# How to Run ISO 105-B02


Bill Tobin – Senior Technical Marketing Specialist

Andy Francis – Marketing Director

Sean Fowler – Senior Technical Director

Dave Duecker - Senior Technical Marketing Specialist

Q-Lab




View Recorded Presentation

# Q-Lab's Standards and Calibration Series

Today is the last of a three-part webinar series on standards, calibration, and documentation

All upcoming and archived webinars can be accessed at: [q-lab.com/webinars](q-lab.com/webinars)

| Date | Topic |
|---|---|
| 01 Sep | Calibration and Documentation |
| 08 Sep | What's New in Standards |
| 15 Sep | How to Run ISO 105-B02 |

# Administrative Notes

You'll receive a follow-up email from info@email.q-lab.com with links to a survey, registration for future webinars, and to download the slides

Use the **Q&A feature in Zoom** to ask us questions today!

**Thank you for attending our webinar!**

We hope you found our webinar on **How to Run ISO 105-B02** to be helpful and insightful. The link below will give you access to the slides and recorded webinar.

You can help us continue to provide valuable and high quality content by completing our 3-question survey about your webinar experience. Every piece of feedback is carefully reviewed by a member of our team.

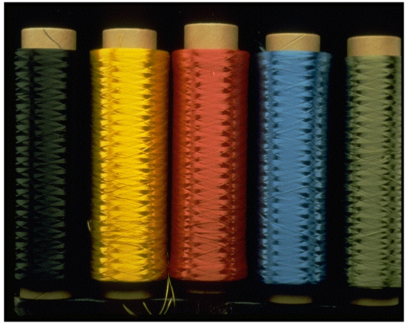
We consistently hold seminars and webinars about weathering, corrosion, standards, and more. The best way to keep up with news and events is by following us on Facebook, Twitter and LinkedIn.

# Overview

- Basics of Lightfastness Testing and Expectations
- Historic Information
- How to run ISO 105-B02
  - Reference Materials
  - Running the test
    - Requirements
    - Method
  - Evaluations

# What is lightfastness of textiles?

- Ability of a textile to resist color change due to exposure to light
- Lightfastness is specific to a particular dye and varies greatly.
  - Lightfastness depends on the structure of dye
  - Varies greatly from dye to dye
  - Reactive dye and Vat dye



# Lightstability vs. Weathering

- Lightfastness (lightstability)
  - Less durable materials, limited outdoor exposure
  - Many tests look only for rapid color degradation

- Weathering
  - outdoor, durable materials
  - Long term fading and fiber degradation

# Colourfastness to Light

- Exposure to light radiation, temperature and humidity affects the fading / color change performance of a colored textile material

- Changes are initiated due to photo- chemical processes of absorbed ultraviolet and visible radiation and the interactions with temperature and humidity.

# Wide range of lightfastness


- One hat is new; the other was worn all summer in a hot environment
- The dyed thread in the “Q” remained lightfast; the rest of the hat faded

# What Kind of Test is ISO 105-B02?

| 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) |

# What Kind of Test is ISO 105-B02?

| 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) |

# History of ISO 105-B02

- 1913 – DEK* develops "Blue Scale" for testing Colourfastness and develops colourfastness standards (DIN)
- 1920s – Further international colourfastness development (AATCC, and SDC)
- 1947 – ISO TC38 on Textiles founded
- 1975 – ISO 105-B (Weathering and Lightfastness) published by ISO

**DEK is the Deutsche Echtheiskommission (German Colorfastness Committee)*

# History of ISO 105-B02

- 1988 – ISO 105-B broken into various parts
  - ISO 105-B01 – General Information (Blue Wool Reference)
  - *ISO 105-B02 – Xenon Arc Colourfastness*
  - ISO 105-B03 – Outdoor Colourfastness
  - ISO 105-B04 – Xenon Arc (Wet-Lightfastness)
  - ISO 105-B05 – Assessment of Photochromism

# History of ISO 105-B02

- ISO 105-B02 has received several revisions over the last 35 years
  - Better control of conditions
  - Performance-based requirements
  - Irradiance-controlled cycles

*However, a lot of the roots of this standard dating over 100 years are still in practice!*

