# Interpreting Standards

## Getting the Most Out of Testing

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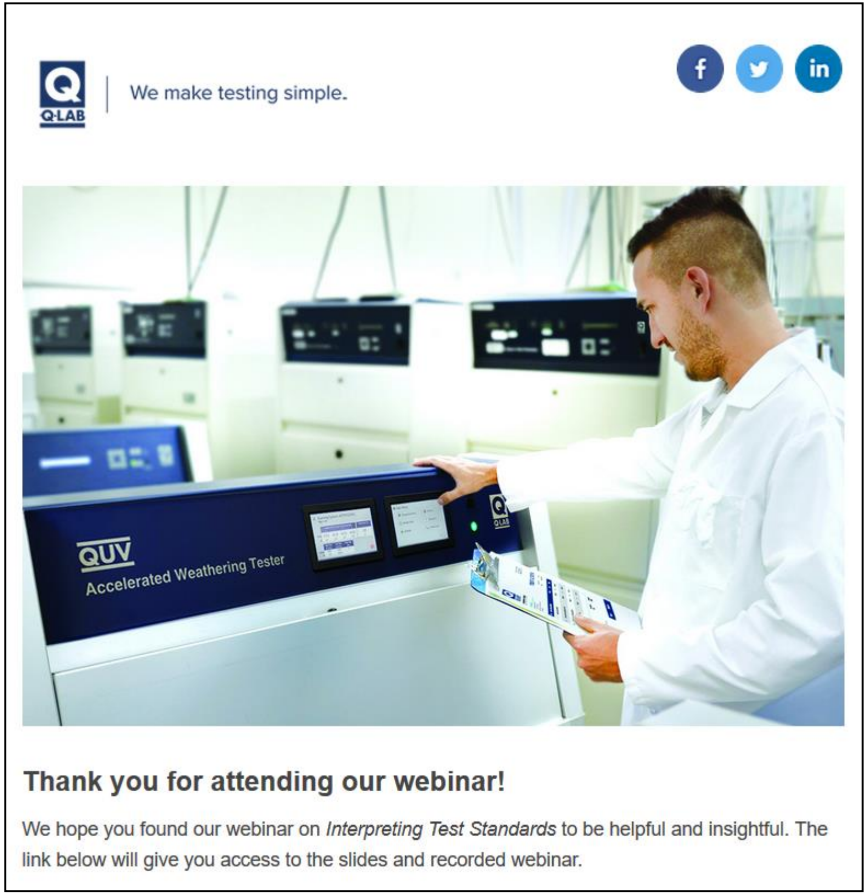


# How Would You Interpret This?

## ASTM G151

5.1.7.2 The irradiance set point control system shall be calibrated at regular intervals relative to an irradiance reference device (that is, a radiometer or other suitable transfer calibration standard) to assure acceptable accuracy and reliability. The irradiance set point control system shall be calibrated when replacing any component of the optical system (for example, at each lamp replacement or filter change) and each time the weathering method is changed. A full calibration of the irradiance set point control system shall be conducted at least once per year. More frequent calibrations and intermediate checks are recommended.


Would you meet the standard if you only had a yearly calibration cert for your calibration radiometer (UC10)?

# What is a "Standard"

## *Per ISO 17025:2017, Section 7.2.1.1*

"Method" as used in this document can be considered synonymous with the term "measurement procedure" as defined in ISO/IEC Guide 99

# What is the Purpose of a Standard?

- To “Standardize” a testing/exposure procedure
- In weathering and corrosion testing, there are two main uses:
  - To improve repeatability and reproducibility
  - To result in “reasonable” results for exposed specimens

# Repeatability and Reproducibility

- **Repeatability** – the closeness of the agreement between the results of successive tests with the same lab/instrument/technician

- **Reproducibility** – the closeness of the agreement between the results of tests replicated by a different lab/instrument/technician

