TABLE 1A—MINIMUM CANDLEPOWER PER INCIDENT FOOTCANDLE - RED REFLEX REFLECTOR*

Observation Angle (deg)	Entrance Angle (deg)				
	0 deg	10 deg Up	10 deg Down	20 deg Left	20 deg Right
0.2	4.5	3.0	3.0	1.5	1.5
1.5	0.07	0.05	0.05	0.03	0.03

*Yellow values shall be 2.5 times indicated red values and white values shall be 4 times indicated red values.

6. Guidelines

6.1 Photometric Design Guidelines—Reflex reflectors, when tested in accordance with paragraph 4.1.5, should be designed at least equal to the values contained in Table 1 or 1A.

6.2 Installation Guidelines—The following guidelines apply to reflex reflectors as used on the vehicle and shall not be considered a part of this report:

6.2.1 Reflex reflectors when used on the exterior of vehicles should be mounted to minimize the accumulation of dirt, grime, and/or snow so that adequate illumination is maintained from the low beam headlamps of approaching vehicles.

6.2.2 If reflex reflectors must perform in severe environments; such as, periodic total immersion in water, the user should specify reflex reflector designs suitable for such use.

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REFLEX REFLECTORS FOR USE ON VEHICLES 2032 mm OR MORE IN OVERALL WIDTH—SAE J2041 JUN92 SAE Information Report

Report of the SAE Heavy-Duty Lighting Standards Committee approved June 1992. Rationale statement available.

1. Scope—This SAE Information Report provides test procedures, requirements, and guidelines for reflex reflectors used on vehicles 2032 mm or more in overall width and 7.6 m or more in length. Reflex reflectors conforming to these requirements may also be used on vehicles less than 2032 mm in overall width.

2. References

2.1 Applicable Documents—The following publications form a part of this specification to the extent specified herein. The latest issue of SAE publications shall apply.

2.1.1 SAE PUBLICATIONS—Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

SAE J576—Plastic Material for Use in Optical Parts Such as Lenses and Reflectors of Motor Vehicle Lighting Devices

SAE J578—Color Specifications

SAE J594—Reflex Reflectors

SAE J759—Lighting Identification

SAE J2139—Test Methods and Equipment for Lighting Devices and Components for Use on Vehicles 2032 mm or More in Overall Width

2.2 Definitions

2.2.1 REFLEX REFLECTORS—Reflex reflectors are devices used on vehicles to alert an approaching driver by reflected light from the lamps on the approaching vehicle of a possible hazard.

2.2.1.1 Type 1 Reflex Reflectors—Type 1 reflex reflectors are devices having a photometric pattern ranging from 20 degrees left to 20 degrees right along the horizontal axis and from 10 degrees up to 10 degrees down along the vertical axis. (See SAE J594.)

2.2.1.2 Type 2 Wide Angle Reflex Reflectors—Type 2 wide angle reflex reflectors are devices having an expanded photometric pattern beyond that for a Type 1 reflex reflector. The photometric pattern covers the area defined by the

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entrance angle corner points of 45L-5U, 45R-5U, 45R-5D, 45L-5D and from 10 U and 10 D along the vertical axis.

Wide angle reflex reflectors may be directional and may require that they be mounted on the vehicle in a fixed orientation to be effective.

2.2.2 OBSERVATION ANGLE—The observation angle is the angle formed by a line from the observation point to the center of the reflective area and a second line from the center of the reflective area to the center of the source of illumination in the vertical plane only.

2.2.3 ENTRANCE ANGLE—The entrance angle is the angle between the axis of the reflex reflector and a line from the center of the reflective area to the center of the source of illumination, with both horizontal and vertical coordinates.

The entrance angle shall be designated left, right, up, and down in accordance with the position of the source of illumination with respect to the axis of the reflex reflector as viewed from behind the reflector.

