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CALIBRATION CERTIFICATE

No: 659/270/46/09

Object of calibration:	**Blackbody simulator**
Type:	Gemini 976
Serial number:	271975-1
Calibration mark:	659/270/46/09
Manufacturer:	ISOTECH LTD.
Customer:	Isothermal Technology Limited, Pine Grove, Southport, England
Order No.:	01/09/SMU/2009 from 30. 09. 2009,
Place and date of calibration:	Laboratory for optical radiometry and pyrometry 05-11. 10. 2009
Number of pages:	4

This calibration certificate confirms the traceability to national standards, which realize the units of measurements in conformity with International System of Units(SI).
The user is obliged to have the object recalibrated at appropriate intervals.

Place and date

Bratislava, 14. 10. 2009

Official stamp

Slovenský metrologický ústav -8- Bratislava

Head of Thermometry, Radiometry and Photometry Centre

Ing. Juraj Ranostaj, Ph.D.

Conditions of calibration:
All measurements were performed after 60 minutes of heating from room temperature or 40 minutes after temperature change +50°C (see tab.A). Temperature stability was better as 0,2°C in full temperature range from 50°C to 550°C (Fig.4).

Environmental conditions
Temperature in laboratory: (22,0 ± 1) °C
Humidity : (45 ± 5) %

Traceability
Blackbody simulator B2 Land, S.N. 12/95/3009 traceable to Natonal Standard of Temperature No. NE 020/B
Standard Platinum Resistance Thermometer Geraberg Pt 10 model 78 S.N. 147/1981 treaceable to National Standard of Temperature No. NE020/A
Infrared Radiation Pyrometer TRT2 S.N. 2694 Heitronics calibrated with Blackbody Simulator Land (see previous item)

Procedure of calibration and results
The local effective emissivity $\varepsilon_a(x=0)$ was derived from the temperature t_m measured with the pyrometer which was calibrated with the standards blackbody B2 (results Tab. 1 and Fig.1).

Tab. 1. Calibration of temperature scale of black-body in form the emissivity

Black-body temperature set on the controller (°C)	t_m (°C) spectral range 8 -14 um	ε_a (x=0), diameter of area is 10 mm
50	49,8	0.9930
100	100,2	1.0027
150	149,9	0.9987
200	199,8	0.9986
250	249,2	0.9953
300	299,2	0.9955
350	349,0	0.9954
400	398,5	0.9941
450	449,8	0.9995
500	499,5	0.9984
550	550,2	1.0006

The mean value of local effective emissivity with the standard error of the mean

$$\varepsilon_a(x = 0) = 0{,}9973 \pm 0{,}0009$$

The material emissivity ε_m of cavity was derived from measured radiances in spectral range 8 um – 14 um near the singular points ($x \approx L_1$, $y \approx 0$) (Fig.1)

$$\varepsilon_m(x \approx L_1, y \approx 0) = 0{,}832 \pm 0{,}012$$

The material emissivity ε_m was used for calculation of local effective emissivities cylindro - conical cavity with apex half-angle $\theta = 60°$ and $L_2 = 160$ mm according to R.E.Bedford and C.K. Ma, JOSA, **65**, 5 (1975) (Fig.2)

