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# FORD LABORATORY TEST METHOD EU-BO 022-01

## TEST METHOD FOR LUMINOUS REFLECTANCE OF MIRRORS

### Application

This procedure describes the basis for measurement of the absolute luminous (visual) specular reflectance of automotive rear view mirrors to C.I.E. (Commission International d' Eclairage) standard illuminant "A" (tungsten light).

### Apparatus Required

The device employed shall consist of a light source, mirror sample holder, photoelectric receptor, indicating meter and associated light shields, circuitry, etc. This device shall be capable of proper calibration and zero adjustments for the required sample measurements and be within the following specific limitations. General guidelines for such systems are described in ASTM (American Society for Testing and Materials) Designation E 179T, "Selection of Geometric Conditions for Measurement of Reflectance and Transmittance" (see 1965 edition, Book of ASTM Standards, Part 30, Page 1383 - 1390). A similar procedure is also described in the 1967 SAE Handbook; SAE J964.

#### Light Source

A tungsten lamp is required with associated light shields and/or other optics necessary to provide a near collimated standard C.I.E. illuminant "A" (i.e. a tungsten light beam having a colour temperature of approx 2854 K or equivalent). Lamp voltage shall be fixed and sufficiently stable to permit instrument calibration and zeroing, then sample measurement, within the accuracy specified.

#### Receptor

A photoelectric cell is required with associated light shields and/or other optics as necessary to adequately receive that light specularly reflected from the sample mirror. The spectral response of the photoreceptor shall be equivalent to that of the normal observer (i.e., the C.I.E. standard observer). Photometric accuracy of the receptor-indicator circuit shall be within +/- 2 % of the full scale, or +/- 10 % of the magnitude of the reading whichever is smaller. The angle of the incident beam ($è_\tau$ ) shall not J exceed 30 deg from the perpendicular to the test surface, and the axis of the receptor shall make an angle ($è_\tau$) with this perpendicular equal to that J of the incident beam (Figure 1). The incident beam upon arrival at the test surface shall have a diameter of 18 mm or larger, and shall not exceed the sample test area. The reflected beam, upon arrival at the photoreceptor, shall not be larger than the photosensitive area and shall not cover less than 50 % of such area, and should strike that area of the photoreceptor used for calibration.

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**Instrument Calibration System**

The instrument shall have means by which calibration can be achieved by projecting the light beam directly onto the receptor unit at a calibration position distance equivalent to the total test position distance. Such a calibration technique is referred to as "Direct Calibration" and is illustrated in Figure 1. In this figure the receptor is shown in the "measure" position by the solid line drawing and in the "calibrate" position by the dashed line drawing.

Equivalent "Indirect Calibration" technique employing a properly calibrated and maintained secondary standard and a fixed instrument geometry are acceptable. In the case of indirect calibrating instruments, the secondary standard is used in the same position as the mirror sample and the receptor is generally fixed in the "test" position (see Figure 1). Calibration adjustments shall be achieved through the use of a properly designed photocell shunt, optical iris, or equivalent means not affecting the linearity of the reflectance measuring system. (Note: Calibration by variation of the light source voltage is not an acceptable means.) It may be desired in some cases (such as when measuring low reflective surfaces) to use an intermediate calibration point (between 0 and 100 % on the scale) with this method. In such a case, a neutral density filter of known transmission value may be inserted in the optical path, and the calibrate control will then be adjusted until the meter reads the percent transmission of the neutral density filter. This filter must be removed before making any reflectivity measurement.

**Instrument Zeroing System**

The instrument shall include means by which the meter can be adjusted to read zero as required in the "Procedure" section of this test method. This is generally achieved by a potentiometer controlled back-bias battery on the measuring photocell. Another method uses a second photocell located adjacent to the light source. The power generated by this second photocell is controlled by a potentiometer and connected electrically in opposition to the measuring photocell as a back-bias. This second back-bias photocell should be electrically and optically equivalent to the measuring photocell if used.

Equivalent means are acceptable. However, any means employed shall provide a sufficiently constant meter zero to permit proper calibration and subsequent sample reflectance measurements.

**Mirror Sample Holder**

The mechanism for holding the sample mirror in position shall be such that the reflecting surface of the sample mirror is in the plane or reflectance of the instrument. In other words, when testing a second surface mirror, for example, (such as a "silvered" mirror or a lead-sulfide mirror) the back, or second, glass surface shall be in the plane of reflectance; or when testing a first surface mirror (such as a first surface chrome mirror), the front, or first, glass surface shall be in the plane of reflectance. Wedge (or "flip") type day/night mirrors require a special fixture to accommodate the small angle between the glass surfaces. Other special mirrors require other special fixtures.



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