Designation: G90 – 10

Standard Practice for Performing Accelerated Outdoor Weathering of Nonmetallic Materials Using Concentrated Natural Sunlight[1]

This standard is issued under the fixed designation G90; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 Fresnel-reflecting concentrators using the sun as source are utilized in the accelerated outdoor exposure testing of nonmetallic materials.

1.2 This practice covers a procedure for performing accelerated outdoor exposure testing of nonmetallic materials using a Fresnel-reflector accelerated outdoor weathering test machine. The apparatus (see Fig. 1 and Fig. 2) and guidelines are described herein to minimize the variables encountered during outdoor accelerated exposure testing.

1.3 This practice does not specify the exposure conditions best suited for the materials to be tested but is limited to the method of obtaining, measuring, and controlling the procedures and certain conditions of the exposure. Sample preparation, test conditions, and evaluation of results are covered in existing methods or specifications for specific materials.

1.4 The Fresnel-reflector accelerated outdoor exposure test machines described may be suitable for the determination of the relative durability of materials exposed to sunlight, heat, and moisture, provided the mechanisms of chemical or physical change, or both, which control the rates of acceleration factors for the materials do not differ significantly.

1.5 This practice establishes uniform sample mounting and in-test maintenance procedures. Also included in the practice are standard provisions for maintenance of the machine and Fresnel-reflector mirrors to ensure cleanliness and durability.

1.6 This practice shall apply to specimens whose size meets the dimensions of the target board as described in 8.2.

1.7 For test machines currently in use, this practice may not apply to specimens exceeding 13 mm (½ in.) in thickness because cooling may be questionable.

1.8 Values stated in SI units are to be regarded as the standard. The inch-pound units in parentheses are provided for information only.

1.9 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D859 Test Method for Silica in Water

D1014 Practice for Conducting Exterior Exposure Tests of Paints and Coatings on Metal Substrates

D1435 Practice for Outdoor Weathering of Plastics

D1898 Practice for Sampling of Plastics (Withdrawn 1998)[3]

D4141 Practice for Conducting Black Box and Solar Concentrating Exposures of Coatings

D4517 Test Method for Low-Level Total Silica in High-Purity Water by Flameless Atomic Absorption Spectroscopy

E816 Test Method for Calibration of Pyrheliometers by Comparison to Reference Pyrheliometers

E824 Test Method for Transfer of Calibration From Reference to Field Radiometers

E903 Test Method for Solar Absorptance, Reflectance, and Transmittance of Materials Using Integrating Spheres

G7 Practice for Atmospheric Environmental Exposure Testing of Nonmetallic Materials

G24 Practice for Conducting Exposures to Daylight Filtered Through Glass

G113 Terminology Relating to Natural and Artificial Weathering Tests of Nonmetallic Materials

G167 Test Method for Calibration of a Pyranometer Using a Pyrheliometer

[1] This practice is under the jurisdiction of ASTM Committee G03 on Weathering and Durabilityand is the direct responsibility of Subcommittee G03.02 on Natural and Environmental Exposure Tests.

Current edition approved June 1, 2010. Published June 2010. Originally approved in 1985. Last previous edition approved in 2005 as G90 – 05. DOI: 10.1520/G0090-10.

[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

[3] The last approved version of this historical standard is referenced on www.astm.org.

A - AIR PLENUM
B - AIR BLOWER
C - ROTOR ASSEMBLY
D - AIR DEFLECTOR
E - A-FRAME ASSEMBLY
F - MIRROR
G - GEAR BOX, ELEV DRIVE
H - MAST, AZIMUTH ADJUST
I - AIR FLOW SWITCH
J - WATER SPRAY NOZZLE
K - CLUTCH DISC, ELEV DRIVE
L - SOLAR CELLS/SHADOW HAT
M - SAMPLE PROTECTION DOOR
N - DOOR RELEASE MECHANISM

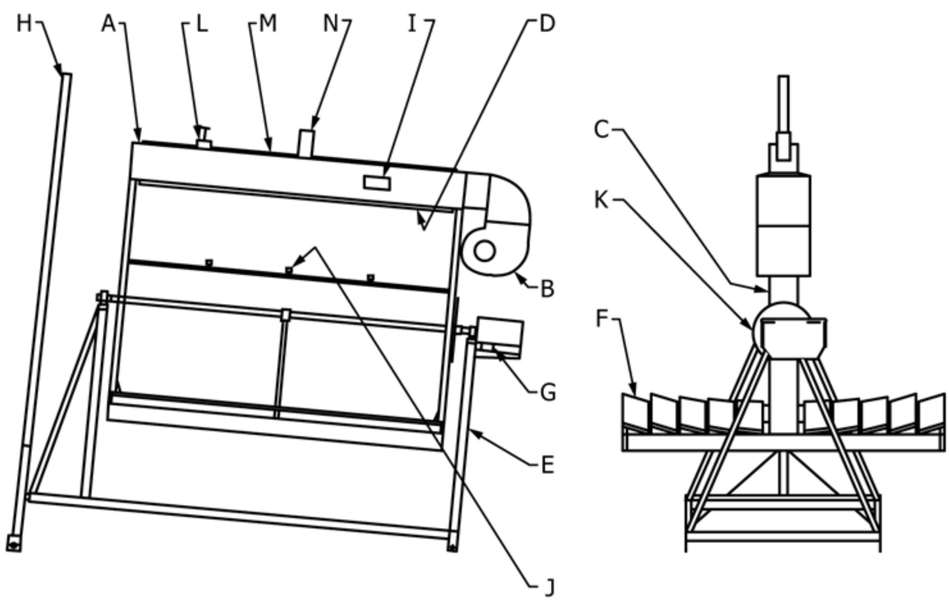


FIG. 1 Schematic of Fresnel-Reflecting Concentrator Accelerated Weathering Machine Single Axis Tracking

G169 Guide for Application of Basic Statistical Methods to Weathering Tests
G173 Tables for Reference Solar Spectral Irradiances: Direct Normal and Hemispherical on 37° Tilted Surface

2.2 *Other Standards:*

SAE J576 Plastic Materials for Use in Optical Parts Such as Lenses and Reflectors of Motor Vehicle Lighting Devices[4]
WMO Guide to Meteorological Instruments and Methods of Observation WMO No. 8, Fifth Edition[5]

3. Terminology

3.1 *Definitions*—Definitions of terms common to G03 durability standards can be found in Terminology G113.