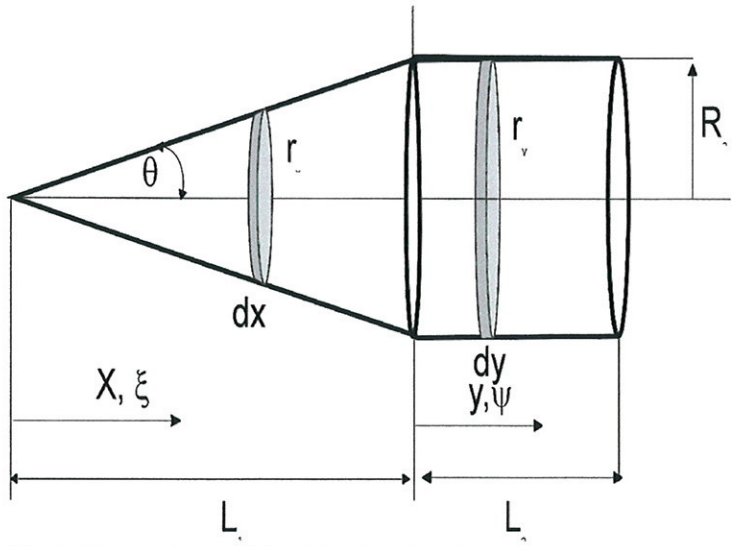

Fig.1 Geometry of blackbody simulator

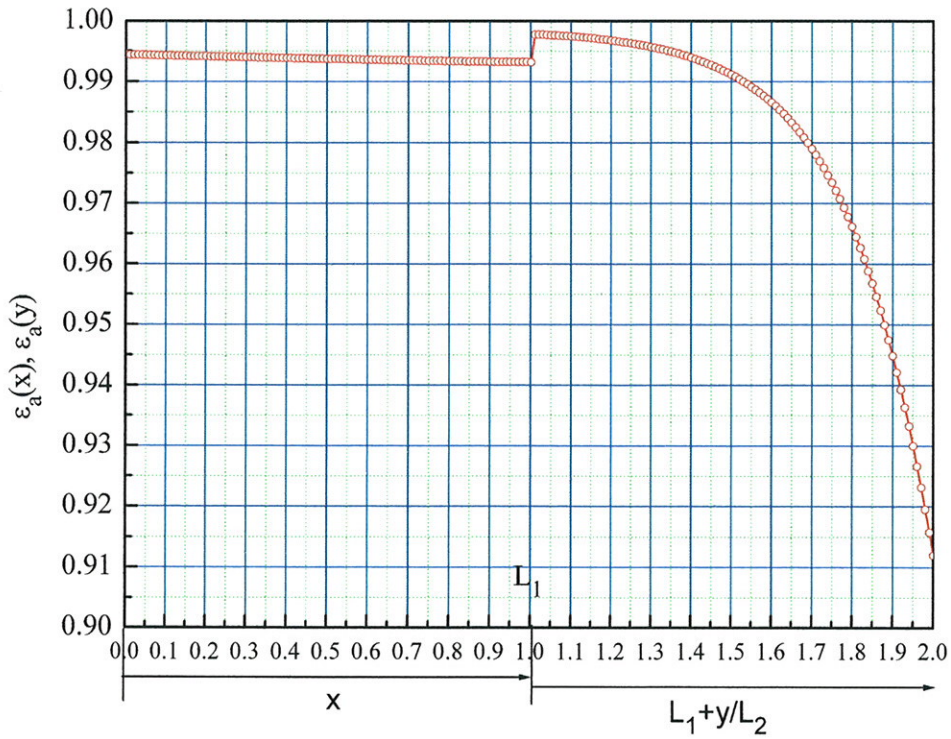

Fig.2 Effective local emissivities of surfaces cylindro-cones with ε=0,832; θ=60°; R_2=32,5 mm, L_2=160 mm.

Temperature along inner walls was measured with pyrometer having target diameter 10 mm at temperature 550°C. Results of these measurements in form of temperatures differences (reference temperature has been taken in the apex of conical part) are in Fig.3.

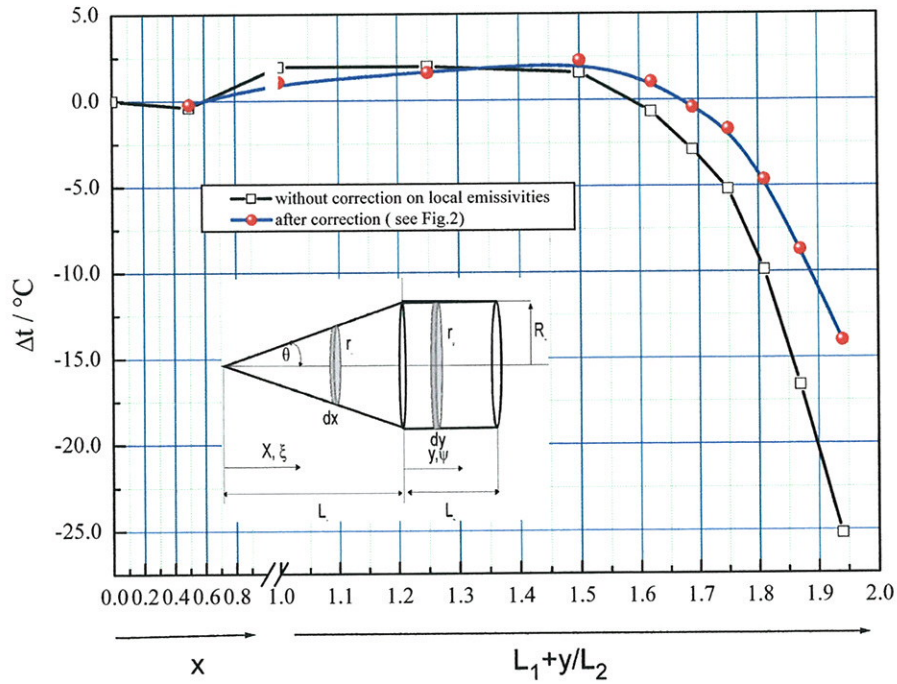

Fig.3 Temperature differences along the inner walls of cavity.

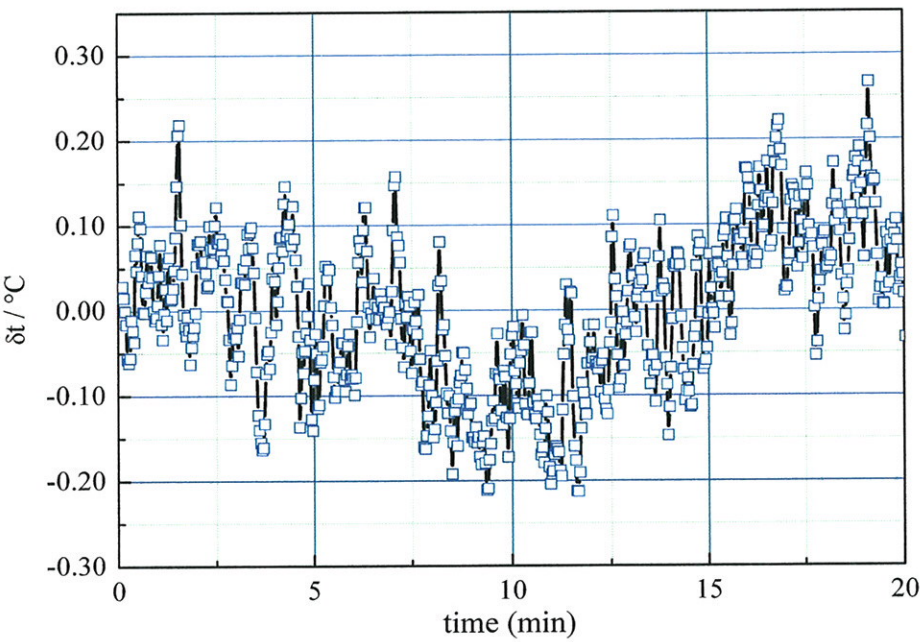

Fig. 4. Time variation of temperature at 150°C detected by a pyrometer looking into the conical part of cavity.

Person in charge: RNDr. P. Nemeček, Ph.D.

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