



Illuminating
ENGINEERING SOCIETY

TECHNICAL MEMORANDUM: STANDARD FORMAT FOR THE ELECTRONIC DATA TRANSFER OF LIGHT OUTPUT MAINTENANCE CHARACTERISTICS OF SOLID-STATE LIGHT SOURCES

AN AMERICAN NATIONAL STANDARD



Documents
www.ies.org
Download from the IES Hub

**TECHNICAL MEMORANDUM:
STANDARD FORMAT FOR THE ELECTRONIC
DATA TRANSFER OF LIGHT OUTPUT
MAINTENANCE CHARACTERISTICS OF
SOLID-STATE LIGHT SOURCES
AN AMERICAN NATIONAL STANDARD**

Publication of this Technical Memorandum
has been approved by IES.
Suggestions for revisions
should be directed to IES.

Prepared by the IES Computer Committee



Copyright 2024 by the Illuminating Engineering Society.

Approved by the IES Standards Committee November 27, 2024, as a Transaction of the Illuminating Engineering Society.

Approved December 3, 2024, as an American National Standard.

All rights reserved. No part of this publication may be reproduced in any form, in any electronic retrieval system or otherwise, without prior written permission of the IES.

Published by the Illuminating Engineering Society, 85 Broad Street, 17th Floor, New York, NY 10004.

IES Standards are developed through committee consensus and produced by the IES Office in New York. Careful attention is given to style and accuracy. If any errors are noted in this document, please forward them to the IES Director of Standards, at standards@ies.org or the above address, for verification and correction. The IES welcomes and urges feedback and comments.

Printed in the United States of America.

ISBN 978-0-87995-470-3

DISCLAIMER

IES publications are developed through the consensus standards development process approved by the American National Standards Institute. This process brings together volunteers representing varied viewpoints and interests to achieve consensus on lighting recommendations. While the IES administers the process and establishes policies and procedures to promote fairness in the development of consensus, it makes no guaranty or warranty as to the accuracy or completeness of any information published herein.

The IES disclaims liability for any injury to persons or property or other damages of any nature whatsoever, whether special, indirect, consequential or compensatory, directly or indirectly resulting from the publication, use of, or reliance on this document.

In issuing and making this document available, the IES is not undertaking to render professional or other services for or on behalf of any person or entity. Nor is the IES undertaking to perform any duty owed by any person or entity to someone else. Anyone using this document should rely on his or her own independent judgment or, as appropriate, seek the advice of a competent professional in determining the exercise of reasonable care in any given circumstances.

The IES has no power, nor does it undertake, to police or enforce compliance with the contents of this document. Nor does the IES list, certify, test or inspect products, designs, or installations for compliance with this document. Any certification or statement of compliance with the requirements of this document shall not be attributable to the IES and is solely the responsibility of the certifier or maker of the statement.

AMERICAN NATIONAL STANDARD

Approval of an American National Standard requires verification by ANSI that the requirements for due process, consensus, and other criteria have been met by the standards developer.

Consensus is established when, in the judgment of the ANSI Board of Standards Review, substantial agreement has been reached by directly and materially affected interests. Substantial agreement means much more than a simple majority, but not necessarily unanimity. Consensus requires that all views and objections be considered, and that a concerted effort be made toward their resolution.

The use of American National Standards is completely voluntary; their existence does not in any respect preclude anyone, whether that person has approved the standards or not, from manufacturing, marketing, purchasing, or using products, processes, or procedures not conforming to the standards.

The American National Standards Institute does not develop standards and will in no circumstances give an interpretation to any American National Standard. Moreover, no person shall have the right or authority to issue an interpretation of an American National Standard in the name of the American National Standards Institute. Requests for interpretations should be addressed to the secretariat or sponsor whose name appears on the title page of this standard.

CAUTION NOTICE: This American National Standard may be revised at any time. The procedures of the American National Standards Institute require that action be taken to reaffirm, revise, or withdraw this standard no later than five years from the date of approval. Purchasers of American National Standards may receive current information on all standards by calling or writing the American National Standards Institute.

Prepared by the IES Computer Committee.