# Standard reference materials in ISO 105 B02

Blue wool

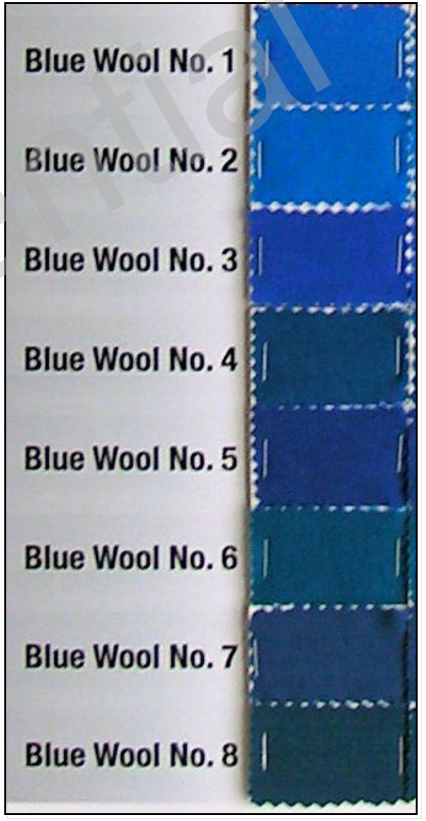
Red azoic dye

# Blue Wools

- Set duration of exposure
- Evaluate color fading
- Verify chamber test conditions
- Improve repeatability and reproducibility
- Use predates modern chamber controls and instrumental color evaluations

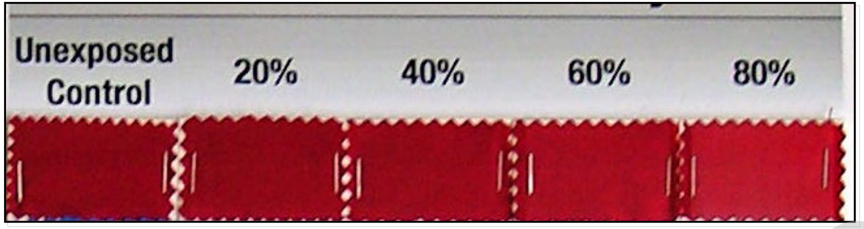
# ISO Blue Wool

- Numerically designated 1-8
- Increased light stability as numbers increase
- Used for comparison to evaluate specimens
- Used to set test duration
- Each blue wool made from a different dye
- Blue wools do not start out with identical colors



# Other Standard Reference Materials

ISO Red Azoic Cloth




Fading based on relative humidity

AATCC Purple Cloth (Xenon Reference Fabric)

Fading based on temperature





We make testing simple.

# A Choice of Xenon Tester

Modern textile test methods ISO-B02, B04, B06, and B10 are *performance-based* standards, open to flatbed and rotating rack testing devices:

<u>Q-SUN Xe-2 and Q-SUN Xe-3 can run this test!</u>

- An important change after almost 60 years of hardware exclusivity
- All test parameters are the same regardless of apparatus
- Performance conditions and reference materials can both be used to validate test equipment