3. Identification Code

3.1 Type 1 Reflex Reflectors may be identified by the code "A" in accordance with SAE J759.

3.2 Type 2 Wide Angle Reflex Reflectors may be identified by the code "A2" in accordance with SAE J759.

4. Tests

4.1 SAE J2139 is a part of this document. The following tests are applicable with the modifications as indicated.

4.1.1 VIBRATION—The device shall be mounted on the test fixture in accordance with the manufacturer's instruction and the horizontal mounting line marked.

The device shall be conditioned in a circulating air oven with the temperature controlled at 46 °C to 49 °C for 60 min. The device and test fixture shall be removed from the oven and without remounting (repressing of adhesive tape or tightening of mounting screws) placed on the vibration test machine and vibrated for 60 min.

4.1.2 MOISTURE

4.1.2.1 Either the Water Spray Moisture Test or Water Submersion Test may be used to test reflex reflectors.

4.1.2.2 Water Spray Moisture Test

4.1.2.2.1 If the reflex reflector is a separate unit and not combined with a lighting device, the light source on-off cycle during the water spray moisture test is not applicable.

4.1.2.2.2 Upon completion of the drain period, the interior of the device shall be observed for moisture accumulation that can be formed by tapping or tilting the device.

4.1.3 DUST

4.1.3.1 If the reflex reflector is a separate unit and not combined with a lighting device, the light source on-off cycle during the dust test is not applicable.

4.1.4 CORROSION

4.1.4.1 If the reflex reflector is a separate unit and not combined with a lighting device, the light source on-off cycle during the corrosion test is not applicable.

4.1.5 PHOTOMETRY

4.1.5.1 The reflex reflector shall be set up for testing as shown in Figure 1.

4.1.5.2 The reflex reflector shall be mounted on the goniometer in accordance with the manufacturer's instructions and with the center of the reflex area at the center of rotation and at the same horizontal level as the source of illumination.

4.1.5.3 The test distance shall be 30 m. The source of illumination shall be a lamp with a 50 mm ± 5 mm effective diameter and with a filament operating at nominal 2856 K color temperature.

4.1.5.4 The observation point shall be located directly above the source of illumination and the opening to the photocell shall not be more than 13 mm vertical by 25 mm horizontal.

4.1.5.5 The H-V axis of the reflex reflector shall be taken as being parallel to the longitudinal axis of the vehicle for front and rear reflectors and perpendicular to a vertical plane passing through the longitudinal axis of the vehicle for side reflectors.

4.1.5.6 Reflex reflectors may have any linear or area dimension but for the photometric test a maximum projected area of 7740 mm^2 contained within a 254 mm diameter circle shall be exposed.

4.1.5.7 If uncolored reflections from the front surface interfere with the photometric readings at any test point, the operator shall check 1 degree above, below, right, and left of the test point, and report the lowest reading and location. The lowest reading shall meet the minimum requirements for that test point.

4.1.5.8 Type 1 reflex reflectors, which do not require a fixed mounted position on the vehicle, shall be rotated about their axis through 360 degrees to find the millicandela per incident lux (minimum candela per incident footcandle) which shall be reported for each test point. If the output falls below the minimum requirements at any test point, the reflector shall be rotated ±5 degrees about its axis from the angle where the minimum output occurred and highest reading and location reported. The highest reading shall meet the minimum requirements for the test point.

4.1.5.9 Type 2, Wide Angle Reflex Reflectors, that maybe directional and may require a fixed orientation shall be mounted in their design position and in accordance with the manufacturer's instructions.

4.1.6 WARPAGE—The device mounted in its design position shall be placed in a circulating air oven with the temperature controlled at 46 °C to 49 °C for 60 min.