Jianzhong Jiao, *Chair*
Ryan Kelley, *Vice Chair*
David N. Randolph, *Secretary*

Members

Wilson Dau	Greg A. Hauser	Richard J. Koshel
Paul K. Ericson	Julie Lynn Johnson	Lance K. Livingston
Groot Gregory	Randall M. King	Joel Spahn

Advisory Members

Dominique Chabaud	Matt S. Kincaid	Avraham M. Mor
Randy D. Gananathan	Adrian Martin	Todd F. Saemisch

CONTENTS

- 1.0 Introduction and Scope 1
- 1.1 Introduction..... 1
- 1.2 Scope 1

- 2.0 Normative References.....1
- 2.1 ECMA-404..... 1
- 2.2 ANSI/IES LM-80-21 1
- 2.3 ANSI/IES TM-27-20 1
- 2.4 RFC 4122 1
- 2.5 W3C Extensible Markup Language (XML) 1.1, 2nd ed..... 2
- 2.6 W3C XML Schema Definition Language (XSD) 1.1. Part 1: Structures 2
- 2.7 W3C XML Schema Definition Language (XSD) 1.1. Part 2: Datatypes 2

- 3.0 Definitions 2

- 4.0 XML Format for Light Output Maintenance Characteristics 2
- 4.1 Version Element 2
- 4.2 Admin Element..... 2
 - 4.2.1 Testing Agency Element..... 2
 - 4.2.2 Report Number Element 3
 - 4.2.3 Report Date Element 3
 - 4.2.4 Test Start Date Element..... 3
 - 4.2.5 Test End Date Element 3
 - 4.2.6 Unique Identifier Element 3
 - 4.2.7 Comment Element 3
 - 4.2.8 Reference Element 3
 - 4.2.9 More Information URI Element 3
- 4.3 Device Under Test Element..... 3
 - 4.3.1 Manufacturer Element 3
 - 4.3.2 Catalog Number Element 3
 - 4.3.3 Description Element 3
 - 4.3.4 Seasoning Duration Element 3
 - 4.3.5 Sampling Method Element..... 4
- 4.4 Test Equipment Element 4
 - 4.4.1 TMP Element..... 4
 - 4.4.2 Life Test Equipment Element 5
 - 4.4.3 Radiometric Test Equipment Element..... 5
 - 4.4.4 Electrical Drive Equipment Element..... 5

4.5 Measurement Set 6

4.5.1 Air Temperature Range Element 6

4.5.2 TMP Temperature Range Element 7

4.5.3 Air Movement Element..... 7

4.5.4 Relative Humidity Element 7

4.5.5 Elapsed Time Element..... 7

4.5.6 Number of DUTs Element..... 7

4.5.7 DUTs Element..... 7

4.6 Custom Data Element..... 9

4.6.1 Name Element..... 9

4.6.2 Unique Identifier Element 9

4.6.3 Any Data Element..... 9

5.0 XML Schema..... 10

6.0 JSON Document Format 14

6.1 XML to JSON Mapping 14

6.2 JSON Schema..... 15

Annex A – Sample Documents 22

A.1 Sample XML Document 22

A.2 Sample JSON Document 24

Annex B – Document Structure Overview..... 27

Informative References 30

1.0 Introduction and Scope

1.1 Introduction

LM-80 tests are conducted to measure the light output maintenance characteristics of solid-state light sources. The resulting data typically targets two commercial uses: 1) reports formatted for human reading (e.g., an LM-80 [see **Section 2.2**] report); or 2) LED lifetime projection calculators (e.g., ANSI/IES TM-21).

Data collected during an LM-80 maintenance test may have other uses beyond these immediate commercial applications. This is particularly true if multiple diverse LM-80 datasets are considered. For example, with multiple datasets, a researcher could use a review-based approach to investigate the correlation between a widely used packaging technology and a particular output maintenance characteristic. By including datasets from multiple manufacturers, trends that relate to the underlying packaging technology, rather than a specific commercial implementation, might be revealed. The revealed trends could then be used to focus subsequent primary research that would seek the root cause. The resulting improved understanding of the packaging technology could then stimulate improvements that could be applied to future products.

Most labs do save LM-80 data; however, data is collected using equipment that varies from laboratory to laboratory, and the data is typically stored in proprietary databases. Because of this, it is not always easy to access or exchange raw LM-80 test data.

This document provides a standard format for the electronic transfer of LM-80 test data in XML format. All required LM-80 report data items are included, as well as optional data items such as the spectral power distribution (SPD). The ordering of data elements does not follow the LM-80 report format; rather, the ordering is more data-centric, with administrative elements first, followed by device-under-test (DUT) items, test conditions, and then results. Where important, the precision required for a particular data element is specified; this helps to reduce uncertainty when the data is used for calculations. The format is described first

in human-readable text, and then computer-readable XML and JSON schemas are provided. Finally, sample XML and JSON documents are included in **Annex A**, and an overview of the document structure is provided in **Annex B**, to aid in picturing the hierarchy.