# Performance Requirements

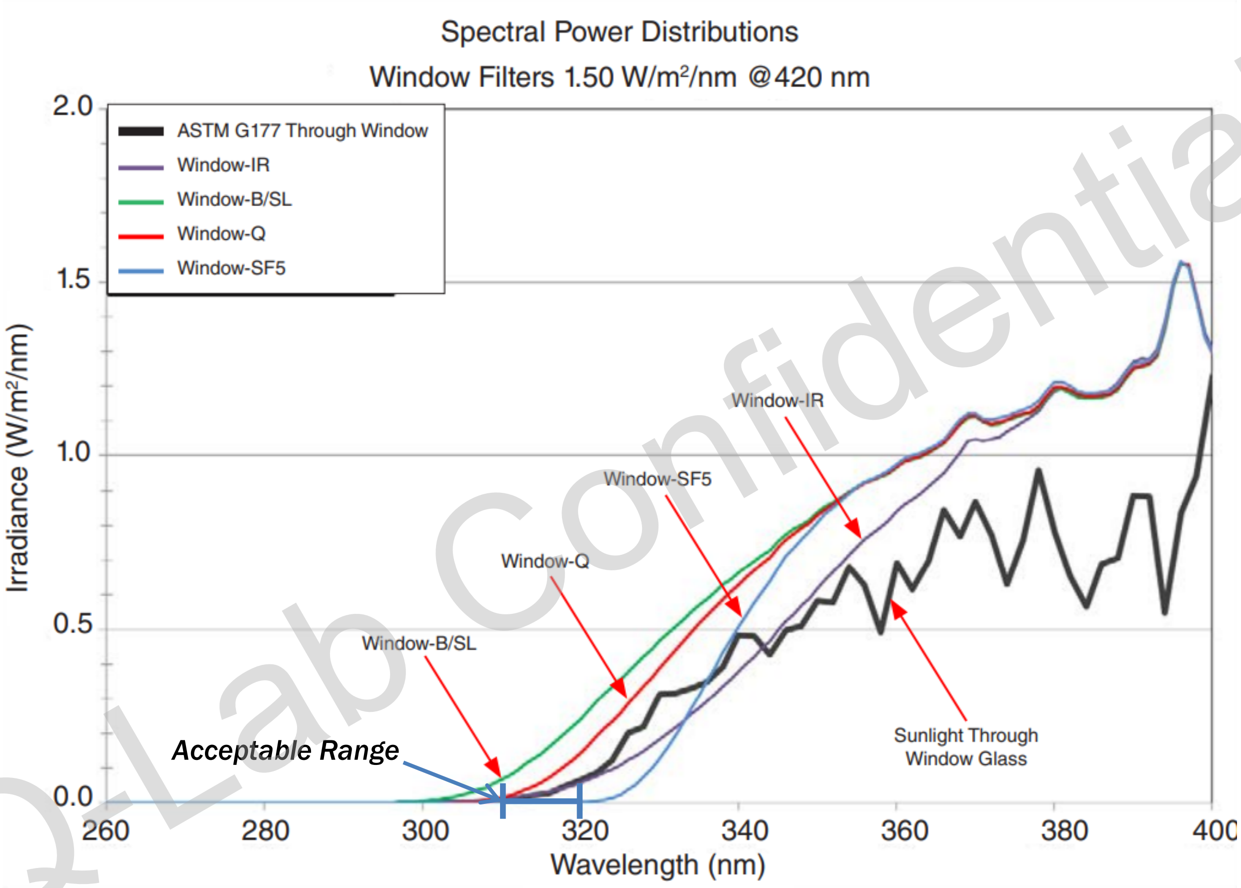
- Main requirements
  - Requirements for Spectral Irradiance
  - Test conditions (Irradiance, Black Panel Temperature)
  - Chamber Verification (Blue Wool and Red Azoic Dye)

# Spectral Irradiance

## A.2 Light source

The light source shall consist of a xenon arc lamp of correlated colour temperature 5500 K to 6500 K, the size of which will depend on the type of apparatus used. The xenon arc lamp shall use filters that provide a reasonable simulation of solar radiation filtered by typical window glass. The transmission of the filter system used shall be at least 90 % between 380 nm and 750 nm, falling to 0 between 310 nm and 320 nm. Infrared radiation from the xenon arc may be attenuated by use of filters to allow better control of the sample temperature.

***This is a longer cut-on wavelength than most Window Filters!***



Spectral Power Distributions
Window Filters 1.50 W/m²/nm @420 nm
ASTM G177 Through Window
Window-IR
Window-B/SL
Window-Q
Window-SF5
Irradiance (W/m²/nm)
2.0
1.5
1.0
0.5
0.0
260
280
300
320
340
360
380
400
Wavelength (nm)
Window-IR
Window-SF5
Window-Q
Window-B/SL
Acceptable Range
Sunlight Through Window Glass

# Performance Requirements

## Window-IR Filters

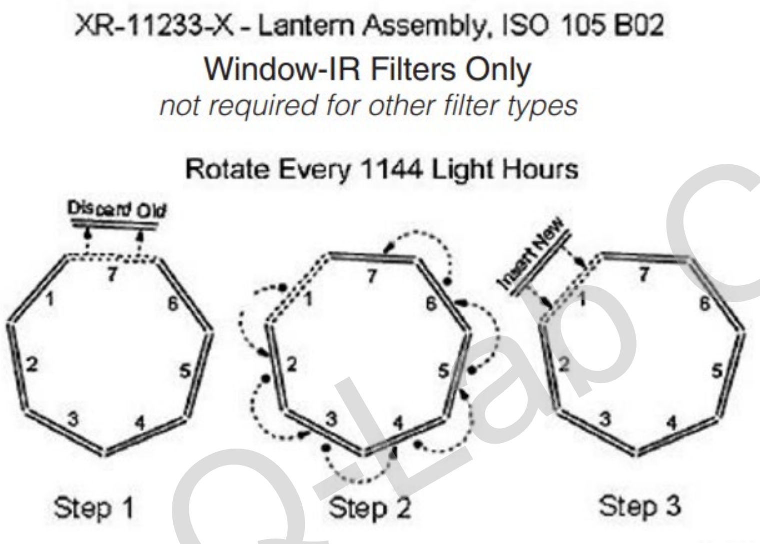
- Window-IR is the only filter that meets the cut-on wavelength and the IR-reducing requirements

