C57.12.37™

IEEE Standard for the Electronic Reporting of Distribution Transformer Test Data

IEEE Power Engineering Society

Sponsored by the
Transformers Committee

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(Revision of
IEEE Std 1388™-2000)

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IEEE Standard for the Electronic Reporting of Distribution Transformer Test Data

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Transformers Committee
of the
IEEE Power Engineering Society

Approved 30 March 2006

IEEE-SA Standards Board

Abstract: This standard provides a basis for the electronic reporting of transformer test data on liquid immersed distribution transformers as defined in the ANSI/IEEE C57.12.2X standards series. The specific set of test data to be reported, and the report format, is detailed along with an extended set of data as an option for the user.
Keywords: distribution transformers, electronic reporting, test data

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Introduction

This introduction is not part of IEEE Std C57.12.37-2006, IEEE Standard for the Electronic Reporting of Distribution Transformer Test Data.

In order to give this standard a number consistent with the other ANSI/IEEE C57 documents, this document will replace IEEE Std 1388™-2000.[a, b] Other changes were incorporated into this revision, as detailed via the Project Approval Request (PAR).

Producers of transformers have always provided users with transformer test data when requested. However, as the majority of users incorporated life time owning costs of distribution transformers into their purchasing decisions through loss evaluation in the late seventies and early eighties, they also began to request that producers report loss data on each transformer shipped. The amount of test data being supplied by producers to users increased dramatically.

In order to handle the volume of data, distribution transformer producers automated the collection of this data in their factories and began supplying computer generated hardcopy test data reports to users. This solution initially benefited the producers because it solved the problem of economically reporting large volumes of data. It also initially satisfied the user's need to be able to verify that they were indeed receiving product that performed as promised.

However, as users began tracking the data and using it for other purposes, they found that having the data on hardcopy reports required them to re-enter the data on their computers. This seemed particularly unproductive since producers already had the data on computers and begged the question of why the data could not just be reported electronically. Many users subsequently began requiring producers to report the data electronically.

A new problem arose. Although differently formatted data on hardcopy reports was highly inconvenient to the users, at least communication was successful. With electronic test data reporting, successful communication could not take place until an agreement on reporting format was reached. As a result, individual users, requesting electronic test data reports, worked with individual producers to design personal reporting formats.

The current situation is that producers are incurring the cost of supplying test data in many different formats and users are incurring the cost of negotiating formats with each of their distribution transformer producers.

In summary, the need for this standard evolved as loss evaluation of distribution transformers became widespread, resulting in the need to report large volumes of data, and the need of users to store this data on their computers. The purpose of this standard is to address the need to standardize electronic test data reporting on distribution transformers and eliminate the unnecessary costs that are being incurred by producers and users due to the lack of a standard.

This revision of IEEE Std 1388-2000 addresses new technology and related changes in data communication and storage means.

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Contents

IEEE Standard for the Electronic Reporting of Distribution Transformer Test Data

1. Overview

This standard is divided into six clauses. Clause 1 provides the scope and purpose of this standard. Clause 2 lists references to other standards that are useful in applying this standard. Clause 3 provides definitions that are either not found in other standards, or have been modified for use with this standard. Clause 4 provides a listing of the data elements in the standard data set and the additional data elements included with the extended data set. Clause 5 gives the specifics of the two test data file formats. Clause 6 addresses the methods of file transfer.

1.1 Scope

This standard provides a basis for electronic reporting of transformer test data on liquid immersed distribution transformers, specifically those defined in the ANSI/IEEE C57.12.2X[1] standards series. This standard defines the standard set of test data to be reported and the format in which it is to be reported when electronic reporting of the test data is specified. In addition, this standard defines an extended set of data for those users who have a need for data.