4. Significance and Use

4.1 Results obtained from this practice can be used to compare the relative durability of materials subjected to the specific test cycle used. No accelerated exposure test can be specified as a total simulation of natural or field exposures. Results obtained from this practice can be considered as representative of natural or field exposures only when the degree of comparative performance has been established for the specific materials being tested.

4.2 The relative durability of materials in natural or field exposure can be very different depending on the location of the exposure because of differences in UV radiation, time of wetness, temperature, pollutants, and other factors. Therefore, even if results from a specific accelerated test condition are found to be useful for comparing the relative durability of materials exposed in a particular exterior location, it cannot be assumed that they will be useful for determining relative durability for a different location.

[4] Available from SAE International (SAE), 400 Commonwealth Dr., Warrendale, PA 15096-0001, http://www.sae.org.
[5] Available from World Meteorological Organization, Geneva, Switzerland.

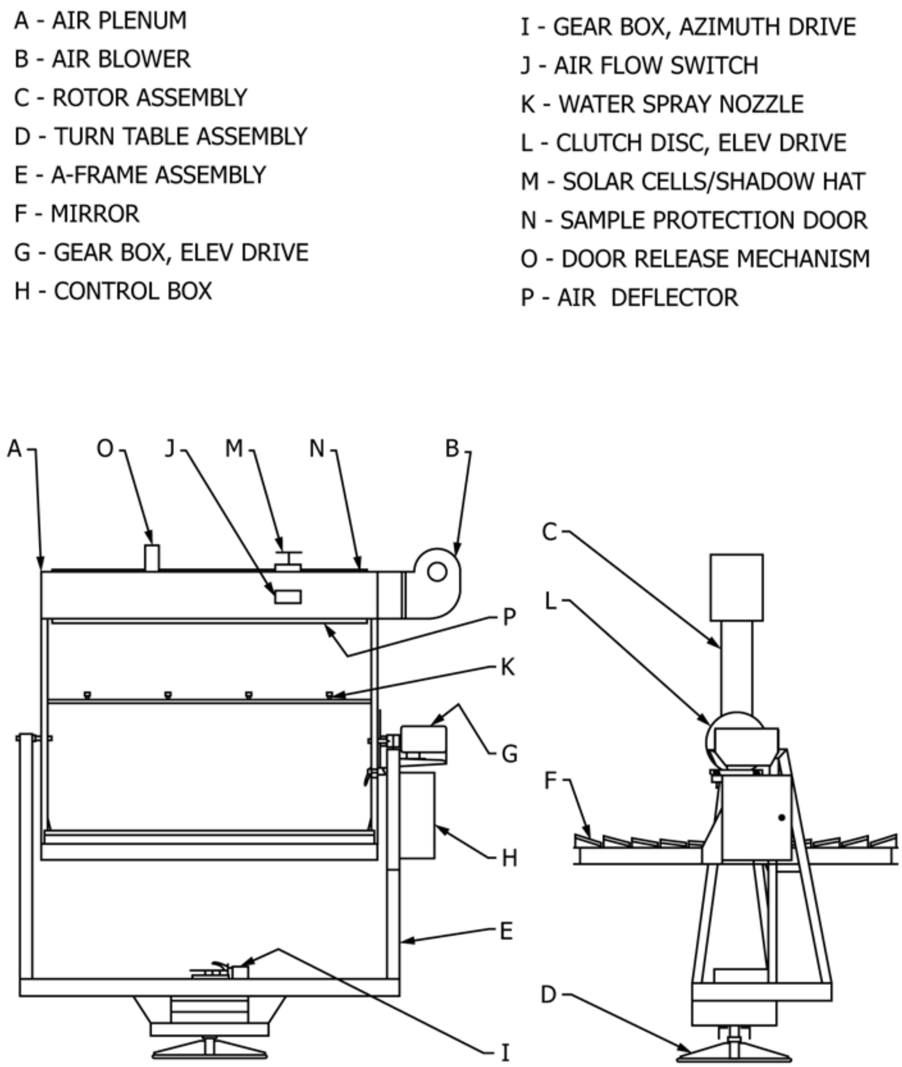


FIG. 2 Dual Axis Tracking

4.3 The use of a single acceleration factor relating the rate of degradation in this accelerated exposure to the rate of degradation in a conventional exterior exposure is not recommended because the acceleration factor varies with the type and formulation of the material. Each material and formulation may respond differently to the increased level of irradiance and differences in temperature and humidity. Thus an acceleration factor determined for one material may not be applicable to other materials. Because of variability in test results under both accelerated and conventional exterior exposures results from a sufficient number of tests must be obtained to determine an acceleration factor for a material. Further, the acceleration factor is applicable to only one exterior exposure location because results from conventional exterior exposures can vary due to seasonal or annual differences in important climatic factors.

4.4 Variations in results may be expected when operating conditions vary within the limits of this practice. For example, there can be large differences in the amount of degradation in a single material between separate, although supposedly identical, exposures carried out for the same duration or number of exposure cycles. This practice is best used to compare the relative performance of materials tested at the same time in the same fresnel reflector device. Because of possible variability between the same type of exposure device and variability in irradiance, temperature and moisture levels at different times, comparing the amount of degradation in materials exposed for the same duration or radiant energy at separate times is not recommended.

4.5 This practice should not be used to establish a "pass/fail" approval of materials after a specific period of exposure unless performance comparisons are made relative to a control material exposed simultaneously, or the variability in the test is defined so that statistically significant pass/fail judgements can be made. It is strongly recommended that at least one control test specimen be exposed with each test. The control test specimen should meet the requirements of Terminology G113, and be chosen so that its failure mode is the same as that of the test specimen. It is preferable to use two control test specimens, one with relatively good durability and one with relatively poor durability.

4.6 The use of at least two replicates of each control test specimen and each material being evaluated is recommended. Consult Guide G169 for performing statistical analysis.

5. Apparatus

5.1 *Test Machines*—Fresnel-reflector test machines used in Cycles 1, 2, and 3 of Table 1 are nearly identical. The only difference between the machines is the addition of a water delivery system to the device used in Cycles 1 and 3. Use of the specific cycle should relate to end use of the material and should be agreed upon by all interested parties.

5.1.1 The Fresnel-reflector test machine is a follow-the-sun apparatus having flat mirrors so positioned that the sun's rays strike them at near-normal incident angles while in operation. The mirrors are arranged to simulate tangents to a parabolic trough in order to reflect sunlight uniformly onto the specimens in the target area (see Fig. 1, Fig. 2, and Fig. 3).

