How to Run ISO 105-B02
如何运行ISO 105-B02

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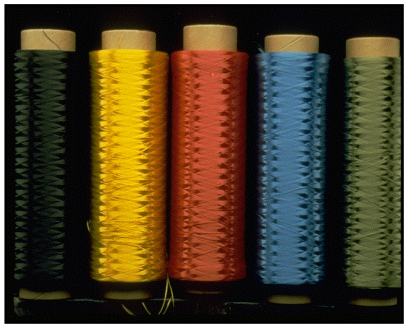
Overview 概述

- Basics of Lightfastness Testing and Expectations
- 日晒色牢度测试机理
- Historic Information 历史背景
- How to run ISO 105-B02 如何运行ISO 105-B02
  - Reference Materials 标准参照材料
  - Running the test 运行测试
    - Requirements 测试要求
    - Method 测试方法
  - Evaluations 评定

What is lightfastness of textiles?

什么是纺织品的日晒色牢度？

- Ability of a textile to resist color change due to exposure to light
- 纺织品抵抗光照引起的颜色变化的能力
- Lightfastness is specific to a particular dye and varies greatly.
- 不同染料的耐光性是不同的，存在很大差异
  - Lightfastness depends on the structure of dye 取决于染料的结构
  - Varies greatly from dye to dye 不同的染料差异很大
  - Reactive dye and Vat dye 活性染料和还原染料



Lightstability vs. Weathering 耐光性vs.老化

- Lightfastness (lightstability) 耐光性（光稳定性）
  - Less durable materials, limited outdoor exposure
  - 较不耐用的材料，几乎没有户外曝晒
  - Many tests look only for rapid color degradation
  - 许多测试只关注快速的褪色
- Weathering 老化
  - outdoor, durable materials 户外曝晒，耐用材料
  - Long term fading and fiber degradation 长时间褪色，纤维降解

Colorfastness to Light 耐光色牢度

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

- 暴露于光，温度和湿度下，会影响有色纺织材料的褪色/变色性能

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

- 变化是由吸收的紫外线和可见光的光化学过程，以及与温度和湿度的相互作用引起的

Wide range of lightfastness 耐光性差异很大

- 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 加速测试类型	Result 结果表示	Test Time 测试时间	Results compared to 结果比较
Quality Control 质量控制	Pass / fail 合格/不合格	• Defined 确定的 • Short 较短	Material specification 材料规格
Qualification / validation 鉴定/验证	Pass / fail 合格/不合格	• Defined 确定的 • Medium-long 中长	Reference material or specification 参考材料或规范
Correlative 相关性	Rank-ordered data 排序	• Open-ended 不确定 • Medium 中等	Natural exposure (Benchmark site) 自然曝晒(基准曝晒场)
Predictive 预测	Service life 使用寿命 Acceleration factor 加速因子	• Open-ended 不确定 • Long 较长	Natural exposure (Service environment) 自然曝晒(使用环境)

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History of ISO 105-B02 ISO 105-B02的历史

- 1913 – DEK* develops “Blue Scale” for testing Colourfastness and develops colourfastness standards (DIN)
- 1913 – 德国色牢度委员会开发了“蓝卡”用于色牢度测试，并制定了色牢度标准
- 1920s – Further international colourfastness development (AATCC, and SDC)
- 1920s – 色牢度测试的进一步发展 (AATCC和SDC)
- 1947 – ISO TC38 on Textiles founded ISO TC38纺织品标委会成立
- 1975 – ISO 105-B (Weathering and Lightfastness) published by ISO
- 1975 – ISO 105-B (老化和耐光性)发布

DEK is the Deutsche Echtheiskommission (German Colorfastness Committee)* ***德国色牢度委员会*

History of ISO 105-B02 ISO 105-B02的历史

- 1988 – ISO 105-B broken into various parts
- 1988 – ISO 105-B分为不同的部分
  - ISO 105-B01 – General Information (Blue Wool Reference) 总则 (蓝色羊毛标样)
  - *ISO 105-B02 – Xenon Arc Colourfastness 氙灯测试*
  - ISO 105-B03 – Outdoor Colourfastness 户外测试
  - ISO 105-B04 – Xenon Arc (Wet-Lightfastness) 氙灯测试 (潮湿-耐光性)
  - ISO 105-B05 – Assessment of Photochromism 光致变色的评估