1.2 Purpose

The purpose of this standard is to define standard methods of reporting and communicating transformer test data in order to allow users and producers to design computer based systems for preparing, communicating, and storing test data. The standard includes test data content, test data format, and test data communications methods. This revision of IEEE Std 1388™-2000 addresses new technology and related changes in data communication and storage means. This revision also addresses and investigates the inclusion of various data items, which were considered for, but not included in, IEEE Std 1388™-2000. Also, this revision addresses the possibility of expanding the list of data elements to include additional data items of interest to the user doing power quality and thermal evaluation work. Changes in currently used computer software will allow consideration of other possible data formats.

[1] Information on references can be found in Clause 2.

2. Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments or corrigenda) applies.

ANSI C57.12.22, American National Standard for Transformers—Pad-Mounted, Compartmental-Type, Self-Cooled Three-Phase Distribution Transformers With High-Voltage Bushings, 2500 kVA and Smaller: High Voltage, 34 500 Grd Y/19 920 Volts and Below; Low Voltage, 480 Volts and Below. [2]

ANSI C57.12.24, American National Standard for Transformers—Underground-Type Three-Phase Distribution Transformers, 2500 kVA and Smaller; High Voltage, 34 500 GrdY/19 920 Volts and Below; Low Voltage, 480 Volts and Below—Requirements.

ANSI C57.12.25, American National Standard for Transformers—Pad-Mounted, Compartmental-Type, Self-Cooled, Single-Phase Distribution Transformers with Separable Insulated High-Voltage Connectors; High Voltage, 34 500 GrdY/19 920 Volts and Below; Low Voltage, 240/120 Volts; 167 kVA and Smaller—Requirements.

ANSI C57.12.40, American National Standard for Secondary Network Transformers Subway and Vault Types (Liquid Immersed)—Requirements.

IEEE Std C57.12.00™, IEEE Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers.[3, 4]

IEEE Std C57.12.20™, IEEE Standard for Overhead-Type Distribution Transformers, 500 kVA and Smaller: High Voltage, 34 500 V and Below; Low Voltage, 7970/13 800Y V and Below.

IEEE Std C57.12.26™, IEEE Standard for Pad-Mounted, Compartmental-Type, Self-Cooled, Three-Phase Distribution Transformers for Use With Separable Insulated High-Voltage Connectors (34 500 Grd Y/19 920 V and Below; 2500 kVA and Smaller).

IEEE Std C57.12.35™, IEEE Standard for Bar Coding for Distribution Transformers.

IEEE C57.12.80™, IEEE Standard Terminology for Power and Distribution Transformers.

IEEE Std C57.12.90™, IEEE Standard Test Code for Liquid-Immersed Distribution, Power, and Regulating Transformers.

3. Definitions

For the purposes of this standard, the following terms and definitions apply. *The Authoritative Dictionary of IEEE Standards Terms* should be referenced for terms not defined in this clause.

3.1 standard reference temperature: The temperature that is used as a standard reference for a particular test parameter.

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4. Test data requirements

4.1 General

This standard defines two different sets of test data the user should request. These two sets will be referred to as the standard data set and the extended data set, respectively. The standard data set should be adequate for purposes of loss test data reporting and shall be supplied unless the user specifies otherwise. The extended data set is included as a means of satisfying users with the need for additional data.

The definition of each data element field includes the data element field name, the data element field length and format, a description of the data element that attempts to define the data element unambiguously, and brief data validation rules.

NOTE—The convention used to define the format of each data element field is as follows: "A*n*" where A indicates the field content is alphanumeric, the number *n* indicates the number of characters in the field; "I*n*" where I indicates the field content is an integer value, the number *n* indicates the number of characters in the field; "F*n.n*" where F indicates the field content is a real number, the first *n* indicates the number of characters in the field, and the second *n* indicates the number of significant digits to the right of the decimal place.[5]

4.2 Standard data set

The standard data set consists of the data element fields discussed in 4.2.1 through 4.2.26.

4.2.1 User name (A23)

The name of the transformer purchaser.

Valid values: Any alphanumeric combination of 23 characters or less.

4.2.2 User order number (A25)

The transformer purchaser's order number.

Valid values: Any alphanumeric combination of 25 characters or less.