# Produce “Reasonable” Results

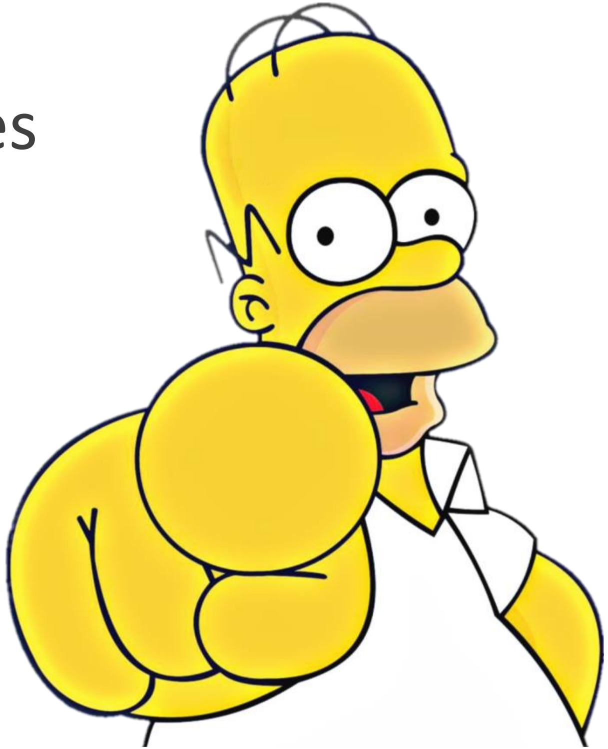
- You can weather/corrode almost anything
- A “reasonable” test can discern between high-performance and low-performance materials
- Doesn’t need to correlate to the real world!

# Types of Accelerated Tests

| Accelerated Test Type | Result | Test Time | Results compared to |
|---|---|---|---|
| Quality Control | Pass / fail | • Defined<br>• Short | Material specification |
| Qualification / validation | Pass / fail | • Defined<br>• Medium-long | Reference material or specification |
| Correlative | Rank-ordered data | • Open-ended<br>• Medium | Natural exposure (Benchmark site) |
| Predictive | Service life<br>Acceleration factor | • Open-ended<br>• Long | Natural exposure (Service environment) |

# Who Writes Standards?

- International Standards Committees
- Industry Trade Organizations
- OEMs
- Test Laboratories/Consultants



# Types of Standards

- **Practice**
- **Test Method**
- **Specification**
- Guide
- Terminology
- Classification

# Practice

- *A set of instructions for performing one or more specific operations that does not produce a test result*
- Is not a “test” on its own, but is often referenced in types of Accelerated Tests.
- Examples:
  - **ISO 4892-2** (Xenon Arc - Plastics)
  - **ASTM G154** (QUV – General Weathering)
  - **ASTM B117** (Salt Fog Exposure)

# Test Method

- *A definitive procedure that may reference a practice, but will produce an evaluation/result*

- Often used as part of Correlative and Predictive tests

- Examples:
  - **JASO M609** (Automotive Corrosion)
  - **ASTM C1257** (QUV – Solvent-release sealants)
  - **ISO 18930** (Outdoor – Color Prints)

# Specification

- *An explicit set of requirements to be satisfied by a material, product, system, or service*
- Most of these are pass/fail tests, like QA or Qualification
- Examples:
  - **ISO 21898** (QUV - FIBC Materials)
  - **Qualicoat** (Xenon Arc – Architectural Coatings)
  - **GMW 14872** (Automotive Corrosion)

# How Would You Interpret This?

## ASTM D7869

9.4 Specimens shall be repositioned at a minimum of every two weeks of operation to improve uniformity of exposure. See Practice G151, Appendix X2 for more specific guidance and figures on repositioning of specimens in both rotating rack and flat array xenon arc light and water apparatus.

9.4.1 Specimens in a rotating rack apparatus shall be repositioned to the position immediately above it; specimens in the top position shall be repositioned to the bottom position.

Do you need to reposition specimens in a rotating rack apparatus when running this test?

# What is Considered Mandatory?

One of the most difficult parts of interpreting a standard is identifying its **mandatory** and **non-mandatory** portions

# Mandatory vs. Non-Mandatory Language

- "Shall"
  - Is used to indicate that a provision is **mandatory**
- "Should"
  - Is used to indicate that a provision is **not mandatory,** but is **recommended as good practice**
- "May"
  - Is used to indicate that a provision is **optional**
- "Will"
  - Is used to express futurity, but **never to indicate any degree of requirement**

# Notes

- Notes (usually) provide reasoning or information for the user
- For that reason, no notes found in the body of a standard can be mandatory!
- The exception to this are notes describing a mandatory table. Those are mandatory!