- Window-IR optical filters age and require regular replacement

# Window-IR Filters

## Replacement Schedule

### Xe-2 (1144 light hours)




### Xe-3 (2800 light hours)

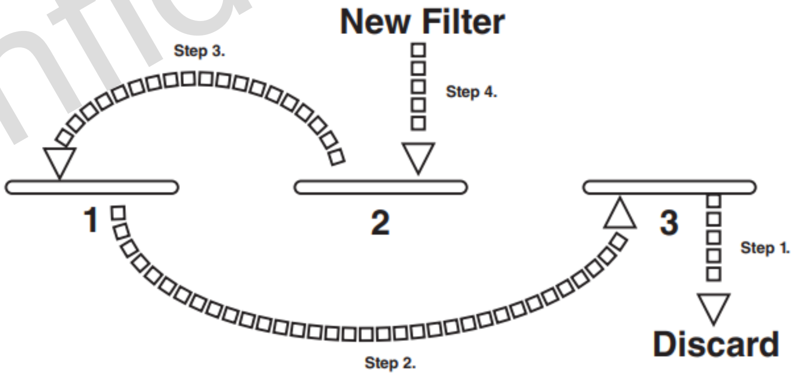



Figure 16.4: Window-IR Optical Filter Replacement Process

# ISO 105-B02

## Exposure Cycles

- A1 is the most common exposure cycle, so we'll focus on that
- The other exposures can be run in the same manner, but with different tester setpoints

**Table 2 — Exposure conditions**

| | Exposure Cycle A1 | Exposure Cycle A2 | Exposure Cycle A3 | Exposure Cycle B |
|---|---|---|---|---|
| Condition: | Normal | Extreme low humidity | Extreme high humidity | — |
| Climatic condition replicated | Temperate zone | Dry | Semi-tropical | — |
| Blue wool references | Series 1 to 8 | | | Series L2 to L9 |
| Black Standard Temperature[a] | (47 ± 3) °C | (62 ± 3) °C | (42 ± 3) °C | (65 ± 3) °C |
| Black Panel Temperature[a] | (45 ± 3) °C | (60 ± 3) °C | (40 ± 3) °C | (63 ± 3) °C |
| Effective humidity (see 8.2)[b] | Approximately 40 % effective humidity. (Note: This is typically achieved when blue wool reference 5 exhibits a contrast equal to grey scale grade 4) | Less than 15 % effective humidity. (Note: This is typically achieved when blue wool reference 6 exhibits a contrast equal to grey scale grade 3-4) | Approximately 85 % effective humidity. (Note: This is typically achieved when blue wool reference 3 exhibits a contrast equal to grey scale grade 4) | Low (Colour fastness of humidity-test control: L6 to L7) |
| Relative humidity | As determined by effective humidity requirement | | | (30 ± 5) % |
| Irradiance[c] | Where irradiance control is available, the irradiance shall be controlled at (42 ± 2) W/m² in the wavelength range 300 nm to 400 nm or (1,10 ± 0,02) W/(m²·nm) at the wavelength 420 nm | | | |

[a] Air chamber temperature control should not be used as air chamber temperature is a different value from Black Standard Temperature and Black panel temperature.

[b] Effective humidity is based on an assessment of the blue wool references after the humidity-test control fabric has been exposed to give a contrast equal to grey scale grade 4 (8.2.5).

Once a contrast equal to grey scale grade 4 on the exposed humidity-test control fabric has been achieved, effective humidity is based on assessment.

[c] The broadband (300 to 400 nm) and narrowband (420 nm) irradiance control values are based on traditional settings and should not be implied as equivalent in all models of test equipment. Consult with the instrument manufacturer for the equivalent irradiance in other controlling wavelengths or bandpasses.

# ISO 105-B02 Exposure Cycle

## "Normal Conditions"

- Irradiance Controlled at 1.10 $W/m^2/nm$ @ 420nm;
  - Window Glass IR Filter
  - Filters must be changed at regular intervals
- Continuous Light only @ 47 °C IBP Temperature
- 39 °C Chamber Air Temperature *
- 40% Relative Humidity *

**Relative Humidity and Chamber air not specifically defined, so these are what we use.*

# Blue Wool Verification

## Irradiance

- Originally, blue wool was the only way to verify the duration or relevance of a test
  - Modern testers can better monitor irradiance/temperature, making it repeatable
- Blue wool should perform in a predictable manner
- **Blue Wool 2 should take about 20-24 hours to fade to gray scale 3**