5.1.2 The test machine is equipped with a blower to cool the test specimens. The air is directed over the specimens by an adjustable deflector along one side of the target area. For unbacked mounting, air is also directed under the specimens. This limits the increase in surface temperatures of most specimens to 10°C above the maximum surface temperature that would be reached when identically mounted specimens are exposed to direct sunlight at normal incidence at the same time and location without concentration.

5.2 *Mirrors*—The Fresnel-reflector system mirrors of machines currently in use have a typical specular, spectral reflectance curve such as that presented in Fig. 4. Other mirrors may be used providing they meet the requirements of 6.2.

5.3 *Photoreceptor Cells*—Two photoreceptor cells, such as silicon solar cells, are installed near the top of the air tunnel on the side facing the sun. A "T" shadow maker is mounted above the cells to illuminate equally one-half of each cell when the test machine is in proper focus. As one cell receives more radiation than the other, the balance is disturbed and a signal is furnished through an amplifier to a reversible motor which adjusts the machine to maintain focus.

5.4 *Tracking System*—The test machine shall be equipped with a system to keep the target area in focus throughout the day. Several options are possible.

TABLE 1 Fresnel-Reflector Test Machine Typical Spray Cycles

Cycle	Daytime Spray Duration	Daytime Dry-Time Duration	Daytime Cycles/h	Nighttime Spray Duration	Nighttime Dry-Time Duration	Nighttime Cycles/h
1	8 min	52 min	1	8 min		water is sprayed on the test specimens at: 9:00 p.m. 12:00 midnight 3:00 a.m.
2	no water spray used			no water spray used		
3[A]	no water spray used			3 min	12 min	4 cycles per hour (from 7PM to 5 AM)

[A] This is the cycle specified in Procedure C of Practice D4141.

5.4.1 Single-axis tracking with manual altitude adjustment (Fig. 1). The test machine's axis is oriented in the north/south direction, with the north pole being altitude-adjustable to account for seasonable variations in solar altitude at zenith.

5.4.2 Dual axis tracking (Fig. 2). The test machine is equipped with two sets of photoreceptor cells, one to control the azimuth rotation of the machine, the other to control the tilt elevation. The axis of the target area remains parallel to the ground. The machine rotates about horizontal and vertical axes to keep the target area in focus.

5.5 *Nozzles*—The test machine used in Cycles 1 and 3 of Table 1 is provided with a nozzle assembly for spraying water onto the specimens during exposure. Fan spray nozzles which provide a uniform fine mist over the specimen area are recommended.

5.6 *Spray Orientation*—The apparatus shall be positioned so that specimens are sprayed at night either with specimens facing up or down.

5.6.1 *Specimens Face Down*—The apparatus is oriented with the mirrors below the target specimen area such that nozzles spray high purity water in an upward direction onto the specimens.

5.6.2 *Specimens Face Up*—The apparatus is oriented with the mirrors above the target specimen area such that nozzles spray high purity water in a downward direction onto the specimens.

NOTE 1—No data has been presented indicating that exposures performed using different spray orientations provide equivalent results, and as such, may provide different test results.

5.7 *Ultraviolet Radiometers*—Instrumental means of measuring 295 to 385 nm ultraviolet radiant exposure shall shall consist of two wavelength-band specific global irradiance radiometers, each connected to an integrating device to indicate the energy received in the specified wavelength band over a given period. The spectral response of the ultraviolet radiometers shall be known and shall be as flat as possible throughout the 295 to 385 nm spectral region utilized. Calibrations shall be performed using sunlight as the source. The pyranometer shall be calibrated in accordance with Method E824 no less often than annually. A black-painted permanent shading disk is positioned over one radiometer as shown in Fig. 6 and Figs. 7-9 to provide a diffuse-only measurement (excluding 6° field of view).

5.8 *Pyranometer*—Instrumental means of measuring full-spectrum solar radiant exposure shall consist of a pyranometer connected to an integrating device to indicate the total energy received over a given period. The pyranometer shall be a World Meteorological Organization (WMO) Second Class instrument or better as defined by the WMO Guide to Meteorological Instruments. The pyranometer shall be calibrated in accordance with Test Method E824 or G167 at least annually.

5.9 *Pyrheliometer*—Instrumental means of measuring full-spectrum solar radiant exposure in a 5 to 6.5 degree field of view shall consist of a pyrheliometer connected to an integrating device to indicate the total energy received over a given period. The pyrheliometer shall be a World Meteorological Organization (WMO) First Class instrument or better as

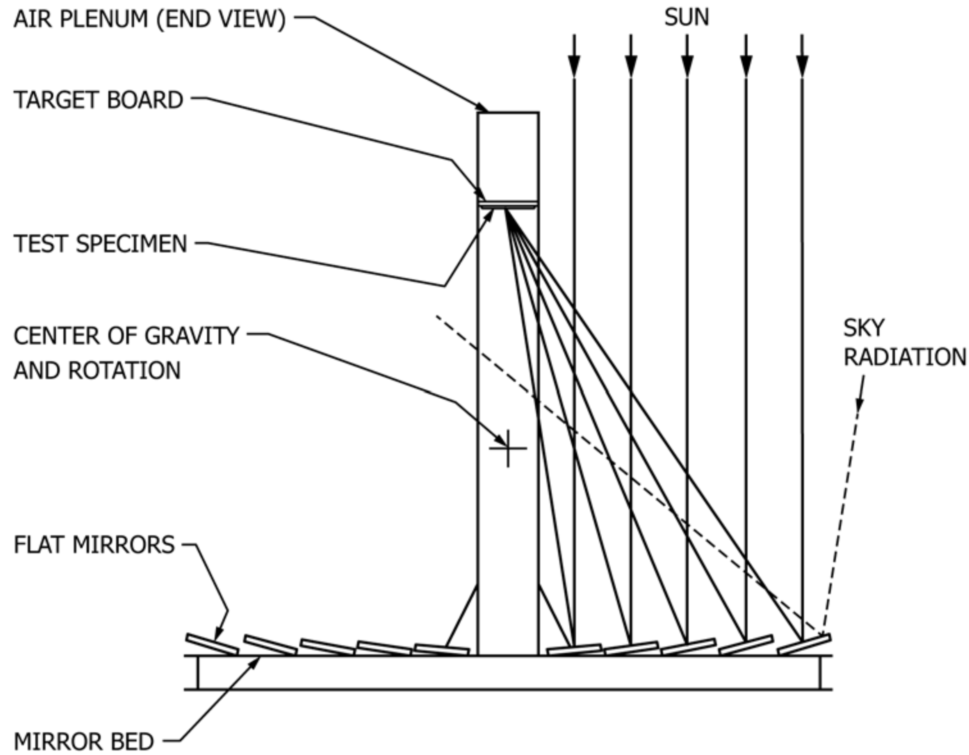


FIG. 3 Schematic of Optical System for a Fresnel Reflecting Concentrator Accelerated Weathering Machine