1.2 Scope

This Technical Memorandum (TM) describes the storage and transfer file format for LM-80 maintenance test data for solid-state light sources, such as LED packages, arrays, and modules; or laser diode packages, arrays, and modules.

This TM does not cover the storage and transfer of derivative data, such as TM-21 projection data.

2.0 Normative References

2.1 ECMA-404

ECMA International. The JSON Data Interchange Syntax, 2nd ed. Geneva: ECMA International; 2017. Online: <https://www.ecma-international.org/>. (Accessed 2023 Aug 31).

2.2 ANSI/IES LM-80-21

Illuminating Engineering Society. Approved Method: Measuring Maintenance of Light Output Characteristics of Solid-State Light Sources. New York: IES; 2021.

2.3 ANSI/IES TM-27-20

Illuminating Engineering Society. Technical Memorandum: IES Standard File Format for the Electronic Transfer of Spectral Data. New York: IES; 2020.

2.4 RFC 4122

Leach P, Mealling M, Salz R. A Universally Unique Identifier (UUID) URN Namespace. Internet Engineering Task Force; 2015 Jul. (RFC 4122). Online: <https://datatracker.ietf.org/doc/html/rfc4122>. (Accessed 2023 Aug 31).

2.5 W3C Extensible Markup Language (XML) 1.1, 2nd ed.

(<http://www.w3.org/TR/xml11>). (Accessed 2023 Aug 31).

2.6 W3C XML Schema Definition Language (XSD) 1.1. Part 1: Structures

(<http://www.w3.org/TR/xmlschema11-1>). (Accessed 2023 Aug 31).

2.7 W3C XML Schema Definition Language (XSD) 1.1. Part 2: Datatypes

(<http://www.w3.org/TR/xmlschema11-2>). (Accessed 2023 Aug 31).

3.0 Definitions

Definitions for the terms used in this TM can be found in normative reference ANSI/IES LM-80-21 (see **Section 2.2**).

4.0 XML Format for Light Output Maintenance Characteristics

The light output maintenance characteristics document shall follow the W3C XML Schema (see **Sections 2.6** and **2.7**) presented in **Section 5**. It shall include the required elements listed in this section, and it may include the optional elements listed in this section.

The XML document is separated into six elements:

- The required `Version` element (**Section 4.1**), which identifies the XML schema version.
- The required `Admin` element (**Section 4.2**), which contains administrative information.
- The required `DeviceUnderTest` element (**Section 4.3**), which contains information about the device under test.
- The required `TestEquipment` element (**Section 4.4**), which contains information about the environmental conditions and equipment used to perform the measurements.
- The required `MeasurementSet` element (**Section 4.5**), which contains information about test results.
- The optional `CustomData` element (**Section 4.6**), which contains information specific to a particular application; for example, government-mandated environmental criteria.

4.1 Version Element

The required `Version` element identifies the XML schema version. It shall be "1.0".

4.2 Admin Element

The required `Admin` element is the parent of the administrative information section. `Admin` elements are listed in **Table 4-1**.

4.2.1 Testing Agency Element. The required `TestAgency` element identifies the testing agency name that performed the data measurements.

Table 4-1. Admin Element Fields

Element Description	Element Name	Data Type	Required/Optional	Document Section
Testing Agency	TestAgency	xs:string	Required	4.2.1
Report Number	ReportNumber	xs:string	Required	4.2.2
Report Date	ReportDate	xs:date	Required	4.2.3
Test Start Date	TestStartDate	xs:date	Required	4.2.4
Test End Date	TestEndDate	xs:date	Required	4.2.5
Unique Identifier	UniqueIdentifier	xs:string	Required	4.2.6
Comment	Comment	xs:string	Optional	4.2.7
Reference	Reference	xs:string	Optional	4.2.8
More Information URI	MoreInfoURI	xs:anyURI	Optional	4.2.9

4.2.2 Report Number Element. The required `ReportNumber` element identifies the testing laboratory report number.

4.2.3 Report Date Element. The required `ReportDate` element identifies the testing laboratory report issue date using the XSD Date data type, YYYY-MM-DD.

4.2.4 Test Start Date Element. The required `TestStartDate` element identifies the test start date, using the XSD Date data type, YYYY-MM-DD.