TABLE 1 Relative Ultraviolet Spectral Power Distribution Specification for Xenon Arc with Daylight Filters[A,B]

| Spectral Bandpass Wavelength λ in nm | Minimum Percent[C] | Benchmark Solar Radiation Percent[D,E,F] | Maximum Percent[C] |
|---|---|---|---|
| λ < 290 | | | 0.15 |
| 290 ≤ λ ≤ 320 | 2.6 | 5.8 | 7.9 |
| 320 < λ ≤ 360 | 28.3 | 40.0 | 40.0 |
| 360 < λ ≤ 400 | 54.2 | 54.2 | 67.5 |

[A] Data in Table 1 are the irradiance in the given bandpass expressed as a percentage of the total irradiance from 290 to 400 nm. The manufacturer is responsible for determining conformance to Table 1. Annex A1 states how to determine relative spectral irradiance.

[B] The data in Table 1 are based on the rectangular integration of 112 spectral power distributions for water and air cooled xenon-arcs with daylight filters of various lots and ages. The spectral power distribution data is for filters and xenon-burners within the aging recommendations of the device manufacturer. The minimum and maximum data are at least the three sigma limits from the mean for all measurements.

[C] The minimum and maximum columns will not necessarily sum to 100 % because they represent the minimum and maximum for the data used. For any individual spectral power distribution, the calculated percentage for the bandpasses in Table 1 will sum to 100 %. For any individual xenon-lamp with daylight filters, the calculated percentage in each bandpass must fall within the minimum and maximum limits of Table 1. Test results can be expected to differ between exposures using xenon arc devices in which the spectral power distributions differ by as much as that allowed by the tolerances. Contact the manufacturer of the xenon-arc devices for specific spectral power distribution data for the xenon-arc and filters used.

[D] The benchmark solar radiation data is defined in ASTM G177 and is for atmospheric conditions and altitude chosen to maximize the fraction of short wavelength solar UV. This data is provided for comparison purposes only.

[E] Previous versions of this standard used solar radiation data from Table 4 of CIE Publication Number 85. See Appendix X4 for more information comparing the solar radiation data used in this standard with that for CIE 85 Table 4.

[F] For the benchmark solar spectrum, the UV irradiance (290 to 400 nm) is 9.8 % and the visible irradiance (400 to 800 nm) is 90.2 % expressed as a percentage of the total irradiance from 290 to 800 nm. The percentages of UV and visible irradiances on samples exposed in xenon arc devices may vary due to the number and reflectance properties of specimens being exposed.

# Sections of a Standard (ASTM)

## Mandatory

- Referenced Documents
- Apparatus
- Reagents and Materials
- Sampling, Test Specimens, and Test Units
- Conditioning
- Procedure
- Report
- Annex (Normative)

## Informative

- Scope
- Principle of Use
- Terminology
- Calibration or Interpretation of Results
- Precision and Bias
- Appendix
- Annex (Informative)

*Some of these sections will be found in all standards, while some are optional sections*

# How Would You Interpret This?

## ISO 9227

Can you intentionally mix 46 g/l NaCl to make this salt solution?

**3.1 Preparation of the sodium chloride solution**

Dissolve a sufficient mass of sodium chloride in distilled or deionized water with a conductivity not higher than 20 µS/cm at 25 °C ± 2 °C to produce a concentration of 50 g/l ± 5 g/l. The sodium chloride concentration of the sprayed solution collected shall be 50 g/l ± 5 g/l. The specific gravity range for a 50 g/l ± 5 g/l solution is 1,029 to 1,036 at 25 °C.

# Tolerance and Operational Fluctuation

- If a value given doesn’t have any range (+/-), it is considered nominal, and doesn’t need to be measured exactly.

- If a range is given, it could be **Tolerance** or **“Operational Fluctuation”**

# Tolerance and Operational Fluctuation

**Tolerance** – the value must be measured (with an accurate reference), and it must be found within the range specified.

- This is very common in test methods

# Tolerance and Operational Fluctuation

**Operational Fluctuation** – A device must be programmed to a specific value and must not fluctuate outside that range on the device (at equilibrium).

