

Compact type of Illuminance meter Calibration System Using Integrating Sphere



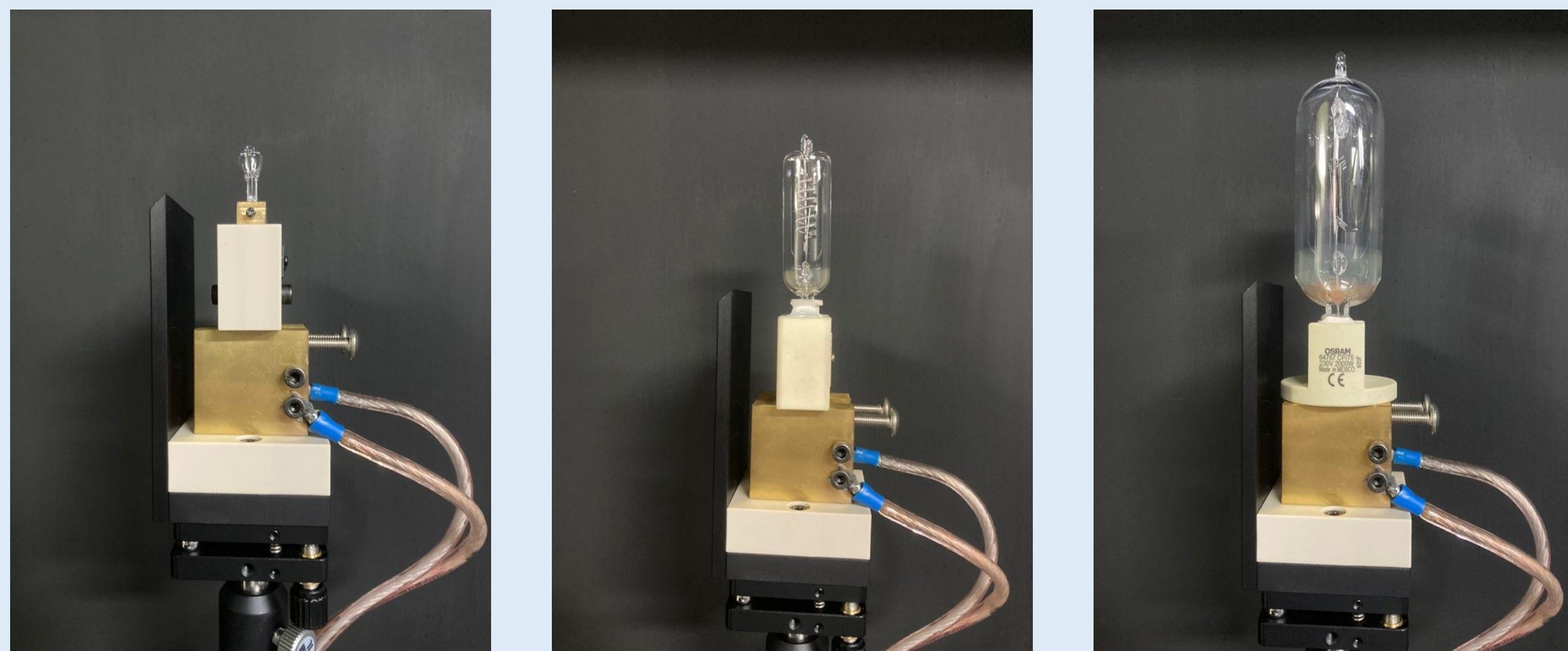
INTRODUCTION

Conventional illuminometer calibration system usually consists of a 1 kW tungsten halogen bulb capable of producing an illuminance of about 5 000 lx at a distance of 500 mm and an optical bench of 6 m or longer, and the distance between the bulb and an illuminance reference sensor is adjusted depending on the illuminance level, which is in the range of 50 lx to 5 000 lx. Calibration of the illuminometer requires a large-scale system using an optical table of 6 m or longer, but the variable illuminance range is limited to 50 lx to 5 000 lx, whereas other illuminance range than 50 lx to 5 000 lx is also required for the calibration.