4.2.3 User stock number (A14)

The material and stores' identification number used by the user for the order item

Valid values: Any alphanumeric combination of 14 characters or less.

4.2.4 Producer identification (A2)

The two character ID of the transformer producer as used on the nameplate.

Valid values: See ANSI C57.12.35.

4.2.5 Producer order number (A14)

The transformer producer's order number.

[5] Notes in text, tables, and figures are given for information only and do not contain requirements needed to implement the standard.

Valid values: Any alphanumeric combination of 14 characters or less.

4.2.6 Producer catalog number (A15)

The material and stores' identification number used by the producer for the order item.

Valid values: Any alphanumeric combination of 15 characters or less.

4.2.7 Producer serial number (A13)

The unique identification number assigned by the producer to the individual transformer for which test data is being reported.

Valid values: Any alphanumeric combination of 13 characters or less. This matches the number of characters allowed for Producer Serial Number in IEEE Std C57.12.35.

4.2.8 Product type (A2)

The product type of the order item.

Valid values: OH-Overhead, PM-Pad Mounted, UG-Underground, NW-Network, DS-Distribution Substation, OT-Other

4.2.9 Number of phases (I1)

Number of phases of order item, standards being single phase, two phase (duplex), or three phase.

Valid values: Integer values of 1, 2, or 3.

4.2.10 kVA rating (F7.1)

Nominal ONAN kVA rating of the order item in kilovolt amperes (kVA).

Valid values: kVA to 1 decimal point.

4.2.11 Primary voltage (A47)

Order item nominal rated primary voltage in volts using standard ANSI nomenclature for nameplate markings. See IEEE Std C57.12.00.

Valid values: Any alphanumeric values of 47 characters or less. The data in this field should duplicate the primary voltage and connection as they appear on the nameplate, unless space does not permit in which case voltage abbreviations should be used. Abbreviations used shall be by mutual agreement with the end user.

4.2.12 Secondary voltage (A28)

Order item nominal rated secondary voltage in volts using standard ANSI nomenclature for nameplate markings. See IEEE Std C57.12.00.

Valid values: Any alphanumeric values of 28 characters or less. The data in this field should duplicate the secondary voltage and connection as they appear on the nameplate, unless space does not permit in which case voltage abbreviations should be used. Abbreviations used shall be by mutual agreement with the end user.

4.2.13 Polarity (A1)

Transformer polarity for single phase only. Three-phase units and phase displacement are not reported.

Valid values: A = Additive, S = Subtractive

4.2.14 Quoted no-load loss (I5)

Quoted no-load losses in watts at nominal ONAN rating in kVA, nominal primary voltage, and standard reference temperature.

Valid values: Any integer from 0 to 99 999.

4.2.15 Quoted load loss (I6)

Quoted load losses in watts at nominal ONAN rating in kVA, nominal primary voltage, and standard reference temperature.

Valid values: Any integer from 0 to 999 999.

4.2.16 Quoted impedance voltage (IZ) (F4.2)

Quoted per unit impedance voltage in percent at nominal ONAN rating in kVA, nominal voltage, and standard reference temperature.

Valid values: Real numbers from 0.00 to 9.99.

4.2.17 Quoted exciting current (IEX) (F4.2)

Quoted per unit exciting current in percent at nominal ONAN rating in kVA and nominal primary voltage.

Valid values: Real number from 0.00 to 9.99.

4.2.18 Tested no-load loss (I5)

Tested no-load losses in watts at nominal ONAN rating in kVA, nominal primary voltage, and standard reference temperature.

Valid values: Any integer from 0 to 99 999.

4.2.19 Tested load loss (I6)

Tested load losses in watts at nominal ONAN rating in kVA, nominal primary voltage, and standard reference temperature.

Valid values: Any integer from 0 to 999 999.

4.2.20 Tested impedance voltage (IZ) (F4.2)

Tested per unit impedance voltage in percent at nominal ONAN rating in kVA, nominal voltage, and standard reference temperature.

Valid values: Real numbers from 0.00 to 9.99.