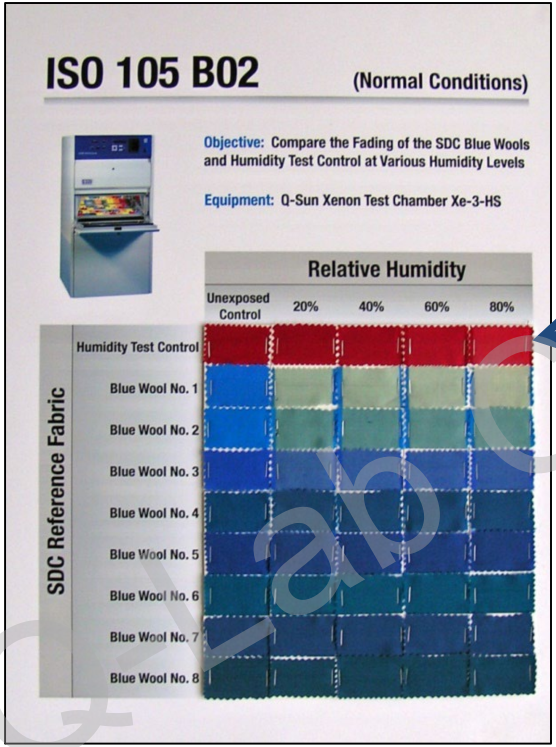
# Red Azoic Dye

## Effective Humidity

- Due to the age of the standard, original testers did not have good control or measurement of relative humidity
- Instead, a dye sensitive to moisture is used to determine effective humidity in most cycles*
- Compare the performance of the red azoic dye to blue wool reference materials to determine effective humidity

**Cycle B uses a standard relative humidity measurement of 40% instead of "effective" humidity*

# ISO 105-B02: Red Azoic Dye



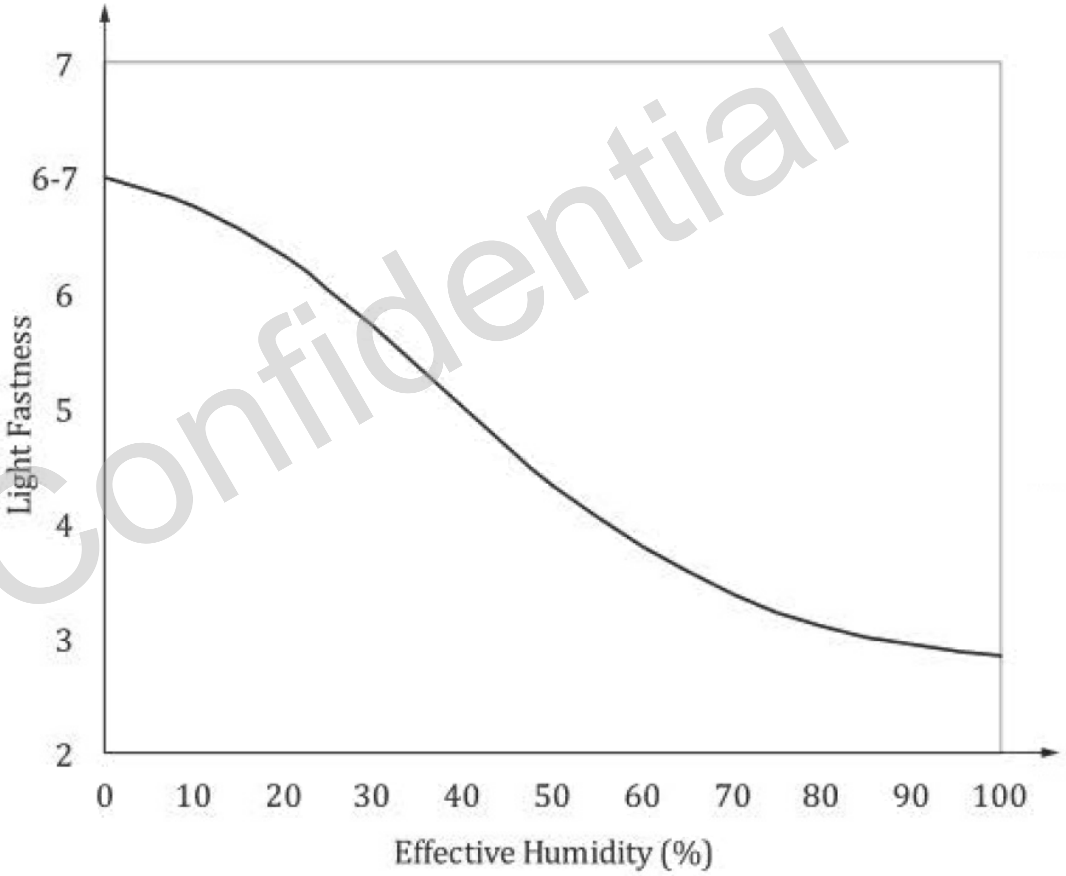

Red azoic dye

Blue Wool 1-8

# Red Azoic Dye

## Effective Humidity

- Compare fading to the nearest blue wool material
  - Better than BW6 = < 15% EH
  - Matching BW5 = 40% EH
  - Matching BW3 = > 85% EH