4.2.5 Test End Date Element. The required `TestEndDate` element identifies the most recent date the data was collected for this report, using the XSD Date data type, YYYY-MM-DD.

4.2.6 Unique Identifier Element. The required `UniqueIdentifier` element contains a Universally Unique Identifier (UUID) as defined by RFC 4122 (see **Section 2.4**). Most scientific programming language libraries include functions that will automatically generate UUIDs.

A UUID is a unique 128-bit value expressed as a string with 32 hexadecimal digits in the format xxxxxxxx-xxxx-xxxx-xxxx-xxxxxxxxxxxx. For example:

21EC2020-3AEA-4069-A2DD-08002B30309D

The intent of the UUID is to uniquely identify the document's measurement data. The document creator shall generate a new UUID whenever the document's measurement data is modified.

4.2.7 Comment Element. The optional `Comment` element provides arbitrary additional information relating to the tested and reported data.

Multiple `Comment` elements may be included.

4.2.8 Reference Element. The optional `Reference` element identifies one or more regulatory standards or other documents with which the luminaire or emitter complies, or the regulatory standards or other documents to which the laboratory measurements conform. This may, for example, be a document name or a web address.

Multiple `Reference` elements may be included.

4.2.9 More Information URI Element. The optional `MoreInfoURI` element provides a Uniform Resource Identifier (URI) address for further device information.

Multiple `MoreInfoURI` elements may be included.

4.3 Device Under Test Element

The required `DUT` element is the parent of the device under test section. `DUT` elements are listed in **Table 4-2**.

4.3.1 Manufacturer Element. The required `Manufacturer` element identifies the manufacturer of the DUT.

4.3.2 Catalog Number Element. The required `CatalogNumber` element identifies the manufacturer's product catalog number or similar identification.

4.3.3 Description Element. The required `Description` element contains a text description of the DUT, including whether it is an LED package, array, or module.

4.3.4 Seasoning Duration Element. The optional `SeasonDuration` element specifies the number of hours that the devices were seasoned prior to testing, as per Section 7.2 of ANSI/IES LM-80-21 (refer to **Section 2.2**).

Table 4-2. Device Under Test Element Fields

Element Description	Element Name	Data Type	Required/Optional	Document Section
Manufacturer	Manufacturer	xs:string	Required	4.3.1
Catalog Number	CatalogNumber	xs:string	Required	4.3.2
Description	Description	xs:string	Required	4.3.3
Seasoning Duration	SeasonDuration	xs:int	Optional	4.3.4
Sampling Method	SamplingMethod	xs:string	Optional	4.3.5

4.3.5 Sampling Method Element. The optional `SamplingMethod` element specifies the DUT sampling method, for example, random sampling or first production reel.

4.4 Test Equipment Element

The required `TestEquipment` element is the parent of the test equipment section. `TestEquipment` elements are listed in **Table 4-3**.

