RESULTS OF A BILATERAL COMPARISON OF LUMINOUS INTENSITY STANDARDS BETWEEN INMETRO (BRASIL) AND INTI (ARGENTINA)

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Abstract. *A bilateral comparison between INMETRO (Brazil) and INTI (Argentina) was carried out in order to demonstrate the equivalence of calibration certificates of luminous intensity standards. Five OSRAM luminous intensity lamps were used as transfer standards. The first measurements were carried out at INMETRO and then the lamps were hand-carried to INTI for the final measurement round. It was concluded that maintained units of both national laboratories differ by less than 0.2%.*

Keywords*: photometry, national standards, mutual recognition of calibration certificates*

1. INTRODUCTION

A bilateral comparison between Instituto Nacional de Metrologia, Normalização e Qualidade Industrial – INMETRO (Brazil) and Instituto Nacional de Tecnologia Industrial – INTI (Argentina) was carried out in order to demonstrate the equivalence of calibration certificates of luminous intensity standards. The maintained units of both laboratories were compared during the period August - September 2000, using a set of lamps as transfer standards. This was the first luminous intensity comparison between INMETRO and INTI.

The first measurements were carried out at INMETRO, and then the lamps were hand-carried to INTI for the final measurement round.

2. COMPARISON MEASUREMENTS

2.1 Transfer lamps

INMETRO and INTI supplied one OSRAM Wi40G and one Wi41G (31V,6A) and three Wi41G (31V,6A) lamps, respectively. These five lamps are identified in Table 1.

INMETRO and INTI lamps were operated with a fixed polarity (negative potential connected to the center contact of the original lamp cap). Lamp voltages were measured by 4-pole technique directly to the cap, in order to evaluate the reproducibility of the electrical parameters.

Table 1: Lamps identification

Identification	Type	Origin Lab.
546	Wi40G	INMETRO
562	Wi41G	INMETRO
INTI 1	Wi41G	INTI
INTI 4	Wi41G	INTI
INTI 5	Wi41G	INTI

2.2 Measurements at each laboratory

2.2.1 Measurements at INMETRO

The unit of luminous intensity, candela, at INMETRO is traceable to the *Bureau International des Poids et Mesures* – BIPM, maintained by a set of lamps and regularly transferred to secondary and working standards. The last connection with BIPM was done in 1999 with a relative uncertainty (k=2) of 1 % . In the future, candela is going to be realized by cryogenic radiometry.

Measurements were performed using an LMT photometric bench at a distance of about 3 m. Lamp current was measured with the help of a shunt resistor (0.1 Ω) . The shunt resistor was calibrated at INMETRO Electricity Division. The expanded uncertainty of the electrical magnitudes was 0.02 %. All lamps were operated at a constant dc current and were aligned with the help of a laser beam (along the bench optical axis) and plumb line (for the perpendicular axis), then the rotation of the lamp was adjusted so that the filament was parallel with the plumb line and perpendicular to the axis of the photometric bench.

Luminous intensity values were obtained with the help of a photometer S1000 LMT system, and all the measurements were computer controlled.

Results obtained at INMETRO are presented in Table 2.

The average room temperature during the measurements was (20.2 ± 0.5) ^{o}C while relative humidity values were kept constant at (57.1 ± 1.0) %.

2.2.2 Measurements at INTI

At INTI the candela was realized last time in 1996, using the room temperature absolute radiometer still operating at that time (now replaced by a cryogenic radiometer), in conjunction with a multi-layered V(λ) filter. Experimental setup, measurement conditions, evaluation of uncertainties and results obtained by INTI in comparisons are described (Sauter, 1999) (Cogno, 2000).

Measurements were performed using a photometric bench at a distance of about 1 m. Lamp current was measured with the help of a shunt resistor (0.01 Ω) . The shunt resistor was calibrated at INTI Electricity Division. The expanded uncertainty of the electrical magnitudes was 0.02 % and all lamps were aligned with the help of a telescope.

The average room temperature during the measurements was (24.0 ± 0.5) ^{o}C while relative humidity values were kept constant at (40 ± 5) %.

Results obtained at INTI are showed in Table 2.

