One kind of headlamp tester unaffected by the detection distance

Zhenzhou Ye [1, a], Jianwen Shao[1, b], Feng Lin [1, c] and Xin Zhang[1, d]

[1]Chemstry and Environment Metrology Department, Zhejiang Province Institute of Metrology, 300 XiaSha Road, China 310018

[a]37022444@qq.com, [b]sloan2459@126.com, [c]linfeng821020@163.com, [d]809541068@qq.com

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Abstract:During the safety testing of in-use vehicle and the factory inspection and adjustment of vehicles in manufacturing factory, the headlamp tester is needed to test the working status of vehicle headlamp. This paper firstly analyze and discuss several problems of headlamp tester during actual use process, in particular to the differences between vehicles parked position and the ideal position, which may lead to the the deviation of test results; secondly make the experimental study, for example, the headlamps tester MQD-6A, the data show that the design can overcome these problems and obtain better measurement result.

Introduction

Vehicle headlamp is mainly used for lighting when the drivers are in poor sight condition such as at night or dark, rain and fog. GB7258《Safe specification for power-driven vehicles operating on roads》made clear requirements on the emission intensity and irradiation direction of far light and close light. GB21861《Safety Technology Inspection Items and Methods of Motor Vehicle》 also clearly required the emission intensity of far light beam one of vehicle safety inspection conditions.

Currently, safety testing for vehicle headlamp in China commonly use fully automatic headlamp tester, and determine whether the emission intensity of far light beam reach the standard based on the detecting results of instruments. In actual testing, the test distance parked by vehicle based on the headlamp tester, by using two sets of photoelectric switch, as shown in Fig. 1.

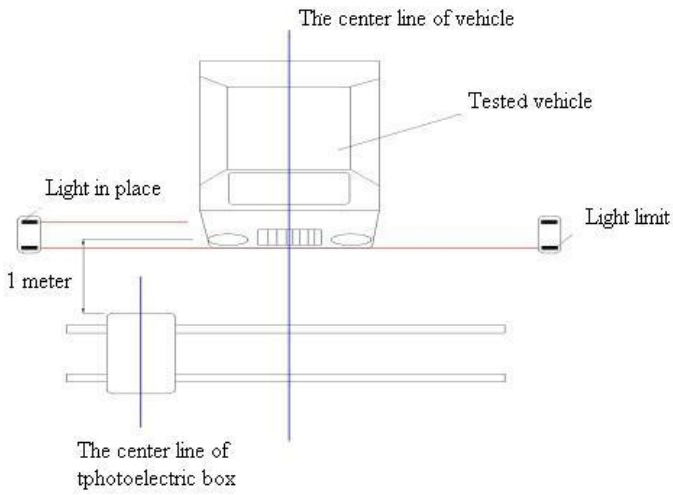

Fig. 1. The schematic diagram of vehicle headlamp in testing station

The method practically limit the most front end of the vehicle. But the relative position of different vehicle models between the headlamp and the most front end is uncertain, and inspectors' improper vehicle driving operation may also cause inaccurate park position, which will all affect the accuracy of result. Therefore, the park distance is common requirement for

headlamp tester.

The measurement working principle of headlamp tester

GB7258 stipulated that all technical parameters of the headlamp shall be measured on the light distribution screen at the distance of 10m on the front of its reference center, while the headlamp tester apply the imaging properties of the optical lens, reducing the demands on the measurement site, as well become more convenient. The light spot on the screen of photoelectric box of the tester is same to the one on the screen of 10m or more, as shown as Fig. 2, Fig. 3.

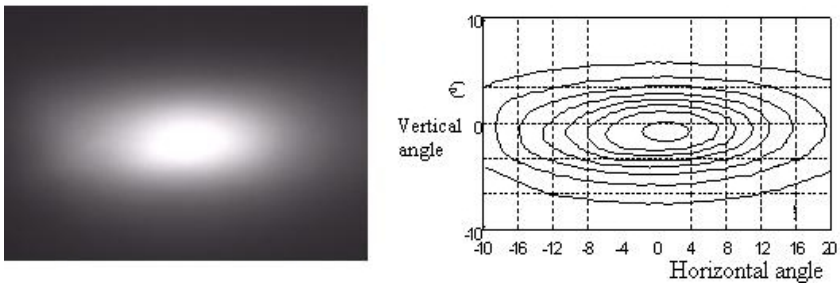

Fig. 2. Lighting distribution characteristics of far light: light spot of far light and light intensity contour