History of ISO 105-B02 ISO 105-B02的历史

- ISO 105-B02 has received several revisions over the last 35 years
- 过去35年，ISO 105-B02修订过好几版
  - Better control of conditions 更好地控制测试条件
  - Performance-based requirements 性能为基础的要求
  - Irradiance-controlled cycles 辐照度控制测试循环

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

Standard reference materials in ISO 105-B02
ISO 105-B02中的标准参照材料

Blue wool 蓝色羊毛标样

Red azoic dye 湿度控制标样

Blue Wools 蓝色羊毛标样

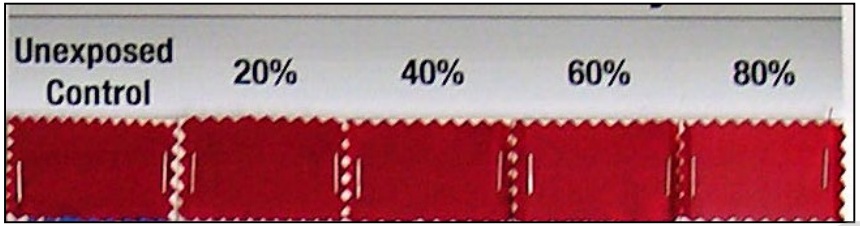
- Set duration of exposure 设置试验时间
- Evaluate color fading 评估试样褪色
- Verify chamber test conditions 验证试验箱
- Improve repeatability and reproducibility
- 提高重复性和再现性
- Use predates modern chamber controls and instrumental color evaluations
- 较早使用

ISO Blue Wool ISO蓝色羊毛标样

- 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 其它标准参照材料

ISO Red Azoic Cloth



Fading based on relative humidity

AATCC Purple Cloth (Xenon Reference Fabric)

Fading based on temperature

A Choice of Xenon Tester 氙灯试验箱的选择

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

Q-SUN Xe-2 and Q-SUN Xe-3 can run this test!

- 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 性能要求

- Main requirements 主要要求
  - Requirements for Spectral Irradiance
  - 光谱辐照度要求
  - Test conditions (Irradiance, Black Panel Temperature)
  - 测试条件 (辐照度，黑板温度)
  - Chamber Verification (Blue Wool and Red Azoic Dye)
  - 试验箱验证 (蓝色羊毛标样和湿度控制标样)