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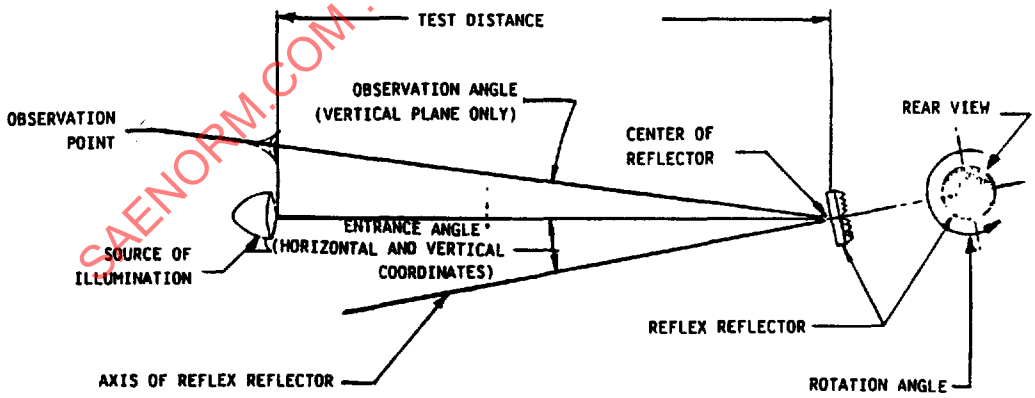

FIGURE 1—REFLEX REFLECTOR SETUP FOR TESTING

4.2 Color—The test sample may be either the reflex reflector or a disc of the same material, technique of fabrication and dye formulation as the reflex reflector.

If a disc is used, the thickness shall be twice the thickness of the reflector as measured from the face of the lens to the apexes of the reflecting elements.

4.3 Plastic Material—SAE J576.

5. Requirements

5.1 Performance Requirements—A device when tested in accordance with the test procedures of this document shall meet the requirements, of SAE J2139.

5.1.1 VIBRATION—Upon completion of the vibration test the reflector shall not have become separated from its mounting means. A Type 2 Wide Angle Reflex Reflector that is directional and requires a fixed orientation when mounted on the vehicle shall not rotate more than 2 degrees above or below the

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horizontal mounting line, unless the reflector meets all photometric requirements of Table 1 or Table 1A at the maximum rotation.

TABLE 1—WIDE ANGLE REFLEX REFLECTORS PHOTOMETRIC PERFORMANCE REQUIREMENTS
MILLICANDELA PER INCIDENT LUX

Obs. Angle (deg)	Ent. Angle (deg)		Red	Yellow	White
	10U	V	420	1050	1680
	5U	45L	50	125	200
		45R	50	125	200
		30L	185	465	740
		20L	280	700	1120
0.2	H	V	420	1050	1680
		20R	280	700	1120
		30R	185	465	740
	5D	45L	50	125	200
		45R	50	125	200
	10D	V	420	1050	1680
	10U	V	5	12	20
	5U	45L	2	5	8
		45R	2	5	8
		30L	3	7	12
		20L	3	7	12
1.5	H	V	6	15	24
		20R	3	7	12
		30R	3	7	12
	5D	45L	2	5	8
		45R	2	5	8
	10D	V	5	12	20

NOTE—Unless otherwise specified, the reflector shall be considered to have failed the photometric requirements of this document if the millicandela per incident lux between test points is less than the lowest values specified for the closest adjacent test points on a horizontal and vertical line defined by the test point pattern of Table 1A.

TABLE 1A—TYPE 2 WIDE ANGLE REFLEX REFLECTORS PHOTOMETRIC PERFORMANCE REQUIREMENTS
CANDELA PER INCIDENT FOOTCANDLE

Obs. Angle (deg)	Ent. Angle (deg)		Red	Yellow	White
	10U	V	4.50	11.25	18.00
	5U	45L	0.50	1.25	2.00
		45R	0.50	1.25	2.00
		30L	2.00	5.00	8.00
		20L	3.00	7.50	12.00
0.2	H	V	4.50	11.25	18.00
		20R	3.00	7.50	12.00
		30R	2.00	5.00	8.00
	5D	45L	0.50	1.25	2.00
		45R	0.50	1.25	2.00
	10D	V	4.50	11.25	18.00
	10U	V	0.05	0.12	0.20
	5U	45L	0.02	0.05	0.08
		45R	0.02	0.05	0.08
		30L	0.03	0.07	0.12
		20L	0.03	0.07	0.12
1.5	H	V	0.07	0.17	0.28
		20R	0.03	0.07	0.12
		30R	0.03	0.07	0.12
	5D	45L	0.02	0.05	0.08
		45R	0.02	0.05	0.08
	10D	V	0.05	0.12	0.20

NOTE—Unless otherwise specified, the reflector shall be considered to have failed the photometric requirements of this document if the candela per incident footcandle between test points is less than the lowest values specified for the closest adjacent test points on a horizontal and vertical line defined by the test point pattern of Table 1.