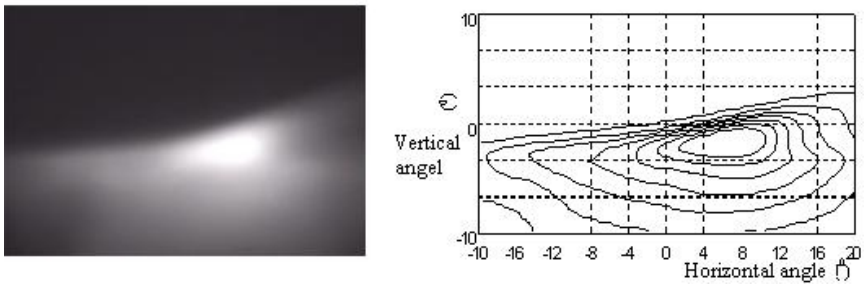

Fig.3. Lighting distribution characteristics of close light: light spot of close light and light intensity contour

According to verification procedures JJG745, when the headlamp far light beam is irradiated on the screen at the distance of 10m, if the illumination on the left of the origin at the distance of 52.4cm on the horizontal axis of screen is same to the one on the right at 52.4cm, and the illumination from the position which is on the above at 17.5cm on the vertical axis is also same to the one under the origin at 17.5cm, then the origin position of the screen coordinates is the center of far light beam, the illumination of where is the headlamp luminous intensity. The far light detection project is the far light beam center position and luminous intensity. The close light detection project is the cutoff line inflection position.

The measurement working principle of double CCD headlamp tester

The automatic headlamp tester MQD-6A is shown in Fig. 4. The measured distance is 1 m. The search light CCD (front CCD) shoot and locate the image of measured lights, and then control optical lens, making the center of lights coincide with the center of lens, so the emitted lights beam through the lens and imaging at the light mask board. The measuring CCD (later CCD) shoot spot image at imaging screen, as shown in Fig. 5 and Fig. 6.

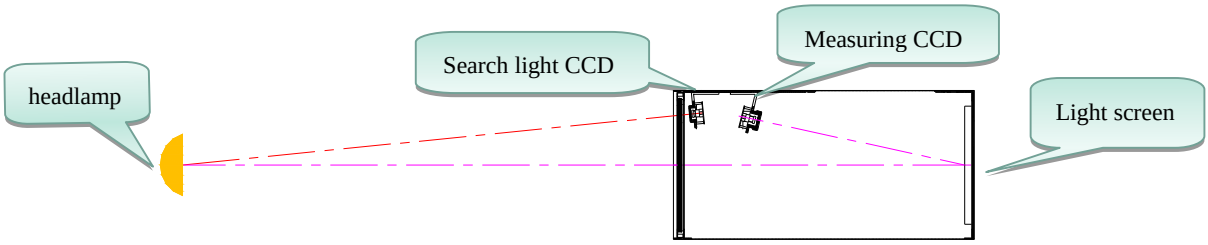

Fig. 4. The working principle of MQD-6A photoelectric box

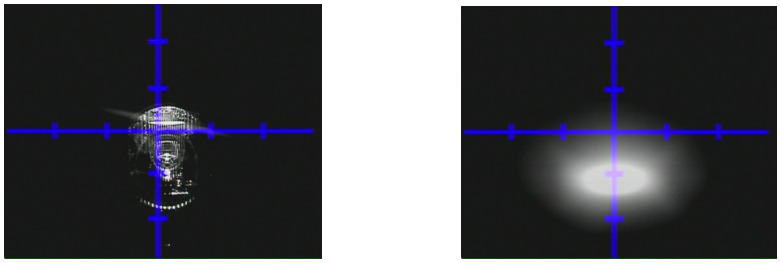

Fig. 5. Far light image shoot by front and later CCD of tester

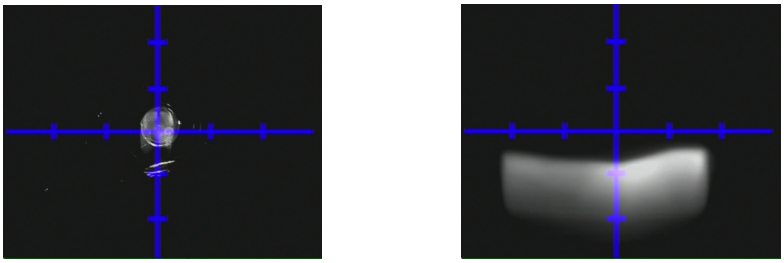

Fig. 6. Close light image shoot by front and later CCD of tester

The essence of lens imaging is that, lights from different directions emitted by a point of headlamp converge together at a certain position through lens, which is called "point imaging". And there are numerous points illuminated by the headlamps, so these points are imaged, and the relative positions of all imaged points are basically unchanged, as shown in Fig.7. Therefore, the light spot image from imaging screen by CCD is same to the one from 10m screen, as the emitted lights can pass through the lens, converge together at the light screen on back of the lens after refraction, and form real image of objects.