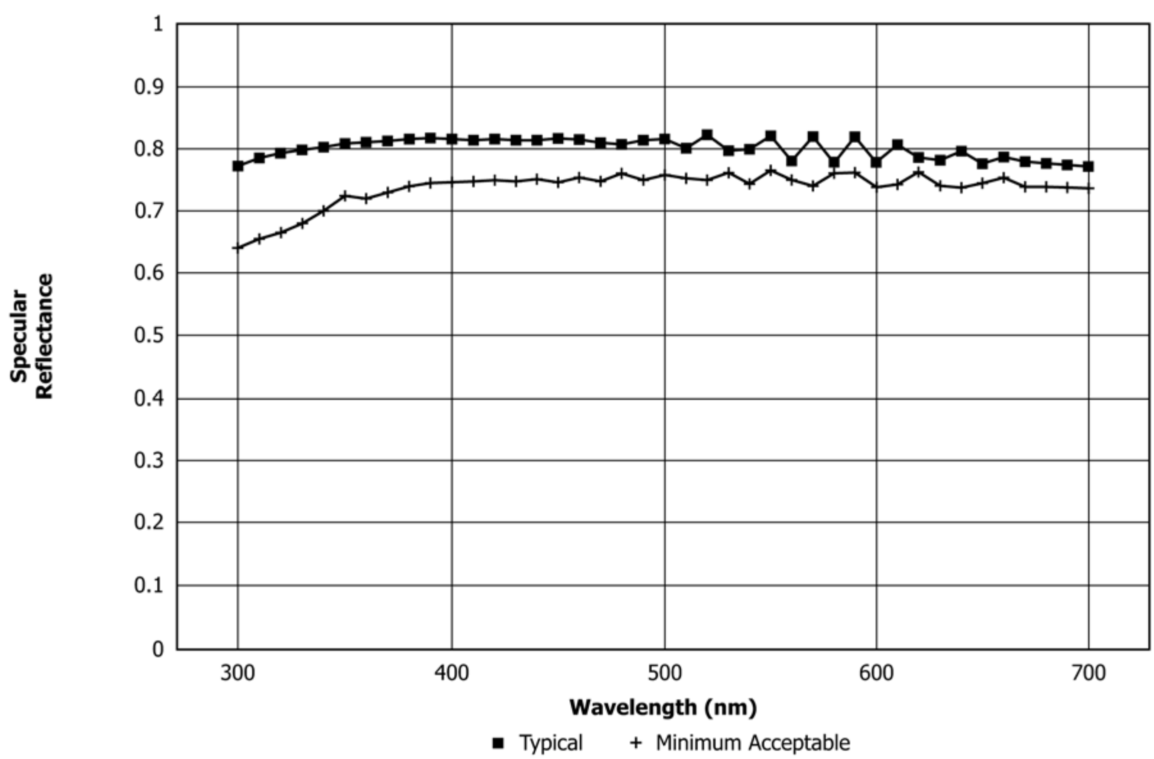


FIG. 4 Typical Specular Reflectance of Mirror Material

defined by the WMO Guide to Meteorological Instruments. The pyrheliometer shall be calibrated in accordance with Test Method E816 at least annually

6. Reagents and Materials

6.1 *Water Quality:*

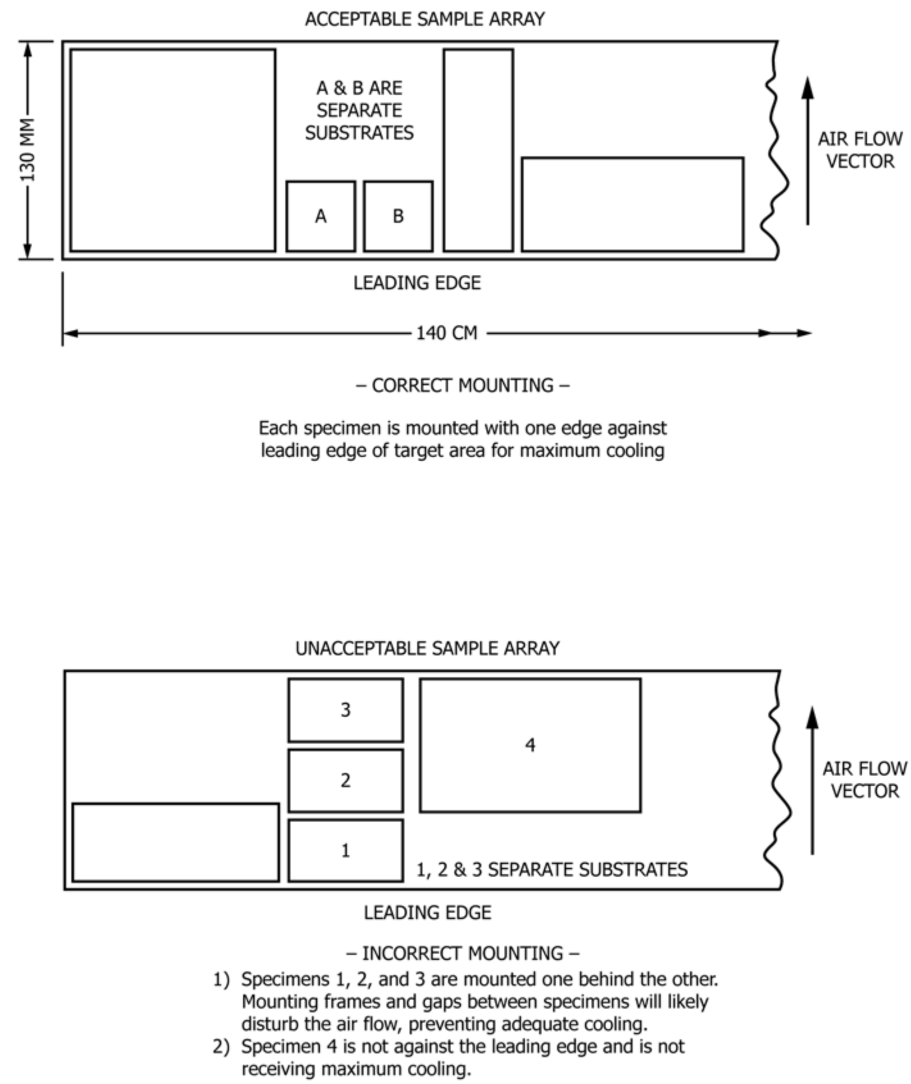


FIG. 5 Examples of Correctly and Incorrectly Mounted Specimens

6.1.1 The purity of water used for specimen spray is very important. Without proper treatment to remove cations, anions, organics, and particularly silica, exposed panels will develop spots or stains that do not occur in exterior exposures.