# Methods in ISO 105-B02

| Method | Reference Material | | Duration |
|---|---|---|---|
| | Material | Purpose | |
| 1 | Blue Wool 1-8 | Evaluation | Specimen reaches Grey Scale 3 |
| 2 | Blue Wool 1-8 | Duration, Evaluation | Most resistant specimen reaches Grey Scale 3 OR Blue Wool 7 reaches Grey Scale 4 |
| 3 | Single Blue Wool | Duration, Evaluation | Blue wool reaches Grey Scale 3 |
| 4 | Known specimen | Duration, Evaluation | Reference material reaches Grey Scale 3 |
| 5 | None | N/A | Specific radiant dosage measured |

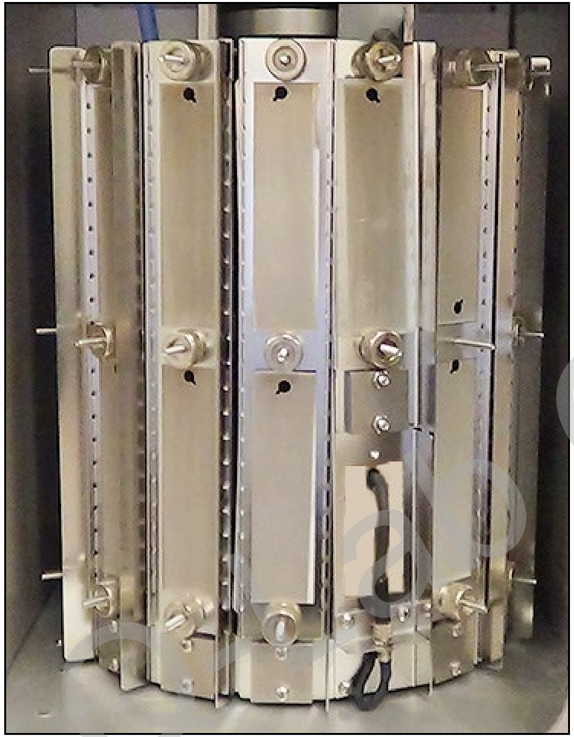
*Different exposure conditions used for different testing goals*

# Methods in ISO 105-B02

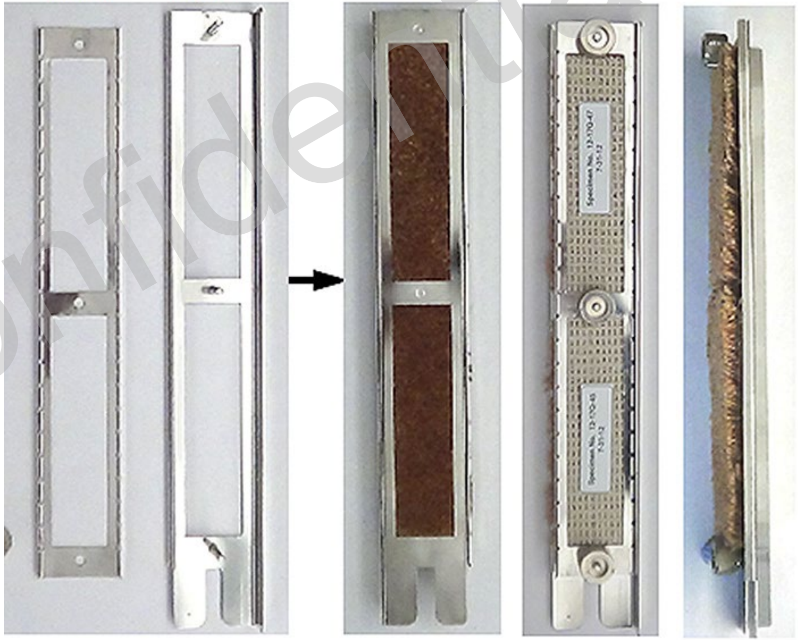
| Method | Description |
|---|---|
| 1 | Most exact and time-consuming test, used for R&D |
| 2 | Comparison of multiple lots of a material |
| 3 | Quality control testing of known materials |
| 4 | Lower-resolution comparison test to reference lot |
| 5 | Standardized test to prescribed dosage |