Spectral Irradiance 光谱辐照度

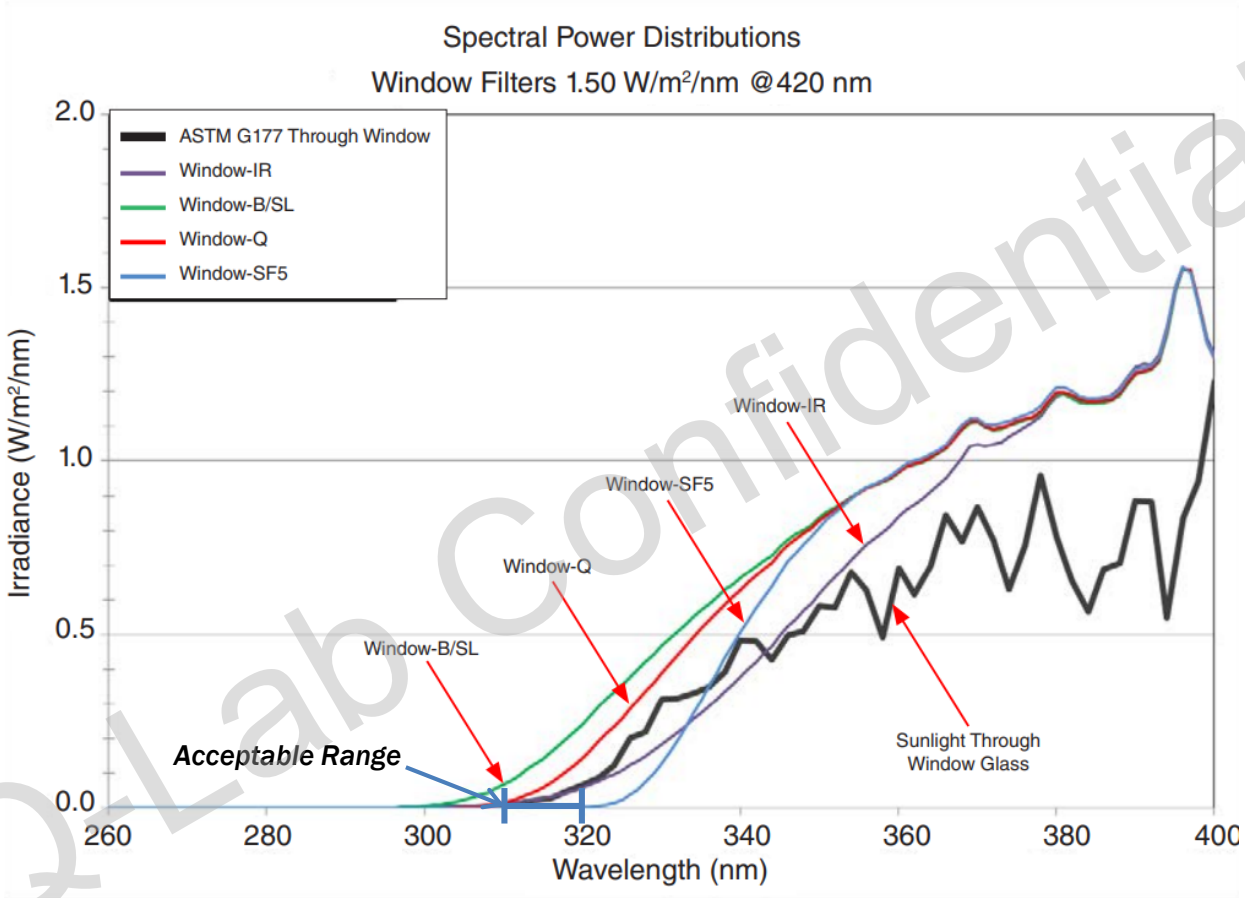
A.2 Light source

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.

光源

光源为氙弧灯，**相关色温**为**5500K~6500K**，**其尺寸由**设备型号而定。**氙弧灯**应使用滤光片来**模**拟经窗玻璃过滤后的太阳辐照。**所用**滤光系统的透光率在**380nm~750nm至少90%**，**而在310nm~320nm**则将为**0**。**氙弧的**红外辐射可通过使用滤热片减弱，**以更好地控制**试样温度。

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



Performance Requirements 性能要求

Window-IR Filters

- Window-IR is the only filter that meets the cut-on wavelength and the IR-reducing requirements
- Window-IR是唯一同时符合截止点要求和红外辐射减弱要求的过滤片

- Window-IR optical filters age and require regular replacement
- Window-IR过滤片会发生老化，并需要定期更换

Window-IR Filters

Replacement Schedule 更换时间表

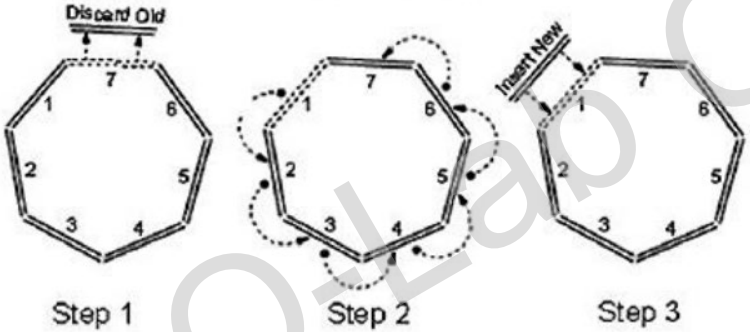
Xe-2 (1144 light hours)

XR-11233-X - Lantern Assembly, ISO 105 B02

Window-IR Filters Only

not required for other filter types

Rotate Every 1144 Light Hours



Xe-3 (2800 light hours)

