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American National Standard for Utility Industry End Device Data Tables

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Foreword (This foreword is not part of American National Standard C12.19-2021)

This is the fourth publication of the ANSI C12.19 Standard. It is release (minor) version 2.2. It is backward compatible with the previous release version 2.1, ANSI C12.19-2012.

The Standard provides common data structures and descriptors to communicate semantic information, controls and data among meter data management systems, utility head-end systems, and End Devices (including meters and related network assets). It has been developed and maintained collaboratively with input from utilities, meter vendors, and service providers; such as NEMA ASC 12 (for ANSI), Measurement Canada (for Industry Canada), IEEE SCC31, AEIC, ETSI, and many other contributors nationally and internationally.

Release 2.2 of the Standard continues to further 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), the stated requirements of Measurement Canada for the approval of a metering device for use in Canada, and NRC (Natural Resources Canada) Canadian Smart Grid Standards Roadmap.

ANSI C12.19 Tables cast the functionality requirements of End Devices (meters, controllers and network nodes) by organizing them using precise structured semantics to define functional groups known as Tables and Procedures. The Tables and Procedures are grouped nominally as 10 Tables per group (Decade). The Standard provides “Standard Tables” and “Standard Procedures” that are fully prescribed by the Standard’s published syntax. Provisions exist for the definition of “Manufacturer Tables” and “Manufacturer Procedures”, so that future innovations can be precisely documented and then implemented using the Standard’s framework and mechanisms (semantic TDL/XML data models that are linked to the End Device Class object identifiers).

A set of “Extended User-defined Tables” can be programmed into the End Devices by end users to decrease communications overheads and increase compaction of data into application-relevant functional units. These can then be communicated as “virtual” Tables and Elements.

The Standard facilitates End Device programming using “Pending Tables” and “Pending Procedures”. It lets applications program End Devices immediately and defer programs’ actuation for a later time. Pending Tables and Procedure functionalities can be used to perform firmware upgrades, including new firmware activation or roll-back. It also enables synchronous activation of clustered End Devices programs using pending event triggers. These capabilities can be used by enterprise systems (such as head-end systems) that need to communicate with a large population of End Devices on an AMI network of the Smart Grid, using minimal network bandwidth.

While the Standard provides a broad range of functionality, it does require that each End Device implement all of the published functions. Implementers and end users are encouraged to choose an appropriate functional subset that best suits their needs. Implementers and end users are also encouraged to program and deploy their End Devices using consistent subsets of Tables, so as to maximize interoperability (e.g., per AEIC guidelines).

Note: The user’s attention is called to the possibility that compliance with this Standard could require use of an invention covered by patent rights.

By publication of this Standard, no position is taken with respect to the validity of any such claim(s) or of any patent rights in connection therewith. If a patent holder has filed a statement of willingness to grant a license under these rights on reasonable and non-discriminatory terms and conditions to applicants desiring to obtain such a license, then details may be obtained from the Secretary.

Listed below are notable differences between this version 2.2 of the Standard and its predecessor ANSI C12.19-2012 version 2.1:

1. Harmonized Table 12, “Units of Measure Entry Table”, descriptions of ID_CODE elements with NEMA C12.24 TR-2011, Definitions for Calculations of VA, VAh, VAR, and VARh for Poly-Phase Electricity Meters.
2. Harmonized communication of End Device Accuracy Class index (E_ACCURACY_CLASS) found in Table 02, “Device Nameplate Table”, to establish correspondence with OIML R46, ANSI C12.1, and ANSI C12.20; as documented in new Annex O (Normative), ANSI C12.19 accuracy class index computation.
3. Added capability to report “fundamental frequency only” readings and support for geolocation reporting.
4. Added missing definitions in clause 3, Definitions, such as Demand Reset, Coincident Demand, Cumulative Demand, Demand Interval, Service Switch, GPS Receiver, Effective Measurement, Time Interval, and User Intervention.
5. Renamed clause 7 from “Compliance and compatibility” to “Conformance to this Standard”.
6. Expanded significantly documentation in clause 7.2, Backward and Forward Compatibility, to provide examples and guidelines for implementers.
7. Renamed clause 8 from “Table transportation issues” to “Table transportation conformance requirements”.
8. Updated Device Class for End Devices that conform to this Standard to “0.*version*.*revision*.*x*”, where *version*, *revision,* and *x* are values communicated by STD_VERSION_NO, STD_REVISION_NO, and MODEL_SELECT (AEIC), respectively, found in Table 00 General Configuration Table.
9. Added new backward compatible flags, ICA_RESPONSE_ENABLED_FLAG and INTERFACE_CHANGE_ALARM_FLAG, to Table 03 End Device Mode Status Table to prevent accidental corruption of read data. This also harmonized with ETSI TS 104 001 specifications.
10. Added new backward compatible capability to selectively clear individual Standard and Manufacturer status flags using Procedure 07, “Clear Standard Status Flags”, and Procedure 08, “Clear Manufacturer Status Flags”.
11. Added flag SET_DELTA_TIME_FLAG to Procedure 10, “Set Date and/or Time”, and Procedure 32, “Set Precision Date and/or Time”. This control flag enables the End Device set time in a manner that the time drift does not affect the End Device’s normal operations when implemented with COARSE_ADJUSTMENT_THRESHOLD of Table 53, “Time Offset Table”.
12. End Devices equipped with Service Switches are supported via in Decade 11, “Load Control and Pricing Tables”. Added additional support and documentation using new Table 119, “Service Switch Control Table”, Procedure 33, “Service Switch Control”, Procedure 34, “Service Switch State Detect”, and Procedure 35, “Actuate Service Switch”.
13. Added new Table 18, “UOM Sensor Identification Table”, to further describe the attributes of the Elements of the UOM_ENTRY_TBL.UOM_ENTRY array. Use of this Table can provide mapping between this Standard’s UOMs descriptors and those used by other Standards, such as Open Field Message Bus (OpenFMB) Model Business Practices and IEC Common Information Model (CIM).
14. Added extensive algorithmic descriptions to Decade 6, “Load Profile Tables”, to provide better guidance to implementers and improve interoperability.
15. Enumerated all history and event codes so that they can now be expressed via TDL/EDL syntax and communicated in a manner that is machine interpretable.
16. Recast the syntax and description of Table 74, “History Log Data Table”, and Table 76, “Event Log Data Table”. Now they are properly expressed using the TDL/XML and Document Form syntax.
17. Documented the capability of the PACKED RECORD syntax to encapsulate records fixed in size. Such records commonly document Procedures’ parameters and event/history logger array elements.

18. Added capability in clause I.2, “XML Form file format of the TDL Document”, to document math elements and equations via MathML using new math XML tag.

This document is formatted jointly according to IEEE and ANSI Standards templates.

When attesting conformance to this Standard, the implementer should refrain from the use of terms, such as “conforming”, “compliant”, or “implementing”, unless the implementer can present a certificate of conformance upon request.

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National Electrical Manufacturers Association
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Utility Industry End Device Data Tables

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 (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.

This Standard provides 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 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.