4.2.21 Tested resistance voltage (IR) (F4.2)

Tested per unit resistance voltage in percent at nominal ONAN rating in kVA, nominal voltage, and standard reference temperature.

Valid values: Real numbers from 0.00 to 9.99.

4.2.22 Tested exciting current (IEX) (F4.2)

Tested per unit exciting current in percent at nominal ONAN rating in kVA and nominal primary voltage.

Valid values: Real numbers from 0.00 to 9.99.

4.2.23 Total mass (I5)

Total weight mass in kilograms (or equivalent force in pounds) of the transformer ordered including the core and coil assembly, tank and fitting assemblies, and insulating fluid as marked on the nameplate.

Valid values: Any integer value from 0 to 99 999.

4.2.24 Mass unit of measure (A2)

Units of mass as specified by user.

Valid values: kg = kilograms, lb = pounds

4.2.25 Date of manufacture (A7)

Year and month in which transformer was made.

Valid values: Alphanumeric in yyyy/mm format.

4.2.26 Test data reporting lot (A7)

Users choose different ways in which to group a “lot” of test data for reporting purposes. This field describes the grouping mechanism. The grouping mechanism should be by user ORDER and user RELEASE, by the time period in which the units were shipped (month, quarter, year) or by some other agreed upon grouping mechanism. Note that due to the financial operating calendars of producers, test data reported for a given month or quarter might not exactly agree with the calendar month or quarter.

Valid values: Any alphanumeric characters of 7 or less. For time-based groupings, periods should be stated as either yyyy/mm or yyyy/qx where yyyy is the year designation, mm is the month, and the quarter is designated in the Q1, Q2, Q3, Q4 format.

4.3 Extended data set

The extended data set consists of all the data element fields in the standard set plus the data element fields discussed in 4.3.1 through 4.3.13.

4.3.1 User release number (A12)

The transformer purchaser’s release number.

Valid values: Any alphanumeric combination of 12 characters or less.

4.3.2 Producer plant location (A10)

The location of the producer's facility in which the product was made. If the producing facility is located in the U.S., provide the two character state abbreviation followed by the producer's plant name/identifier. If outside the U.S., provide the name, or code, of the province, state, or country.

Valid values: Any alphanumeric combination of 10 characters or less.

4.3.3 Quoted loss guarantee type (A2)

For standard reporting purposes, losses are assumed to be guaranteed average. This field is to qualify losses guaranteed in some other way.

Valid values: GA = guaranteed average, GM = guaranteed maximum, NG = not guaranteed.

4.3.4 No-load loss evaluation factor (F5.2)

The normalized no-load loss evaluation factor, in currency as specified by the user, per watt. This will be supplied at time of quote by user.

Valid values: Real numbers from 00.00 to 99.99.

4.3.5 Load loss evaluation factor (F5.2)

The normalized load loss evaluation factor, in currency as specified by the user, per watt. This will be supplied at time of quote by user.

Valid values: Real numbers from 00.00 to 99.99.

4.3.6 Frequency (I2)

The nominal operating frequency of the transformer.

Valid values: Any integer from 0 to 99.

4.3.7 Cooling class (A9)

The cooling class of the transformer stated per ANSI standard conventions such as ONAN, ONAN/ONAF.

Valid values: ONAN, ONAN/ONAF, KNAN/KNAF, LNAN/LNAF.

4.3.8 Average winding temperature rise (A5)

The rated average winding temperature rise of the transformer in degrees Celsius.

Valid values: 55, 55/65, 65, other as agreed upon by the user and producer.

4.3.9 Type of insulating fluid (A8)

The type of insulating fluid in the transformer.

Valid values: Oil, LFHC, silicone, other as agreed upon by the user and producer. NONE for Dry Type TRs.

4.3.10 No-load loss reference temperature (I2)

Any non-standard reference temperature used for quoting and reporting no-load losses in degrees Celsius.

Valid values: Any integer from 0 to 99.

4.3.11 Load loss reference temperature (I2)

Any non-standard reference temperature used for quoting and reporting load losses in degrees Celsius.