3. FINAL RESULTS

The final results of the luminous intensity of luminous intensity measurements (I_V) are summarized in Table 2. First column characterizes each lamp, distribution temperature is in the second column; current, voltage and luminous intensity values at INMETRO are in the third, fourth and fifth columns, respectively; sixth, seventh, and eighth columns correspond to current, voltage and luminous intensity at INTI, respectively. The deviations of the voltage (ΔV) and luminous intensity (ΔI_v), for repeated measurements, carried out at the INMETRO and INTI are given in the last two columns, respectively. The average is given in the before last line and the average excluded INTI 1 is given in the last line of the Table (Lamp INTI 1 was excluded because its stability wasn't good enough). Results of luminous intensity are also presented in Figure 1.

Table 2: Final results comparison between INMETRO and INTI

		INMETRO			INTI			INTI / INMETRO	
Lamp	**Distr. Temp (K)**	**Current (A)**	**Voltage (V)**	**I_v (cd)**	**Current (A)**	**Voltage (V)**	**I_v (cd)**	**ΔV (%)**	**ΔI_v (%)**
546	2856	5.680	30.50	275.9	5.680	30.49	275.8	-0.033	-0.04
562	2856	5.700	30.69	272.1	5.700	30.68	272.8	-0.033	+0.26
INTI 1	ca. 2800	5.763	29.79	214.8	5.763	29.80	216.8	+0.033	+0.70
INTI 4	ca. 2800	5.743	29.47	203.8	5.743	29.47	204.5	0.000	+0.34
INTI 5	ca. 2800	5.754	29.22	206.8	5.754	29.22	206.3	0.000	-0.24
Average								-0.007	**+0.20**
Average (excluding INTI 1)								-0.017	**+0.08**

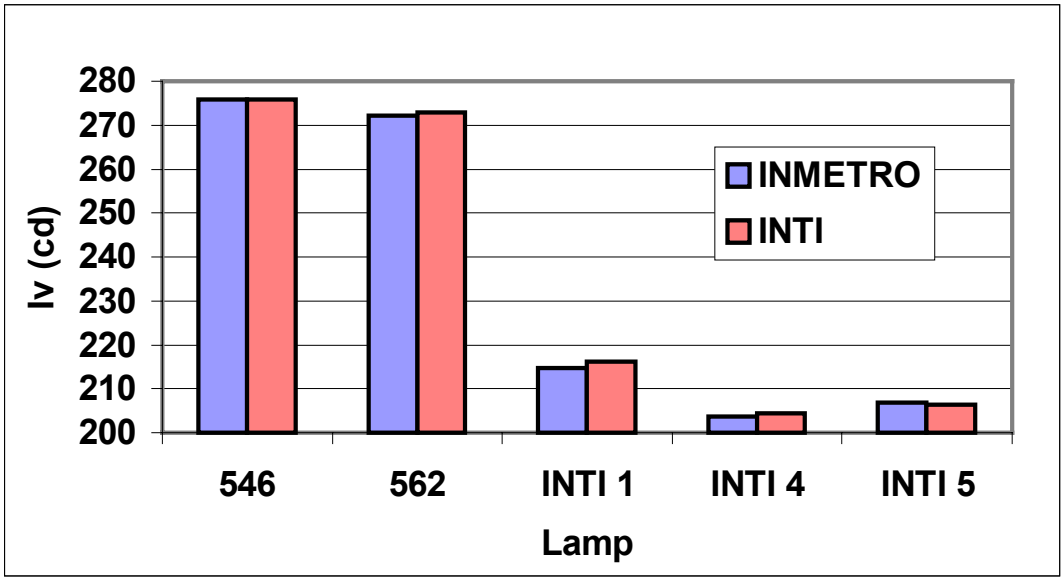

Figure1: Results of luminous intensity comparison between INMETRO and INTI

4. CONCLUSION

A bilateral comparison of luminous intensity units was carried out between INMETRO and INTI. It is concluded that the units maintained and/or realized by both national laboratories differ by less than 0,2%. This result is a sound technical basis for a mutual recognition arrangement of calibration certificates of this magnitude between both countries.

5. REFERENCES

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