**From ISO 4892-2, Table 3**

*NOTE 1 The ± tolerances given for irradiance, black-standard temperature and relative humidity are the allowable fluctuations of the parameter concerned about the given value under equilibrium conditions. This does not mean that the value may vary by plus/minus the amount indicated from the given value.*

# Uniformity

- Many times, tolerance for the sensor and operational fluctuation values are interpreted as uniformity (performance at all ranges in the chamber).
- **Tolerance/Operational Fluctuation should not be interpreted as uniformity**

# How Would You Interpret This?

*7.2.3 Irradiance – The irradiance used shall be agreed upon by all parties.*
***Note 3:*** *When first developed, the equipment available would run at 0.35 $W/m^2/nm$ @ 340 nm, so this shall be the irradiance used.*

Would a laboratory be deficient if they agreed upon a different irradiance?

# Conflicting Information

What happens when you find conflicting or incorrect information?

- Two mandatory clauses contradict one another
- Equipment with the listed tolerance is no longer commercially available (and another range is used)
- Important, mandatory information found in non-mandatory sections (Appendix/Notes)

# Hardware-Specific Requirements

- Some standards list hardware specific requirements, without technical merit
- It's basically the same as a local ordinance requiring that you drive a specific model of car, rather than meeting certain safety and environmental requirements

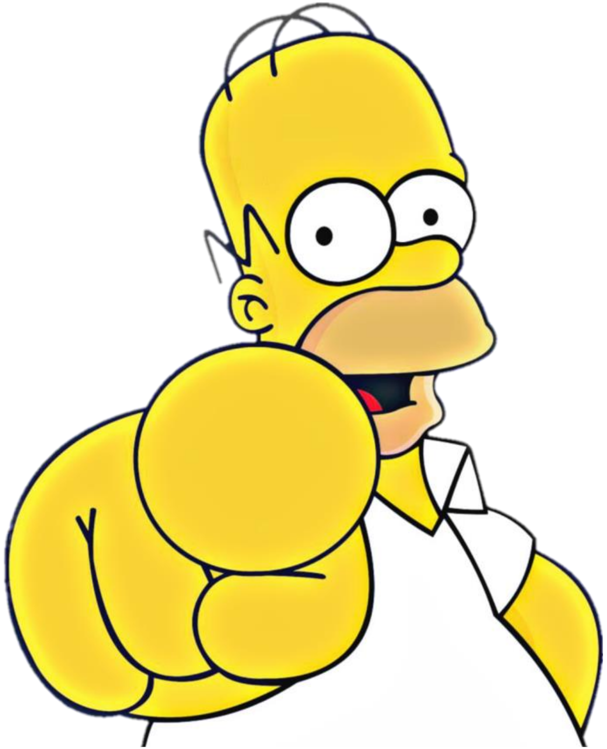
# Hardware-Specific Requirements

- International Standards Organizations (ASTM, ISO) have committed to removing hardware specific requirements in favor of performance-based standards.

- So if you see a hardware-specific requirement, ask if there's data to back it up! **Most of the time, it's just a historic requirement with no data.**

# What Can Be Done?

Get involved!
You’re the expert!



# Getting Involved in Standards

Standards organizations (like ASTM or ISO) are always looking for users to get involved!

- ISO requires participation with the national "Techincal Advisory Group" (TAG)
- ASTM lets you join and get started today.

# ASTM is International!

- Anyone can be a member of ASTM
- Membership is inexpensive
- **Everyone has a vote**
- **All negative votes must be addressed**

# Going Beyond the Standard

- As mentioned in the beginning, one of the main goals of standards is to increase repeatability and reproducibility

- But what if the standard isn't thorough enough?

# Best Practices when Running Tests

## *Always conditions specimens the same way!*

Do you wash your specimens before exposure? Store them in a controlled environment? Some standards require this, but when it's not well documented, doing things the same way will help!

# Best Practices when Running Tests

***Always mount specimens the same way!***

Specimen mounting plays a major role in specimen temperature, and can affect exposure results. When possible, use the same tray/holder/backing between tests.

# Best Practices when Running Tests

## *Run control specimens!*


As an extra check to ensure nothing has changed, run a material you're familiar with. If the results for that material don't make sense, something might be wrong.

# Best Practices when Running Tests

***Document Everything!***

If results do change, finding the root cause is easier if you document any work done on a tester. The report section is the bare minimum, nothing is stopping you from recording more information.

# Questions?

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