6.1.2 Water used for specimen spray shall leave no objectional deposits or stains on the exposed specimens. It is strongly recommended that the water contain a maximum of 1-ppm solids and a maximum of 0.2-ppm silica. Silica levels should be determined using the procedures defined in Test Methods D859 or D4517. Prepackaged analysis kits are commercially available that are capable of detecting silica levels of less than 200 parts per billion (ppb). A combination of deionization and reverse osmosis treatment can effectively produce water with the desired purity. If the spray water used is above 1-ppm solids, the solids and silica levels must be reported.

6.1.3 If specimens are found to have deposits or stains after exposure in the apparatus, the water purity must be checked to determine if it meets the requirements above. On some occasions, exposed specimens can be contaminated by deposits from bacteria that can grow in the purified water used for specimen spray. If bacterial contamination is detected, the entire system used for specimen water spray must be flushed with chlorine and thoroughly rinsed before resuming exposures. Although it does not always correlate with silica content, it is recommended that resistivity of water used for specimen spray be continuously monitored and that exposures be discontinued whenever the resistivity falls below 1 MΩ.

6.2 The mirrors used on Fresnel-reflector test machines shall be flat and shall have specular ultraviolet reflectance of 65 % or greater at 310-nm wavelength as measured by Test Method E903 or other method found to give equivalent results. Fig. 4 shows typical specular reflectance and typical minimum specular reflectance curves.

7. Safety Precautions

7.1 Suitable eye protection shall be required when working with Fresnel-reflector test machines to prevent ultraviolet and infrared damage. Manipulation of the reflectors for daily

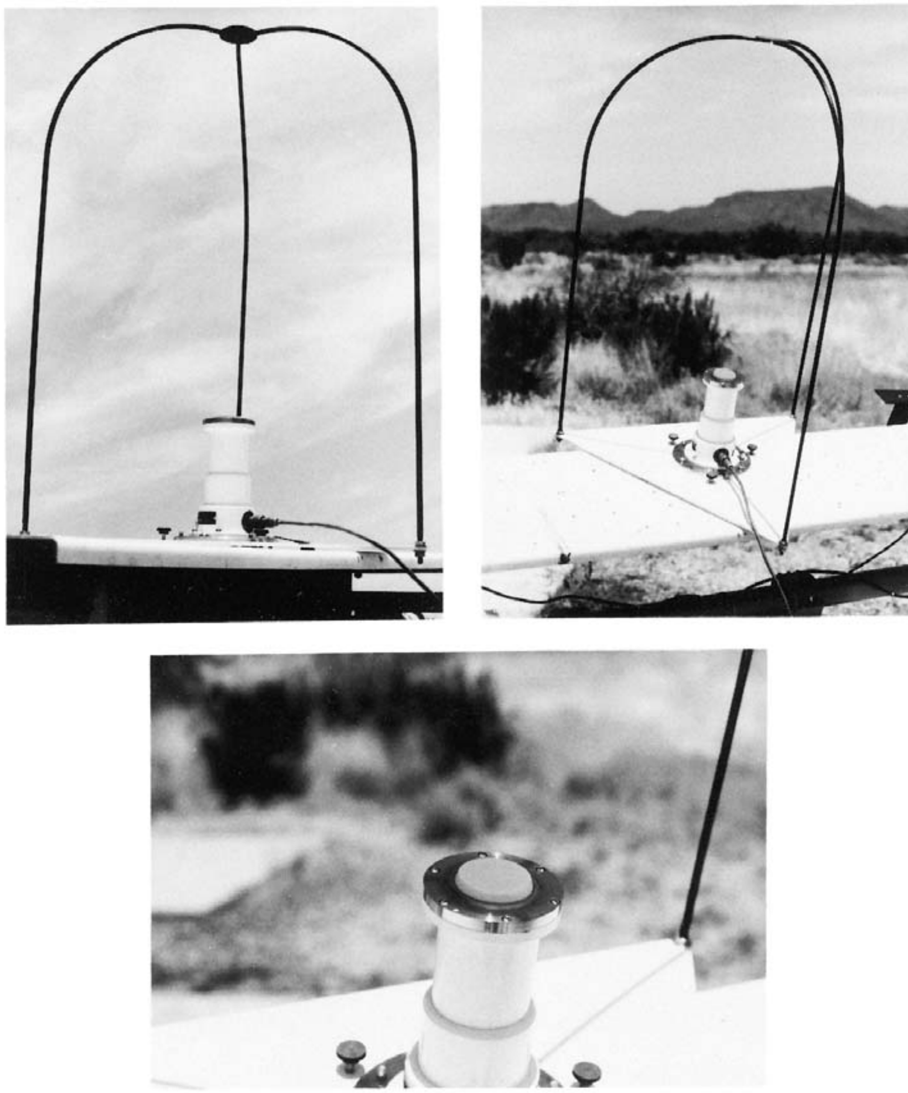


FIG. 6 Shading Disk In Operation

maintenance or for the purpose of sample mounting/dismounting and inspection can accidentally reflect the concentrated sunlight upon the face. Sunglasses having high extinction for ultraviolet are the most important; aluminized glasses will prevent accidental burning of the retina by infrared.

7.2 The blower shall be covered with a heavy-duty protective screen to prevent accidental injury and to keep loose clothing from the fan during start-up, shutdown, maintenance, inspection, or sample exchange.

7.3 It is recommended that operators protect exposed parts of the body by using sunscreen, loose long sleeve shirts and trousers, and wide brim hats or other suitable covering.

8. Test Specimens

8.1 Users of the accelerated outdoor exposure test method described should follow the statistical procedures for sampling presented in Practice D1898.