*Different exposure conditions used for different testing goals*

# Open-Backed Specimen Holders



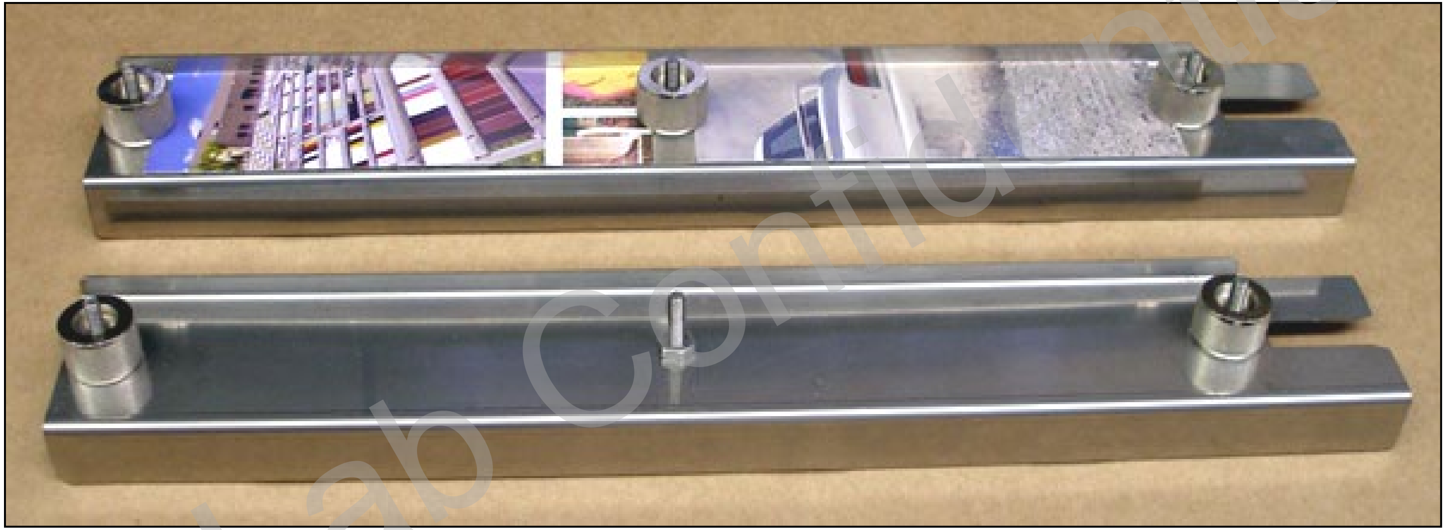
Rear Plate | Front Plate | Front | Rear | Side



Open Back Holder Components

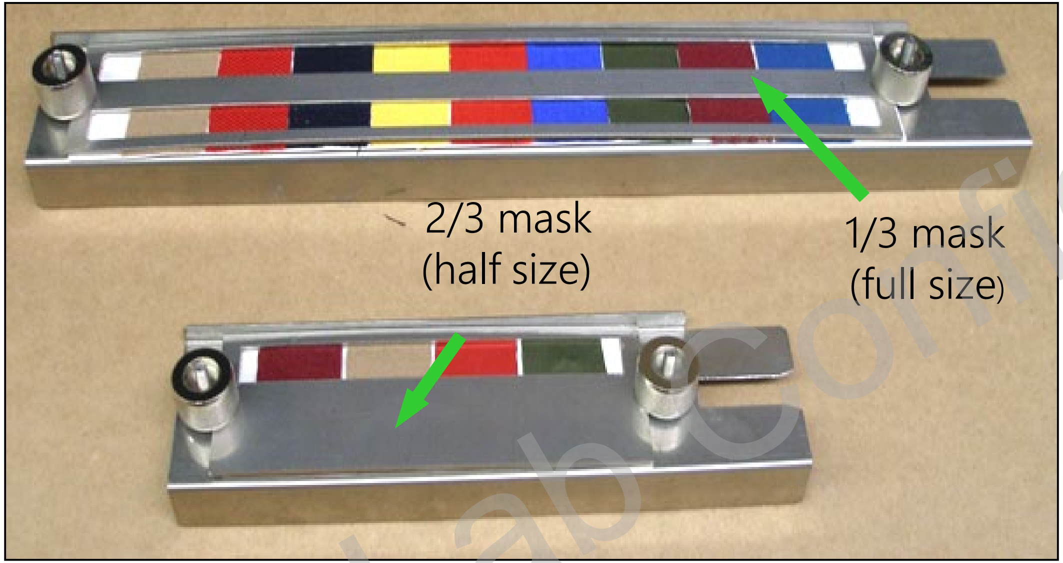
Mounted Specimen

# Solid-Backed Specimen Holders



Sample holder with optional center nut for mounting 2 smaller samples.