Valid values: Any integer from 0 to 99.

4.3.12 Reserved space (Unspecified 45)

This field should be used for any additional data mutually agreed upon by the user and producer.

Valid values: Any alphanumeric or integer characters as designated.

4.3.13 Free format text field (A148)

This space should be used for any free format text information as mutually agreed upon by the user and producer.

Valid values: Any alphanumeric characters.

4.4 Calculated data

There are a number of data fields that are not included in either the standard data set or the extended data set because they can easily be calculated from the data provided. Included are the items found in 4.4.1 through 4.4.4.

4.4.1 Total losses

Total losses would be reported as the sum of the No-Load and Load losses despite the small discrepancy introduced due to the differences in reference temperatures.

4.4.2 Per unit reactance

Per unit reactance of a transformer can be calculated from the per unit resistance and per unit impedance as shown in IEEE Std C57.12.90.

4.4.3 Regulation

Regulation can be calculated based on per unit resistance, reactance, and impedance along with the chosen load power factor as shown in IEEE Std C57.12.90.

4.4.4 Efficiency

Efficiency can be calculated based on the transformer kVA and its losses as shown in IEEE Std C57.12.90. Approximate efficiency at various loads can be calculated by remembering that the load losses vary roughly as the square of the per unit load. Note that load losses are comprised of the sum of I^2R losses and stray losses, not accounting for the fact that the stray loss component of load losses does not vary as the square of the load is the major weakness in this efficiency approximation.

5. Test data file format

5.1 General

This standard defines two file formats the user should request. They will be referred to as the flat-file format and the comma-delimited variable format, respectively. The flat file format is the simplest and will be used unless the user specifies otherwise.

5.2 Flat file format

5.2.1 General

The flat file format was chosen over other file formats because it can be easily defined and easily understood. Further, it is equally useful whether the user's computer is a mainframe or a personal computer. The flat file format defined here is kept as simple as possible. No attempt is made to separate header data from line item data. The benefit is that each record in the file completely defines the test data for each transformer on which test data is being reported. Flat files are also referred to as Fixed Length Files in which each line or record (file) consists of a specific number of characters. Each data element field is located in a predefined position in the string of data element fields and each data element field contains a predetermined number of characters. For Alphanumeric fields, unused element positions are left blank. In Numeric and Integer fields, the unused elements will be filled with zero (0) so that data field position is maintained in a consistent fashion in each record.

The file definition is ASCII format with each record (line) representing an individual transformer in the case of the standard data set. The record layout is given below for both the standard data set transformer record and the extended data set transformer record. When the extended data set record is requested, the data elements of the standard data set listed in Table 1 will be shown on one line, immediately followed on a separate line by the data elements shown in Table 2, and together, the two lines will constitute an extended data set transformer record. Alphanumeric fields are defined as left justified with unused elements left blank. Integer and Fixed Decimal fields are right justified with the balance of the field filled with zeros.

Test data element fields could have been defined as either header data or item detail data. Header data applies to all transformers in the report or to a group of transformers. Item data applies to only one transformer in the report. The benefit of excluding header data would have been to eliminate the repetition of data in the file; the cost would have been a loss of simplicity. Therefore, header data is included in each transformer record.

5.2.2 Standard data set transformer record

The record layout for the standard data set is given in Table 1. The field sequence number, field name, field length, and from-to column is given for each data element field in the record. The standard data set transformer record consists of one line.