8.2 The maximum length and width of specimens cannot be larger than the length or width of the target area, or both.

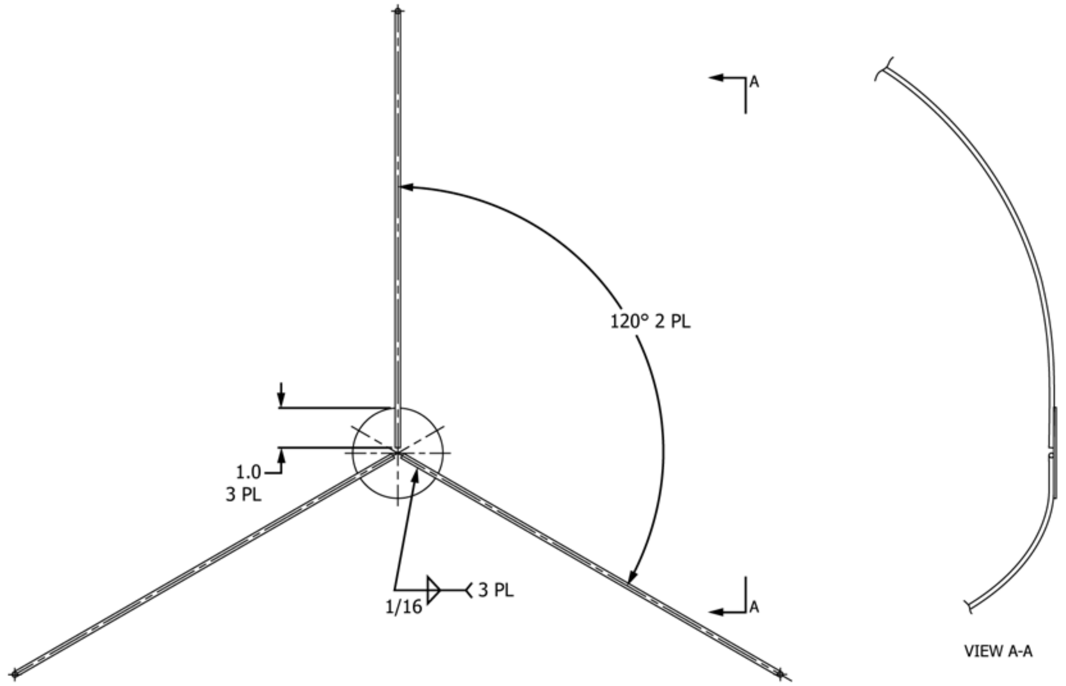
8.3 The air-cooling process and mechanism may limit specimen thickness to 13 mm (½ in.) or less.

8.4 Fig. 5 shows typical mounting for specimens smaller than the maximum allowable size. The leading edge of specimens to be mounted closest to the airflow shall be aligned with the leading edge of the target boards so as not to disrupt the airflow. Specimens shall not be mounted in a manner that disrupts the uniform airflow used for cooling.

9. Specimen Mounting

9.1 Specimens are to be mounted facing the mirror array on a target board in order to receive the reflected concentration of natural sunlight from the test machine mirrors (see Fig. 5).

9.1.1 *Noninsulated Mounting*—Mount the framed test specimens approximately 5 to 6 mm off the target board. Position



① -101 SHADING DISC ASSEMBLY

FIG. 7 Shading Disk and Support Bars

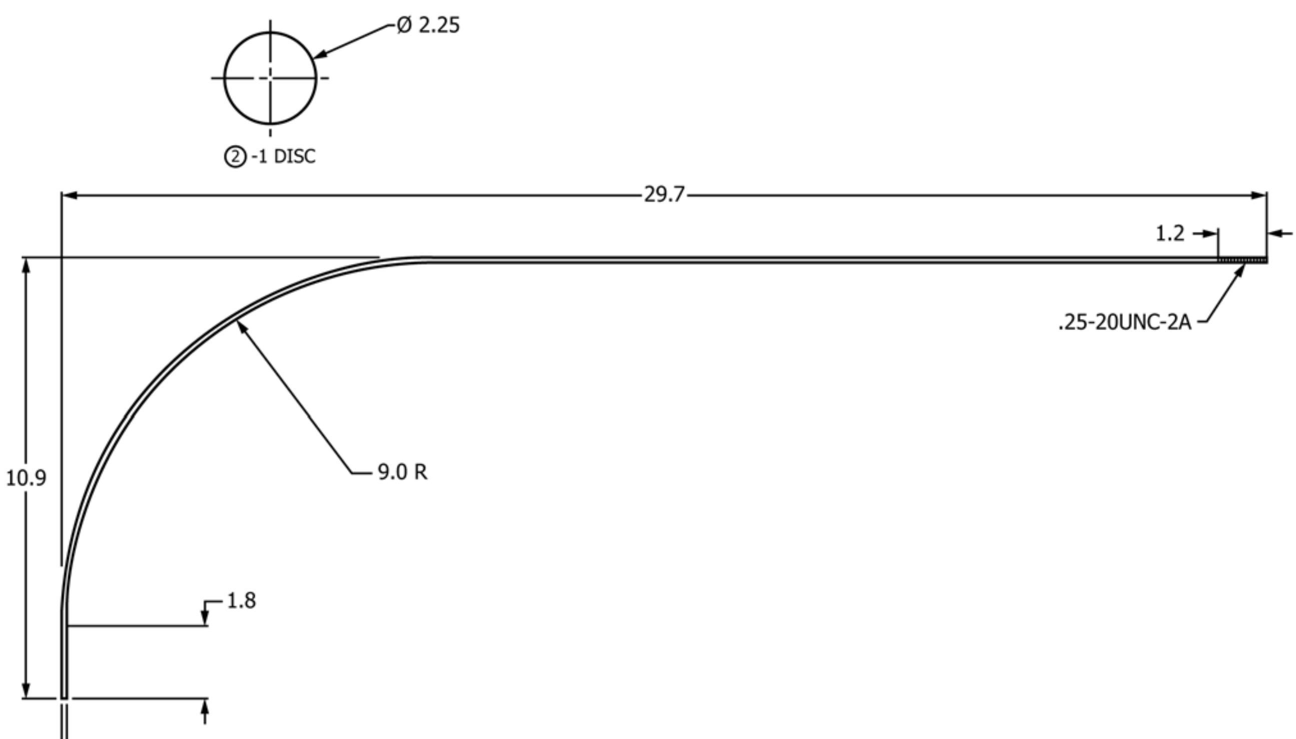


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FIG. 8 Shading Disk Support Bar

the samples to ensure adequate clearance is maintained between the air-delivery slot and the frame. Adjust the machine's