METHODS & RESULTS

Replace Bulb

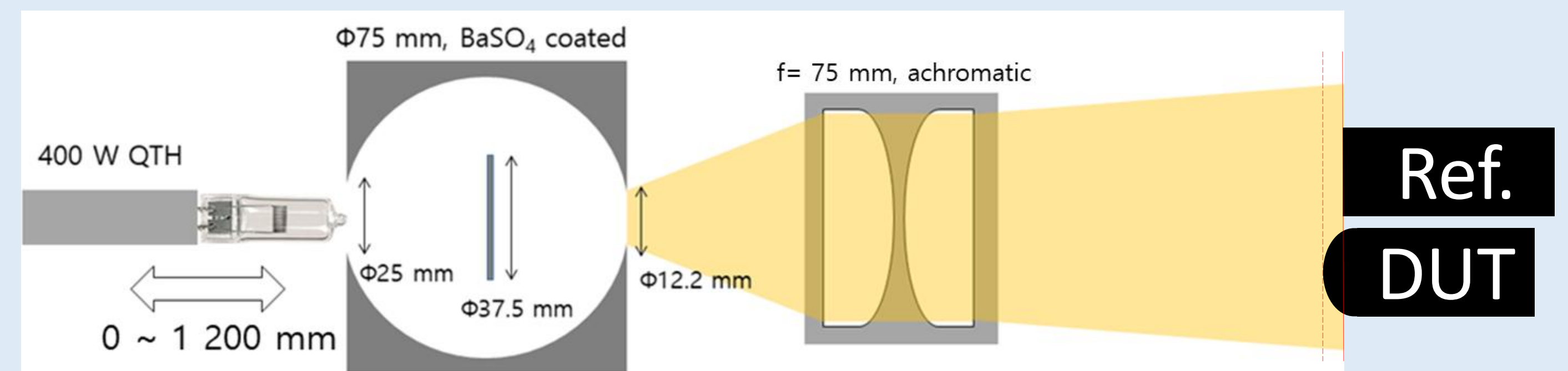
In order to cover the 0.5 lx to 20 000 lx range, it is necessary to replace the 1 kW bulb with other light bulbs of e.g. 10 W or 2 kW rating. Since the previously lit bulb is very hot, the bulb must be cooled down slowly before replacing it with other bulb, then the other bulb must be turned on slowly and it takes at least 15 minutes for stabilization. From the point of view of a dedicated calibration laboratory, it is inevitable to spend a large amount of money to install and maintain such a large system, and it is also inefficient in system operation's respect.



It is necessary to replace the 10 W, 1k W, 2k W three types of bulb.