5.1.2 MOISTURE

5.1.2.1 Upon completion of the moisture test, the reflex reflector shall not have become separated from its mounting means.

5.1.3 DUST

5.1.3.1 Upon completion of the dust test, the reflex reflector shall not have become separated from its mounting means.

5.1.4 CORROSION

5.1.4.1 Upon completion of the corrosion test, the reflex reflector shall not have become separated from its mounting means.

5.1.5 PHOTOMETRY

5.1.5.1 Type 1, Reflex Reflectors shall meet the photometric performance requirements of Table 2 or Table 2A and the footnotes.

5.1.5.2 Type 2, Wide Angle Reflex Reflectors shall meet the photometric performance requirements of Table 1 or Table 1A and the footnotes.

TABLE 2—TYPE 1 REFLEX REFLECTORS PHOTOMETRIC PERFORMANCE REQUIREMENTS
MILLICANDELA PER INCIDENT LUX

Obs. Angle (deg)	Ent. Angle (deg)		Red	Yellow	White
	10U	V	280	700	1120
		20L	140	350	560
0.2	H	V	420	1050	1680
		20R	140	350	560
	10D	V	280	700	1120
	10U	V	5	12	20
		20L	3	7	12
1.5	H	V	6	15	24
		20R	3	7	12
	10D	V	5	12	20

TABLE 2A—TYPE 1 REFLEX REFLECTORS PHOTOMETRIC PERFORMANCE REQUIREMENTS
CANDELA PER INCIDENT FOOTCANDLE

Obs. Angle (deg)	Ent. Angle (deg)		Red	Yellow	White
	10U	V	3.0	7.5	12.00
		20L	1.5	3.75	6.00
0.2	H	V	4.5	11.25	18.00
		20R	1.5	3.75	6.00
	10D	V	3.0	7.5	12.00
	10U	V	0.05	0.12	0.20
		20L	0.03	0.07	0.12
1.5	H	V	0.07	0.17	0.28
		20R	0.03	0.07	0.12
	10D	V	0.05	0.12	0.20

5.1.6 WARPAGE

5.2 Color—The color of the reflected light shall be red, yellow, or white as specified in SAE J578.

5.3 Material Requirements—Plastic materials used in optical parts shall meet the requirements of SAE J576.

5.4 Design Requirements

5.4.1 The face of a Type 2 Wide Angle Reflex Reflector that is directional and requires a fixed orientation when mounted on the vehicle shall be marked with the word TOP. Mounting instructions, including a diagram, shall be included on the outside of the packaging or attached to the reflector and visible when purchased.

5.4.2 Means shall be provided to keep fixed orientation reflex reflectors from rotating more than 2 degrees unless the reflector meets all photometric requirements at the maximum rotation.

5.5 Installation Requirements

5.5.1 Type 2, Wide Angle Reflex Reflectors that are directional may require mounting on the vehicle in a fixed orientation to be effective and shall be mounted on the vehicle in accordance with the manufacturer's instructions.

5.5.2 Type 1 and Type 2 reflectors shall be mounted not less than 380 mm nor more than 1525 mm above the road surface as measured from the center of the reflector at vehicle curb weight.

5.5.3 Visibility of the reflected light shall not be obstructed by any part of the vehicle throughout the specified photometric test pattern unless the reflector is designed to comply with these obstructions in place.

5.5.4 The reflex reflector shall be mounted on the rigid structure of the vehicle.

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