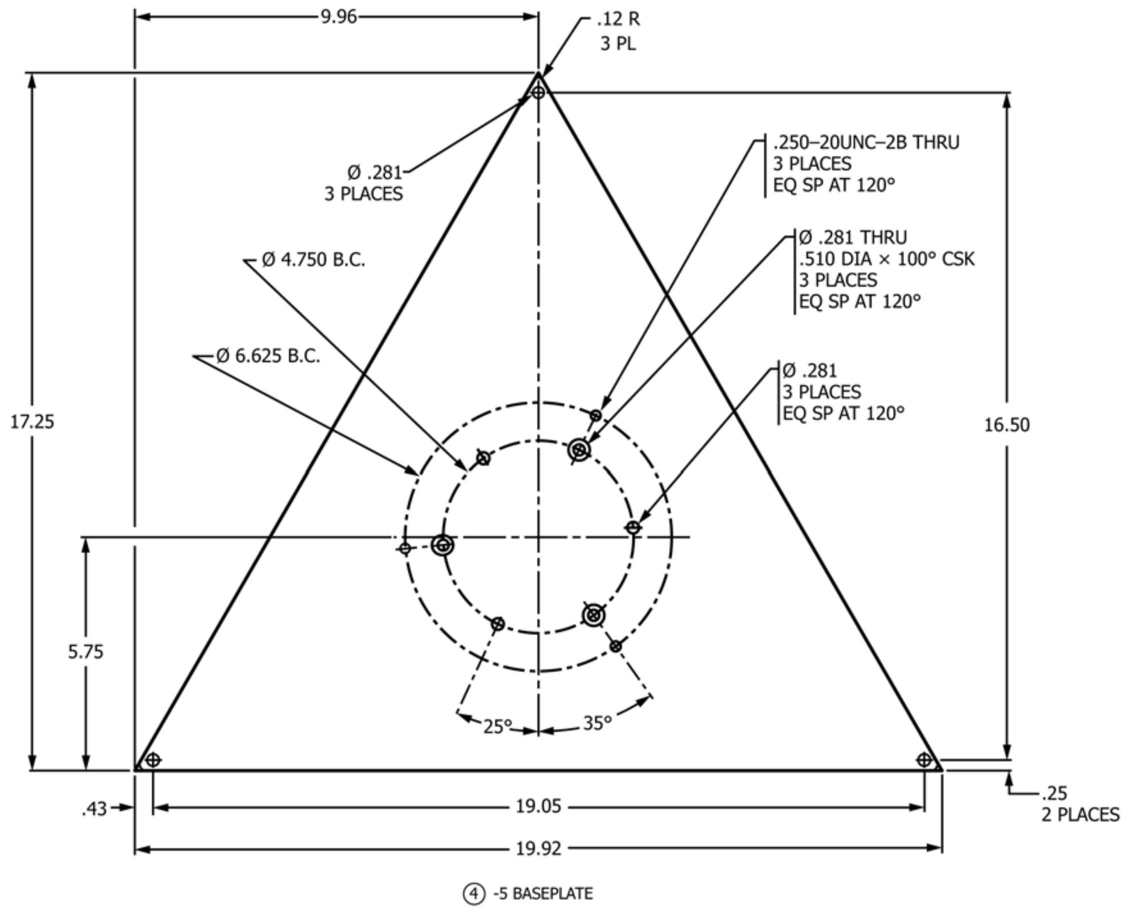

FIG. 9 Shading Disk Base

air deflector to provide a clearance of from 10 to 14 mm (3⁄8 to 9⁄16 in.) between the exposed surface of the test specimen and the air deflector lip.

9.1.2 *Insulated Mounting*—Mount the test specimens directly against an insulated backing such as 13-mm (1⁄2-in.) thick plywood.

9.2 It is recommended that specimens that are not coated metal be mounted for non-insulated exposures.

9.3 Any other mounting is acceptable if agreed upon between supplier and testing laboratory.

9.4 When using this method to accelerate the exposure of materials under glass, as in Practice G24, it is recommended to use glass as specified in Practice G24 in these tests.

NOTE 2—For under glass exposure testing using Cycle 2 (no sprays), careful adjustment is required of the air deflector to achieve adequate specimen cooling.

10. Procedure

10.1 Start the test by pointing the machine's solar cell sun tracker at the sun to gain solar acquisition. Actuate the water-spray system as required. See Table 1 for typical spray schedules. Other moisture cycles may be used.

10.2 Operation is not recommended when the direct beam radiation, as measured by a 6° pyrheliometer, is reduced to 600 W/m^2 or less for 30 min or more by prevailing cloud cover or when the ratio between the direct beam and normal incident global (hemispherical) radiation as measured with a pyranometer falls below 75 %.

10.3 Determine the solar radiant exposure of the test specimens in accordance with the following formula:

$$H_s = M\rho_s \sum_{i=1}^{N} H_d \quad (1)$$

$$\rho_s = \frac{\rho}{M} \sum_{i=1}^{M} \cos\theta_i \quad (2)$$

where:

H_s = solar radiant exposure, J/m^2;
M = number of mirrors;
ρ_s = the average energy-weighted specular reflectance of the mirrors;
ρ = the cosine corrected specular reflectance;
N = number of days of exposure;
θ_i = the angle of incidence of the irradiance from each mirror at the specimen target area; and
H_d = direct-normal daily solar radiant exposure measured in a 6° field of view, J/m^2.

10.3.1 To determine total full spectrum solar radiant exposure, H_d in Eq 1 shall be determined as the integration of total irradiance with respect to time. Irradiance shall be measured using a pyrheliometer as specified in 5.9. The measurement of reflectance (ρ) shall be the energy-weighted specular reflectance in the wavelength region of 295 to 2800 nm, calculated using the air mass 1.5 spectrum and procedure outlined in G173.

10.3.2 To determine the ultraviolet (295 to 385 nm) solar radiant exposure, H_d in Eq 1 shall be determined as the integration of ultraviolet irradiance with respect to time. Irradiance shall be measured using two ultraviolet radiometers as specified in 5.7. H_d is determined using the following formula:

$$H_d = H_t - H_{do} \tag{3}$$

where:

H_t = hemispherical daily solar radiant exposure (J/m^2), and
H_{do} = diffuse-only daily solar radiant exposure (J/m^2) (excluding direct-normal radiant exposure in a 6° field of view).

10.3.2.1 *Initial Calibration Check*—The two ultraviolet radiometers shall be calibrated at the same time at least annually against a standard source of spectral irradiance. Instrument calibration constants shall be checked by mounting both instruments at the same orientation for at least 1 h under clear sky conditions. If a difference of more than 2 % exists between instruments, they shall be recalibrated.