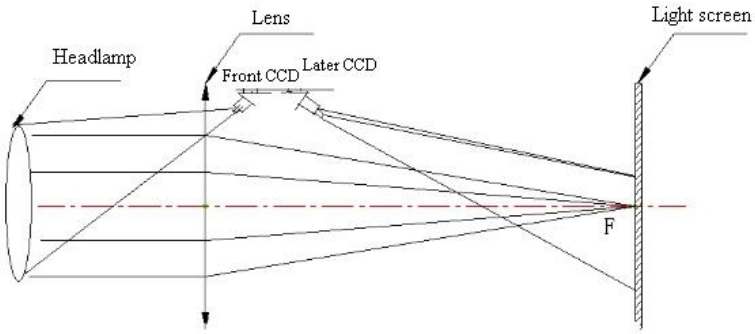

Fig. 7. The path diagram of lens imaging

Experimental data of light tester

In order to study the data repeatability of different measured distance, fix the standard light source

on movable rails. The distance from the tester is between 0.7 to 1.3 meters. According to the provisions of JJG745 《Verification Regulation of Headlamp Tester for Motor Vehicle》, test the headlamp tester by pre-calibrated 1 meter distance, the test data obtained is shown in Table 1.

Analyze the data in Table 1, the maximum permissible error satisfies the requirements from JJG745 that indication error of far light emission intensity is no more than 12 percent, and the indication error of far-axis offset value (angle) is no more than 4.4cm/dam.

Table 1. The consistency of angle and light intensity measured at different distances of Standard light (The light intensity of standard light is 200×100cd; above for + value, below for - value; left for + value, right for - value)

Set the Angle and light intensity \ Detect distance		0.7m	0.8m	0.9m	1m	1.1m	1.2m	1.3m	maximum deviation
1	Below 2° (mm)	-348	-338	-342	-344	-346	-328	-322	28
	Left 2° (mm)	346	362	358	349	362	342	340	12
	Light intensity×100cd	198	199	199	196	191	189	179	10.5%
2	Below 2° (mm)	-346	-344	-347	-352	-348	-328	-322	28
	Right 2° (mm)	-361	-360	-341	-351	-358	-348	-341	11
	Light intensity×100cd	203	198	197	196	191	184	180	10%
3	Above 2° (mm)	348	345	345	343	334	342	343	16
	Left 0° (mm)	-12	-8	-10	-3	-8	-3	-8	12
	Light intensity×100cd	201	204	207	203	204	201	204	3.5%
4	Below 2° (mm)	-353	-352	-347	-351	-359	-342	-338	12
	Left 0° (mm)	-18	-12	-22	-13	-16	-12	-13	22
	Light intensity×100cd	202	201	198	197	191	184	187	8%

In order to simulate the operation of routine testing, replace light source to actual headlamp to test, and use power supply for power to ensure job stability.The data obtained is shown in Table 2 and Table 3.

Table 2. The repeatability test at different measuring distance of Audi headlamp

Detect distance	0.7m	0.8m	0.9m	1m	1.1m	1.2m	1.3m	Maximum deviation
Vertical deviation (mm/dam)	-535	-533	-529	-533	-533	-533	-528	7
Horizontal deviation (mm/dam)	82	77	79	77	76	69	67	15
Light intensity×100cd	252	254	253	254	253	251	244	3%

Table 3. The repeatability test at different measuring distance of Santana light

Detect distance	0.7m	0.8m	0.9m	1m	1.1m	1.2m	1.3m	Maximum deviation
Vertical deviation (mm/dam)	-45	-43	-39	-37	-36	-36	-31	14
Horizontal deviation (mm/dam)	232	224	229	225	224	221	217	15
Light intensity×100cd	379	384	383	384	383	382	372	2.4%

Conclusion

The operating results above have shown that the double CCD headlamp tester has better consistency for headlamp testing within 0.7-1.3 meter range, and can effectively avoid false results caused by different distance from vehicle location to tester. Particularly, rearrange test adjustment stations of headlamp is no longer required, which could save manpower and improve the production efficiency. On the other hand, it effectively prevent the dispute caused by different vehicle park location.

References

[1] GB 7258-2012 Safe specification for power-driven vehicles operating on roads.

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