4.4.1 TMP Element. The required TMP element is the parent of the Temperature Measurement Point information.

4.4.1.1 Location Element. The required `Location` element describes the TMP position.

4.4.1.2 Image Element. The required `Image` element is a Base64 encoded image of the TMP location.

Table 4-3. Test Equipment Element Fields

Element Description	Element Name	Data Type	Required/Optional	Document Section
TMP Element	TMP	XML Element	Required	4.4.1
Location	<code>Location</code>	xs:string	Required	4.4.1.1
Image	<code>Image</code>	xs:string	Required	4.4.1.2
Life Test Equipment	LifeTestEquipment	XML Element	Required	4.4.2
System Type	<code>SystemType</code>	xs:string	Required	4.4.2.1
Description	<code>Description</code>	xs:string	Required	4.4.2.2
Manufacturer	<code>Manufacturer</code>	xs:string	Required	4.4.2.3
Model Number	<code>ModelNumber</code>	xs:string	Required	4.4.2.4
Calibration Date	<code>CalibrationDate</code>	xs:date	Required	4.4.2.5
Uncertainty	<code>Uncertainty</code>	xs:string	Optional	4.4.2.6
Radiometric Test Equipment	RadiometricTestEquipment	XML Element	Required	4.4.3
System Type	<code>SystemType</code>	xs:string	Required	4.4.3.1
Description	<code>Description</code>	xs:string	Required	4.4.3.2
Manufacturer	<code>Manufacturer</code>	xs:string	Required	4.4.3.3
Model Number	<code>ModelNumber</code>	xs:string	Required	4.4.3.4
Calibration Date	<code>CalibrationDate</code>	xs:date	Required	4.4.3.5
Uncertainty	<code>Uncertainty</code>	xs:string	Optional	4.4.3.6
Sphere Drift Correction	<code>SphereDriftCorrection</code>	xs:string	Optional	4.4.3.7
Temperature Correction	<code>TemperatureCorrection</code>	xs:string	Optional	4.4.3.8
Maximum Measurable Wavelength	<code>MaxMeasureWavelength</code>	xs:decimal	Optional	4.4.3.9
Minimum Measurable Wavelength	<code>MinMeasureWavelength</code>	xs:decimal	Optional	4.4.3.10
Peak Wavelength Method	<code>PeakWavelengthMethod</code>	xs:string	Optional	4.4.3.11
Electrical Drive Equipment	ElectricalDriveEquipment	XML Element	Required	4.4.4
System Type	<code>SystemType</code>	xs:string	Required	4.4.4.1
Description	<code>Description</code>	xs:string	Required	4.4.4.2
Manufacturer	<code>Manufacturer</code>	xs:string	Required	4.4.4.3
Model Number	<code>ModelNumber</code>	xs:string	Required	4.4.4.4
Calibration Date	<code>CalibrationDate</code>	xs:date	Required	4.4.4.5
Uncertainty	<code>Uncertainty</code>	xs:string	Optional	4.4.4.6

4.4.2 Life Test Equipment Element. The required `LifeTestEquipment` element is the parent of the elements related to the life test equipment.

4.4.2.1 SystemTypeElement. The required `SystemType` element specifies the system.

4.4.2.2 Description Element. The required `Description` element provides additional details about the life test system.

4.4.2.3 Manufacturer Element. The required `Manufacturer` element is the manufacturer of the life test equipment.

4.4.2.4 Model Number Element. The required `ModelNumber` element is the model number for the life test equipment.

4.4.2.5 Calibration Date Element. The required `CalibrationDate` element is the date of the last calibration of the equipment, using the XSD Date data type, YYYY-MM-DD.

4.4.2.6 Uncertainty Element. The optional `Uncertainty` element describes the uncertainty in the life test equipment.

4.4.3 Radiometric Test Equipment Element. The required `RadiometricTestEquipment` element is the parent of the elements related to the radiometric test equipment.

4.4.3.1 SystemTypeElement. The required `SystemType` element specifies the measurement system. Valid values include:

`IntegratingSphere`
`IntegratingHemisphere`
`Gonioradiometer`

Values other than these three may be used.

4.4.3.2 Description Element. The required `Description` element provides additional details about the measurement system.

4.4.3.3 Manufacturer Element. The required

`Manufacturer` element is the manufacturer of the radiometric test equipment.

4.4.3.4 Model Number Element. The required `ModelNumber` element is the model number for the radiometric test equipment.

4.4.3.5 Calibration Date Element. The required `CalibrationDate` element is the date of the last calibration of the equipment, using the XSD Date data type, YYYY-MM-DD.

4.4.3.6 Uncertainty Element. The optional `Uncertainty` element describes the uncertainty in the radiometric test equipment.

4.4.3.7 Sphere Drift Correction Element. The optional `SphereDriftCorrection` element describes any sphere drift corrections made to the measurement systems' responsivity as per Section 6.2 of normative reference ANSI/IES LM-80-21 (refer to **Section 2.2**). This element shall be included if any sphere drift correction was performed.

4.4.3.8 Temperature Correction Element. The optional `TemperatureCorrection` element describes any temperature corrections made to the measurement systems' responsivity. This element shall be included if any temperature correction was performed.

4.4.3.9 Maximum Measurable Wavelength Element. The optional `MaxMeasureWavelength` element contains the highest measurable wavelength based on the limitations of the radiometric test equipment.

4.4.3.10 Minimum Measurable Wavelength Element. The optional `MinMeasureWavelength` element contains the lowest measurable wavelength based on the limitations of the radiometric test equipment.

4.4.3.11 Peak Wavelength Method Element. The optional `PeakWavelengthMethod` element specifies the method of calculation for peak wavelength.

ANSI/IES LM-80-21 Section 3.10 indicates that for spectra which contain two peaks, the region for the peak of interest can be specified in a number of ways, such as "pump emission" or "phosphor emission," or as the peak within a specified wavelength band, such as "peak within 300 to 500 nm."