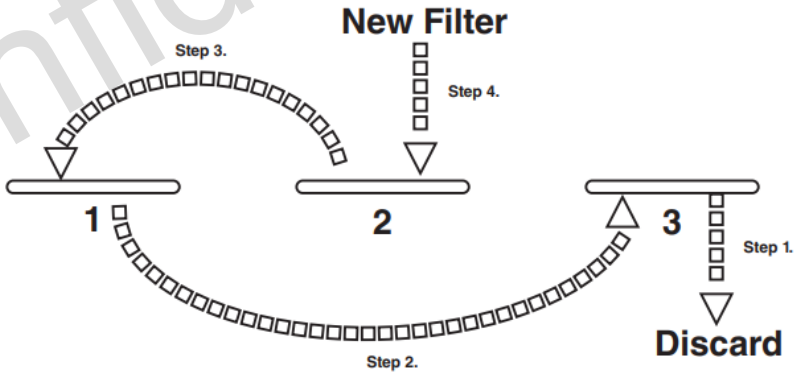


Figure 16.4: Window-IR Optical Filter Replacement Process

ISO 105-B02

Exposure Cycles 曝晒周期

- 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” 通常条件

- 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 蓝色羊毛标样验证

Irradiance 辐照度

- Originally, blue wool was the only way to verify the duration or relevance of a test
- 最初，蓝色羊毛标样是验证测试时间的唯一方法
  - Modern testers can better monitor irradiance/temperature, making it repeatable
  - 现代试验箱可以更好地监测辐照度/温度，使其可重复
- Blue wool should perform in a predictable manner
- 蓝色羊毛标样应可预测
- Blue Wool 2 should take about 20-24 hours to fade to gray scale 3
- 蓝色羊毛标样2应大约需要20-24h褪色为灰色样卡3级

Red Azoic Dye 湿度控制标样

Effective Humidity 有效湿度

- Due to the age of the standard, original testers did not have good control or measurement of relative humidity
- 由于标准年代久远，最初的设备不能很好地控制或测量相对湿度
- Instead, a dye sensitive to moisture is used to determine effective humidity in most cycles*
- 反而，在大多数测试循环中，使用对湿度敏感的染料来确定有效湿度
- Compare the performance of the red azoic dye to blue wool reference materials to determine effective humidity
- 比较湿度控制标样和蓝色羊毛标样的性能以确定有效湿度