Table 1—Standard data set

Field	Data element field name	Data type	Field length	Columns
1	User name	A	23	1–23
2	User order number	A	25	24–48
3	User stock number	A	14	49–62
4	Producer identification	A	2	63–64
5	Producer order number	A	14	65–78
6	Producer catalog number	A	15	79–93
7	Producer serial number	A	13	94–106
8	Product type	A	2	107–108
9	Number of phases	I	1	109
10	kVA	F	7.1	110–116
11	Primary voltage	A	47	117–163
12	Secondary voltage	A	28	164–191
13	Polarity	A	1	192
14	Quoted no-load loss	I	5	193–197
15	Quoted load loss	I	6	198–203
16	Quoted IZ	F	4	204–207
17	Quoted IEX	F	4	208–211
18	Tested no-load loss	I	5	212–216
19	Tested load loss	I	6	217–222
20	Tested IZ	F	4	223–226
21	Tested IR	F	4	227–230
22	Tested IEX	F	4	231–234
23	Total mass	I	5	235–239
24	Mass unit of measure	A	2	240–241
25	Date of manufacture	A	7	242–248
26	Test data reporting lot	A	7	249–255

5.2.3 Extended data set transformer record

The record layout is given in Table 2 for the additional data elements which, when included with the standard data set, comprise the extended data set. The field sequence number, field name, field length, and from-to columns is given for each data element field in the record. The extended data set record consists of two lines.

Table 2—Additional Data

Field	Data element field name	Data type	Field length	Columns
1	User release number	A	12	1–12
2	Producer plant location	A	10	13–22
3	Quoted loss guarantee type	A	2	23–24
4	No-load loss evaluation factor	F	5	25–29
5	Load loss evaluation factor	F	5	30–34
6	Frequency	I	2	35–36
7	Cooling class	A	9	37–45
8	Average winding temperature rise	A	5	46–50
9	Type of insulating fluid	A	8	51–58
10	No-load loss reference temperature	I	2	59–60
11	Load loss reference temperature	I	2	61–62
12	Reserved space (blank)		45	63–107
13	Free format text field	A	148	108–255

5.2.4 Consolidated record

If the user's computer system has no limitations that preclude receipt of a single record longer than 256 characters, the user should choose to specify a consolidated flat file record. When the consolidated record is specified, the user will receive a single flat file record 510 characters in length. The data in the record will be made up of the standard data set fields followed by the additional fields which together comprise the extended data set in a single, one line record. Each record will provide data on a single item (transformer).

5.3 Comma delimited variable format

5.3.1 General

The comma delimited file format is one in which the fields of data are provided in a known sequential order with commas delimiting (separating) successive fields. It is preferred by many PC users. It is a standard option offered in this standard.

5.3.2 Standard data set

When the user specifies the standard data set and a comma-delimited file, they will receive the standard set of test data described above in 5.2.2. The data set length can vary from that specified in the table, but must conform to those data types outlined in the table.

5.3.3 Extended data set

When the user specifies the extended data set and a comma delimited file, they will receive both the standard data set fields and the additional fields, which together comprise the extended data set described above in a single comma delimited file with all data items for each transformer record on a single line. When the extended data set is specified, only the single line record is offered. The data set length may vary from that specified in the tables, but must conform to those data types outlined in the tables.

6. Test data file transfer

6.1 General

Once the test data requirements and the test data report file are defined, the test data report file can be created. The user can now choose the most convenient method of file transfer. The transfer method can be as simple as mailing the file or as sophisticated as telecommunicating the file. The point in the order cycle at which this information is to be communicated shall be negotiated between the user and the producer.

6.2 Transfer by mail service

For transfer by mail, the standard media for file transfer is an agreed upon removable storage media, e.g., 3.5 in DS-HD (double sided, high density) floppy disk or CD-ROM. The user shall provide a mailing address for the test data if it is different than the order shipping address.

6.3 Transfer by telecommunications

For transfer by telecommunication, the user shall provide detailed instructions to the producer. Data transfer via a service provider is recommended for this option.

6.3.1 Data transfer directly to user

If the data is to be transferred directly from the producer to the user, the user is responsible for providing the producer with the necessary information for establishing a communications link. Although the sender is expected to take reasonable measures to prevent sending a file containing a virus or otherwise compromising the security of a receiver's system, the receiver is ultimately responsible for protection of its system from intrusions.

6.3.2 Data compression

If requested by the user, standard compression software may be used to reduce the file size.

6.3.3 Encryption of data

Unless otherwise agreed to by producer and user, electronic test data will not be encrypted.