# Textile Masking




- Method 1, 3, 4
  - ¼, ½, and ¾ masks
- Method 2, 5
  - 1/3 and 2/3 masks

# ISO 105-B02

## Test Protocol

- **Duration** determined by comparing blue wool or specimen to gray scale (Depending on Method)
- **Evaluation** - exposed specimens are graded against the 8 blue wools
- Alternative Methods use 2 blue wools in a pass/fail test, agreed upon reference without blue wool, or radiant energy

# Test Duration and Evaluations

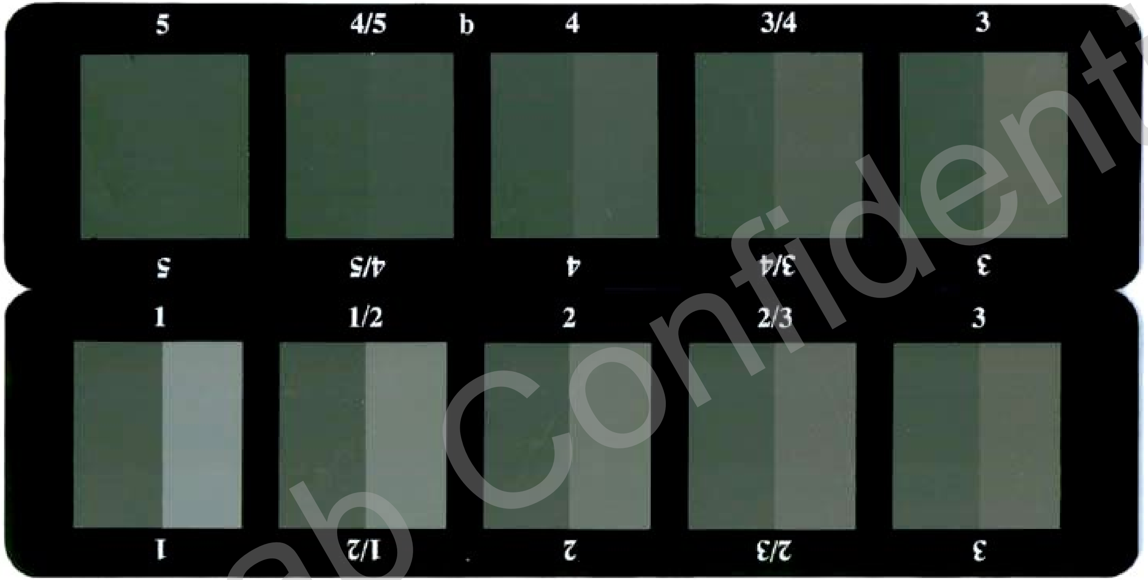
- ISO 105-B02 contains several options for setting the duration and rating specimens
- Example: Expose several specimens and complete set of blue wools
  - Run until blue wool #1 fades to gray scale 4—specimens that have faded to gray scale 4 are rated as "1"
  - Run again until blue wool #2 fades to gray scale 4—specimens that have faded to gray scale 4 are rated as "2"
  - And so on (2 and 4 are common apparel specifications)

# ISO Blue Wool for Evaluation


Specimen Blue Wool

| Fastness grade | Degree of fading | Light fastness |
|---|---|---|
| Grade 8 | None | Outstanding |
| Grade 7 | Very, very slight | Excellent |
| Grade 6 | Slight | Very good |
| Grade 5 | Moderate | Good |
| Grade 4 | Appreciable | Moderate |
| Grade 3 | Significant | Fair |
| Grade 2 | Extensive | Poor |
| Grade 1 | Very extensive | Very poor |

# ISO Grey Scale for evaluation




- Used for visual evaluations
- Along with blue wools used to time tests
- Color gray scales different from staining gray scales

# Summary

- The history of ISO 105-B02 creates complex requirements for running the test.
- As a performance-based standard, both the Q-SUN Xe-2 and Q-SUN Xe-3 can run this test
- Effective Humidity is a complex subject
- Various methods and masking are used, depending on your specific requirements
- Evaluations for fading are still mostly done with grayscale.

# Thank you for your attention!

# Questions?

Send your inquiry to:
info@q-lab.com