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

ISO 105-B02: Red Azoic Dye

Red azoic dye

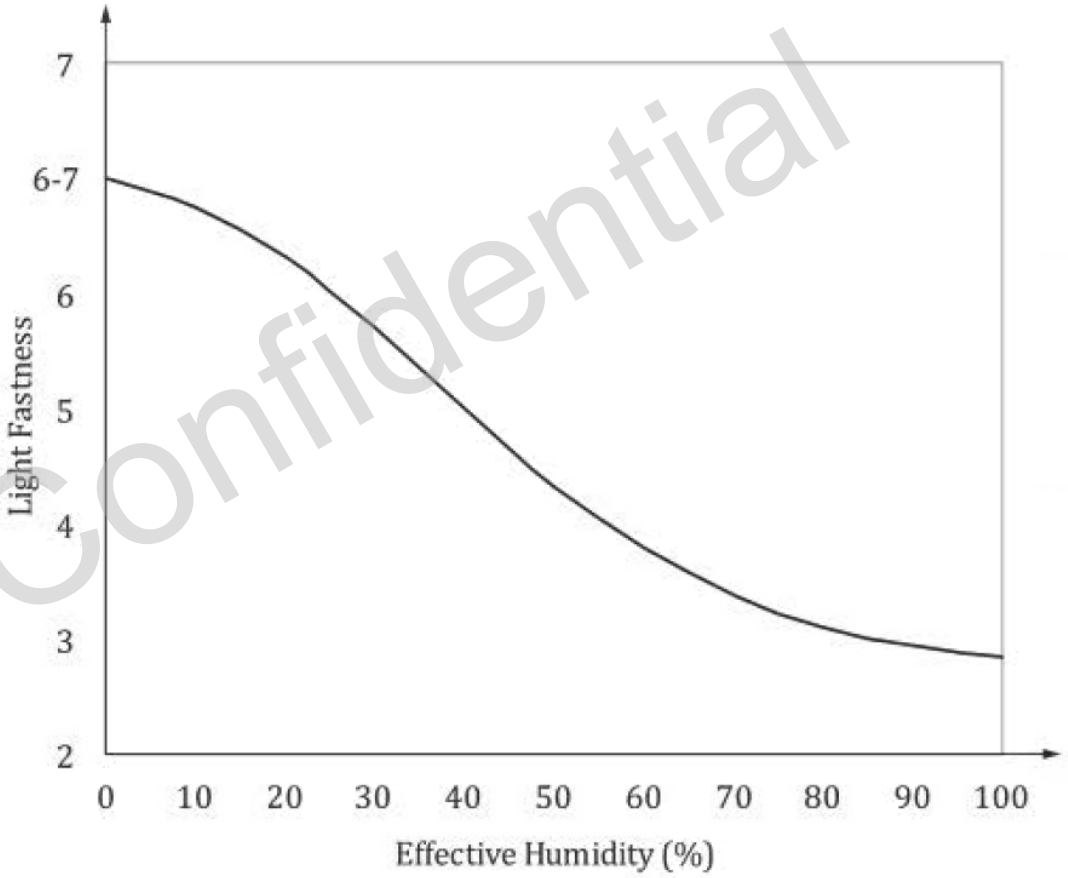
Blue Wool 1-8

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

注：测试时间为湿度控制标样曝晒和未曝晒部分的色差到达灰色样卡4级。



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

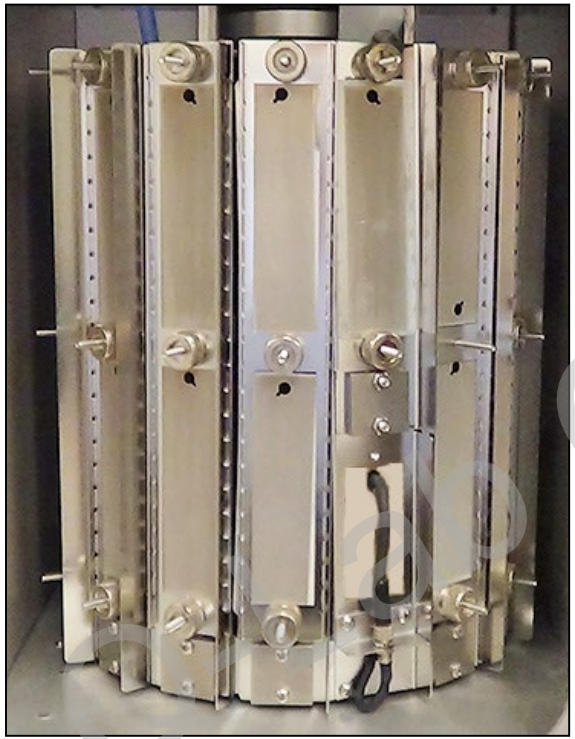
Different exposure conditions used for different testing goals