10.3.2.2 *Periodic Calibration Check*—At least monthly, for 1 h under clear sky conditions, both instruments shall be tracked off-altitude approximately 15° with no shading on the normally shaded instrument's diffuser. If the radiant exposure indicated from the two instruments differ by more than 2 %, the radiometers shall be recalibrated.

10.3.2.3 Clear sky conditions shall be defined as a diffuse percentage of total radiation (300 to 3000 nm) less than or equal to 20 %.

10.3.3 *Sample Calculation of Ultraviolet Radiant Exposure:*

10.3.3.1 The following table shows hypothetical incident angles for the ten mirrors contained on the apparatus described in Section 5.

Mirror #	θ_i	cos θ_i
1,10	34.3°	0.826
2,9	28.7°	0.877
3,8	22.5°	0.924
4,7	15.9°	0.962
5,6	8.8°	0.988

Solving the summation term in Eq 2 of 10.3 yields the following:

$$\sum_{i=1}^{M} \cos\theta_i = \tag{4}$$

$$2(0.826)+2(0.877)+2(0.924)+2(0.962)+2(0.988) = 9.154$$

If measured mirror specular reflectance ρ from 300 to 385 nm were 80 % or 0.80, then ρ_s would calculate as follows:

$$\rho_s = \frac{0.80}{10} \times 9.154 = 0.732 \tag{5}$$

If H_d for several days were as follows:

Date	H_d (MJ/m^2)
8/12/91	0.744
8/13/91	0.872
8/14/91	0.704
Total	2.320

Then,

$$H_s = 10(0.732)(2.320) = 16.98 \text{ MJ/m}^2 \tag{6}$$

10.4 Instruments used for measuring either total or ultraviolet radiant exposure in accordance with 10.3.1 and 10.3.2 shall be mounted to a tracking stand capable of tracking the sun to within ±0.5°.

10.5 Clean all mirrors as necessary to maintain the reflectance specified in 6.2. **Do not wait until surface contaminants reduce reflectance at 310 nm to 65 % before cleaning mirrors.**

NOTE 3—To preserve near-pristine surface conditions for optimum specular reflection, it is recommended that mirrors be cleaned on an established frequency to minimize the effects of surface deposits that may alter spectral irradiance at the target. Use a nonabrasive, nonresidue-producing cleaning procedure. If rapid accumulation of contamination occurs, atmospheric conditions are probably unsuitable for operation of the apparatus. Variation in spectral irradiance introduced by contamination of mirror surfaces contributes to the uncertainties of the exposure procedure and must be considered part of the experimental errors.

10.6 At least every six months, measure the specular reflectance of each mirror in two places along the mirror's centerline using a portable specular reflectometer with narrow-band-pass filters centered at 310-nm wavelength:[6] (*1*) 15 cm from the north edge and (*2*) 15 cm from the south edge. Visibly inspect each mirror and measure any additional areas which appear nonuniform. Update the value of ρ_s, using actual average values of specular reflectance. Replace individual mirrors if the average 310-nm specular reflectance is less than 0.65 (65 %).

10.7 If measurement of specular reflectance of the mirrors used in exposure devices is not practical, mount small, representative specimens of the mirror material. Place the representative specimens next to the mirror locations described in 10.6. These representative specimens must be of the same material and lot number as the mirrors used in the instrument. The representative specimens must also be installed at the same time as the mirrors. At least every six months, measure the specular reflectance of the representative specimens at 310 nm. Replace individual mirrors if the average 310-nm specular reflectance of the representative specimens is less than 0.65 (65 %).

10.8 Monitor and adjust the tracking system and mirrors such that at no time during the day does any portion of the target board fail to receive visible illumination.

10.9 Remove the specimens according to one of the following schedules:

10.9.1 Preselected ultraviolet or total solar radiant exposure.

10.9.2 Preselected percent of change based upon control samples.

[6] Freese, J.M., "The Development of a Second Generation Portable Specular Reflectometer," *Proceedings of the Line-Focus Solar Thermal Energy Technology Development—A Seminar for Industry*, Sandia Laboratories, 1980.

10.9.3 Preselected loss of original value, such as gloss retention, color change, and so forth.

NOTE 4—It is recommended that exposures on Fresnel-reflector test machines use specimens from the same lot of material on which the natural weathering characteristics have previously been ascertained.

11. Report

11.1 Report the following information:

11.1.1 Spray cycle and orientation used,

11.1.2 Water quality if the conditions in 6.1 are not met,

11.1.3 Inclusive dates of exposure,

11.1.4 Ultraviolet solar radiant exposure, from 295 to 385 nm in MJ/m^2,

11.1.5 Total solar radiant exposure (typically 300 to 3000 nm) in MJ/m^2,

11.1.6 Accurate identification of all specimens,

11.1.7 Mounting conditions (insulated or noninsulated),

11.1.8 Any unusual aspects of the test, such as temperature extremes, that might affect the exposure results,

11.1.9 The serial number and last calibration date of the instrument used to measure ultraviolet irradiance as described in 10.3.2, if not reported elsewhere, and

11.1.10 The transmittance characteristics of glass used for under glass exposure tests.

11.2 Reports may optionally include the following information:

11.2.1 Daily total radiation accumulated,

11.2.2 Ambient temperature (daily high, low, and mean),

11.2.3 Humidity (daily high, low, and mean),

11.2.4 Ultraviolet deposited in selected wavelengths, as determined from the solar radiation and mirror reflectance data, or as measured in the target plane, and

11.2.5 Inspection and measurement reports.

12. Evaluation of Tests

12.1 The selection of appropriate test methods is beyond the scope of this practice. Typical reporting criteria can be found in Test Method D1014, Practice D1435, Practice G7, Practice G24, and SAE J576.

12.2 Specimens that have been previously weathered in a specific environment are useful in establishing the relationship between accelerated and real-time tests. The relationship between accelerated and real time tests (acceleration factor) established for one material should not be assumed to be the same for modifications of the material or for any other material. The relationship can change significantly with a small change in composition of the material or incorporation of an additive.

12.3 Unexposed file specimens should be provided by the purchaser to ensure an accurate assessment of visual evaluation. The use of the unexposed portion of the specimens (shielded by the flange of the mounting frames) should not be used in visual evaluations unless unexposed file specimens are not provided by the purchaser. If this portion of the sample is used, the report should note this condition.

13. Keywords

13.1 durability; exposure; fresnel-reflector; weathering