Integrating Sphere and Reference Plane

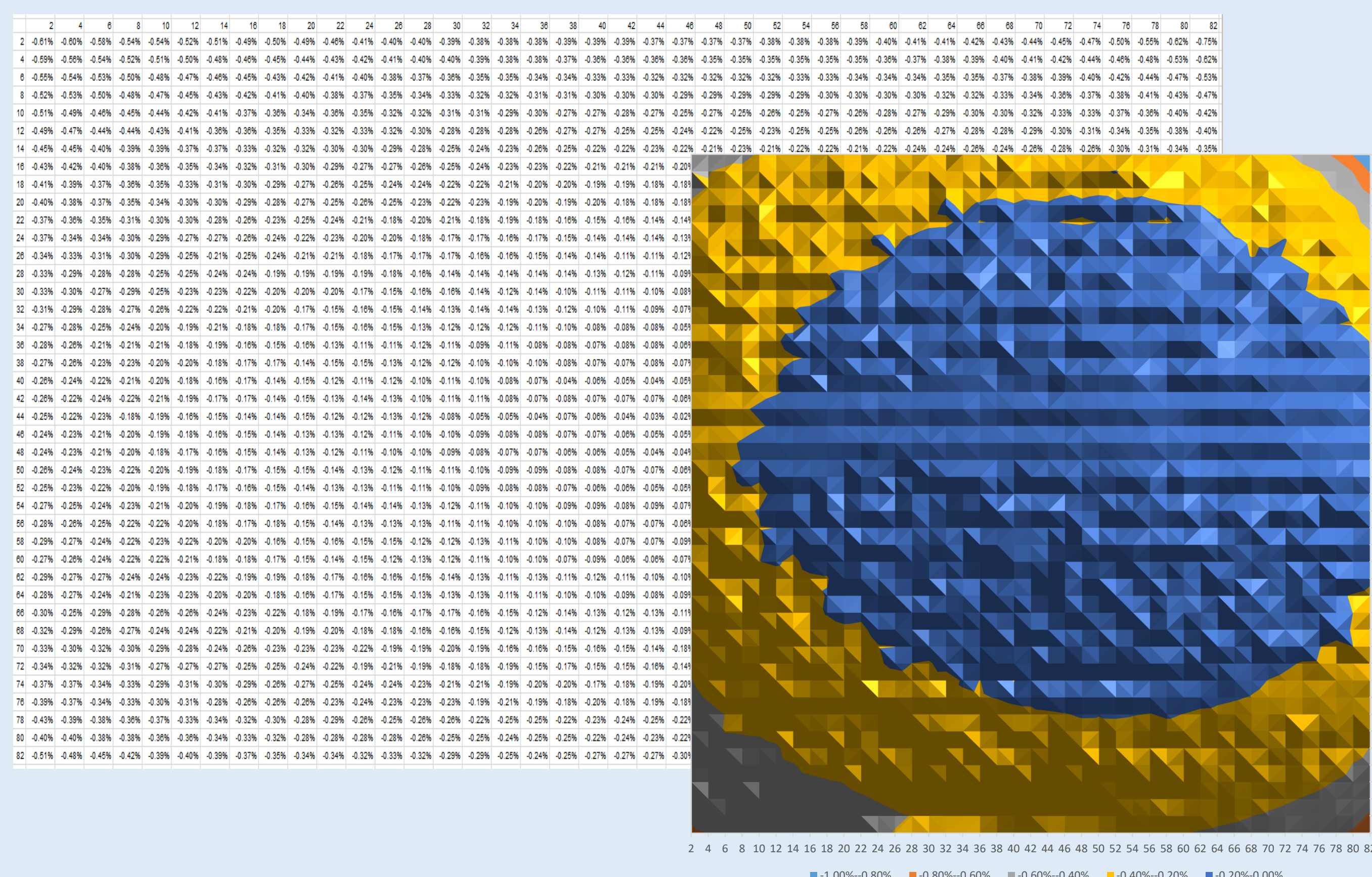
In order to solve above problem, a compact reference light source for illuminometer calibration has been developed using a 400 W bulb and an integrating sphere, and an automatic stage has also been installed to miniaturize the calibration system and to minimize the movement of the person performing the calibration. In order to reduce the uncertainty due to the reference plane mismatch, a measurement plane is placed at a distance of 800 mm from the end of the lens of the integrating sphere.



Test result at a distance of 500 mm, a 1 mm difference between the reference and the target device causes a 0.5% difference in illuminance.

Uniformity and Color Temperature

A light source having a uniformity of $\pm 0.1\%$ at a diameter of 60 mm is used, whose color temperature is maintained within $\pm 30\text{ K}$ in the range of 0.5 lx to 2 000 lx. with the total illuminance range of 0.1 lx to 2 000 lx. The illuminance range is obtained by varying the distance from 800 mm to 2 000 mm including 800 mm of reference plane mismatch distance, using the automatic stage, from the bulb to the integrating sphere, of which position is fixed relative to the measurement plane.



It has a uniformity of 0.2 % ($\pm 0.1\%$) within a diameter of 60 mm and 0.4 % within a diameter of 80 mm or more.

Data Comparison

Ref. sensor	6 m system	IS system	Ratio	Ref. sensor	6 m system	IS system	Ratio	Ref. sensor	6 m system	IS system	Ratio
1500	1339	1346	100.5%	1500	1494	1503	100.6%	1500	1504	1510	100.4%
1000	894.9	897.7	100.3%	1000	997.0	1002	100.5%	1000	1005	1008	100.4%
500.0	449.5	448.4	99.8%	500	501.1	501.0	100.0%	500.0	504.5	503.9	99.9%
300.0	269.0	268.4	99.8%	300	299.8	300.6	100.3%	300.0	303.2	302.4	99.7%
100.0	89.09	88.56	99.4%	100	100.6	99.86	99.3%	100.0	101.5	100.6	99.1%
50.00	44.03	43.61	99.1%	50	50.00	50.14	100.3%	50.00	50.63	50.30	99.3%

Data comparison between the existing 6 m system and the newly developed system

The control program provides updates suitable for all end users.

CONCLUSION

If a conventional light source channel with a 2 kW light bulb that is movable using the automatic stage is installed parallel to the compact light channel in the system, we can produce an illuminance level in the range from 0.1 lx up to 20 000 lx. A reference sensor and a DUT sensor can be aligned for calibration to each light channel in the transverse measurement plane. And with this capability, the system will be upgraded to measure luminance, luminosity and color coordinates in the future.



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