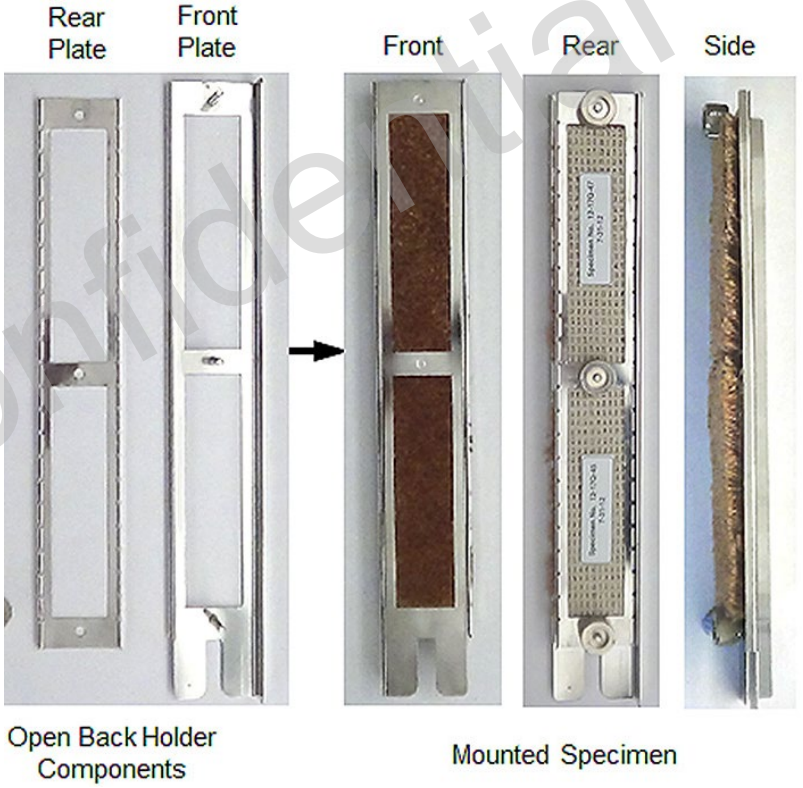
Methods in ISO 105-B02

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 镂空样品架

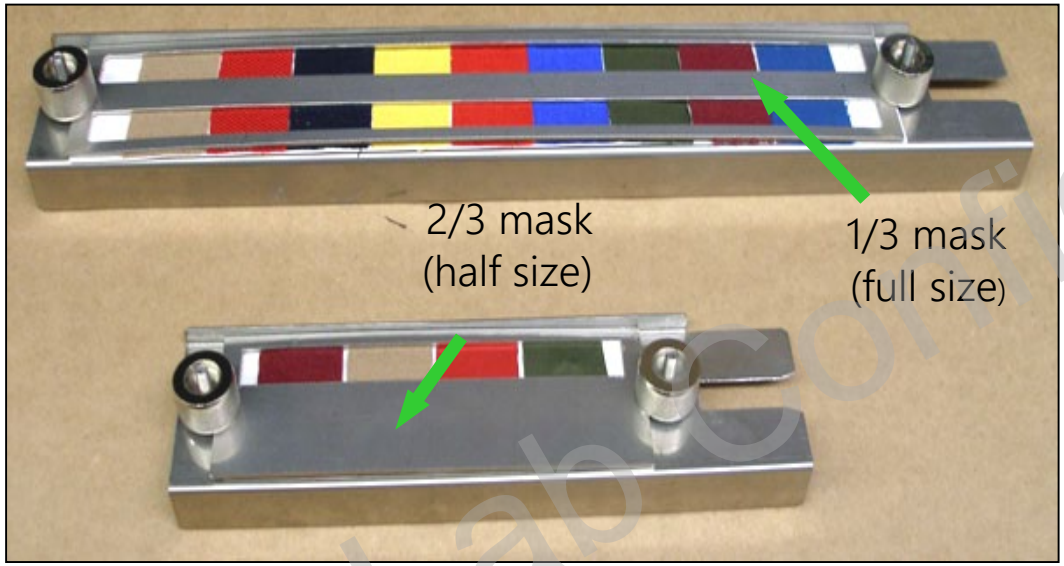




Solid-Backed Specimen Holders 实心样品架

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

Textile Masking 纺织品遮盖物



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

ISO 105-B02

Test Protocol 测试方案

- **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

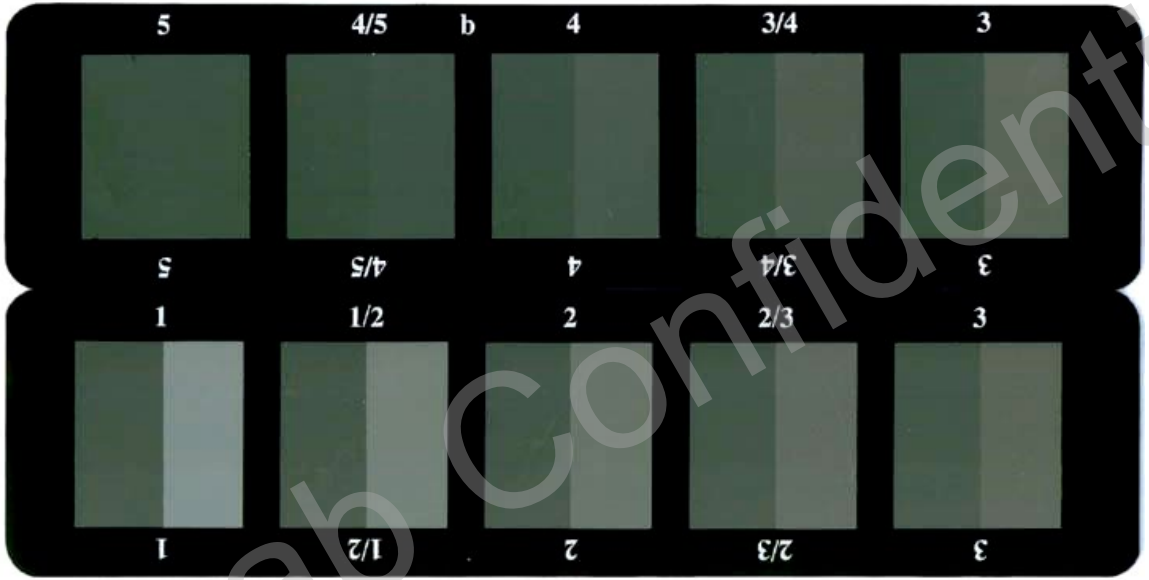
Test Duration and Evaluations 测试时间与评估

- ISO 105-B02 contains several options for setting the duration and rating specimens
- ISO 105-B02中有几种设置测试时间及评估试样等级的方法
- Example: Expose several specimens and complete set of blue wools
- 示例：曝晒几个试样及一整套蓝色羊毛标样
  - 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

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:
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