clause I.3.1.5, “<description> Document Form.”
66. Inserted copyright notice in clause I.3.1.5, “<description> Document Form.”
67. Inserted documentation about schema constraints issues in clause I.3.1.6, “The Schema Constraints Problem.”
68. Corrected type mapping in clause I.4, “EDL XML Form Encoding of Final Element Values.”
69. Updated device class registration information in Annex J, “Universal Identifier.”
70. Corrected section numbering in Annex L, “Registering or Updating DEVICE CLASS OID.”

Members of ASC 12 SC 17 WG2 wish to thank and extend their deepest appreciation for the significant contribution of the balloting members of IEEE P1377, the AEIC AMTIT members, NIST, and SGIP/PAP5 and SGIP/PAP6 members, who provided invaluable input into the making of this revision of the Standard.

Interpretation requests for, questions about, or suggestions for improvement to this Standard are welcome. They should be sent to:

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The Secretariat of the Accredited Standards Committee on Electricity Metering, C12, is held by the National Electrical Manufacturers Association (NEMA) and the National Institute of Standards and Technology (NIST). At the time this Standard was processed and approved, the C12 Committee had the following members:

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1 Overview

1.1 SCOPE

This Standard defines a Table structure for utility application data to be passed between an End Device and any other device. It neither defines device design criteria nor specifies the language or protocol used to transport that data. The Tables defined in this Standard represent a data structure that shall be used to transport the data, not necessarily the data storage format used inside the End Device.

1.2 PURPOSE

The Utility Industry has a need for a Standard that provides an interoperable "plug-and-play" environment for field metering devices. The purpose of this Standard is to define the framework and data structures for transporting Utility End Device data to and from End Devices and for use by enterprise systems.

This Standard is intended to accommodate the concept of an advanced metering infrastructure, such as that identified by the Office of Electricity Delivery and Energy Reliability of the U.S. Department of Energy; the Smart Metering Initiative of the Ontario Ministry of Energy (Canada); and the stated requirements of Measurement Canada for the approval of a metering device for use in Canada.

This Standard is to provide a uniform, structured, and adaptive data model, such that Utility End Devices and ancillary devices (e.g., home appliances and communication technology) can operate in a "plug-and-play" and multisource enterprise Advanced Metering Infrastructure (AMI) environment.

This Standard extends the definitions provided by IEEE Std 1377-1998 to include provisions for enterprise-level asset management, data management, and uniform data exchange capability, through the use of common and managed Extensible Markup Language (XML)/Table Definition Language (TDL) and XML/Exchange Data Language (EDL) End Device Class models.

2 Normative References

The following referenced documents are indispensable for the application of this document (i.e., they must be understood and used, so each referenced document is cited in text and its relationship to this document is explained). For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments or corrigenda) applies.

AEICGL-2010, *Smart Grid/AEIC AMI Interoperability Standard Guidelines for ANSI C12.19 / IEEE 1377 / MC12.19 End Device Communications and Supporting Enterprise Devices, Network and Related Accessories,* The Association of Edison Illuminating Companies (AEIC), v2.0, 2010.[1]

ANSI C12.10-2011, *American National Standard for Physical Aspects of Watthour Meters—Safety Standard*[2]

ANSI C12.19, *American National Standard for Utility Industry End Device Data Tables*

ANSI C12.19-1997, *American National Standard for Utility Industry End Device Data Tables*

ANSI C12.19-2008, *American National Standard for Utility Industry End Device Data Tables*

[1] AEIC publications are available from The Association of Edison Illuminating Companies (http://www.aeic.org/). This document is available from http://www.aeic.org/meter_service/AEICSmartGridStandardv2-11-19-10.pdf.
[2] ANSI publications are available from the American National Standards Institute (http://www.ansi.org/).

