

# Calibration Report: Absolute Cavity Radiometers S.N. 31041 and 31105

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## SUMMARY

Calibration date: 2002 September 27.

Next calibration due: 2003 September 27.

Calibrations of two Absolute Cavity Radiometers have been completed. The World Radiation References (WRRs) and associated uncertainties with respect to SI units (U95%) are as follows:

Absolute Cavity Radiometer	Controller	WRR	U95%
31041	34970A	0.99785	0.34
31105	34970A	1.00357	0.35

Application:

$$I = \text{WRR} * (I_o) \pm \text{U95\%}$$

Where:

I = WRR corrected irradiance, Watt/meter<sup>2</sup>.

I<sub>o</sub> = Irradiance output of the cavity-controller system, Watt/meter<sup>2</sup>.

U95% = the 95 % confidence interval.

Calibration certificates from the National Renewable Energy Laboratory located in Golden Colorado are included in this document.

## DISCUSSION

Calibration data from Absolute Cavity Radiometers were collected at NREL in September 2002. The serial numbers of these sensors are 31041 and 31105. The calibration standards used were those kept at NREL. These calibration data were analyzed to produce a new World Radiation Reference (WRR) factor and 95-percent uncertainty bound (U95), WRT SI units, for each radiometer. These coefficients are compared to prior calibration results. The instrument setup, data collection, data analysis and uncertainty calculation are as reported in the NPC2001 reference.

## CALIBRATION HISTORIES

	Test Cavity Serial Number	Controller	WRR	U95% WRT SI
NPC2002	31041	34970A	0.99785	0.34
NPC2001	31041	34970A	0.99793	0.33
NPC2001	31041	406	0.99830	0.35
IPC-IX (2000)	31041	406	0.99799	0.55
NPC1999	31041	406	0.99827	0.39
NPC1998	31041	406	0.99833	0.37
NPC1997	31041	406	0.99961	0.42
NPC2002	31105	34970A	1.00357	0.35
NPC2001	31105	34970A	1.00327	0.34

Calibrations labeled NPCyear took place at the National Renewable Energy Laboratory in Golden, Colorado. Calibrations labeled IPC took place at the World Radiation Center in Davos, Switzerland.



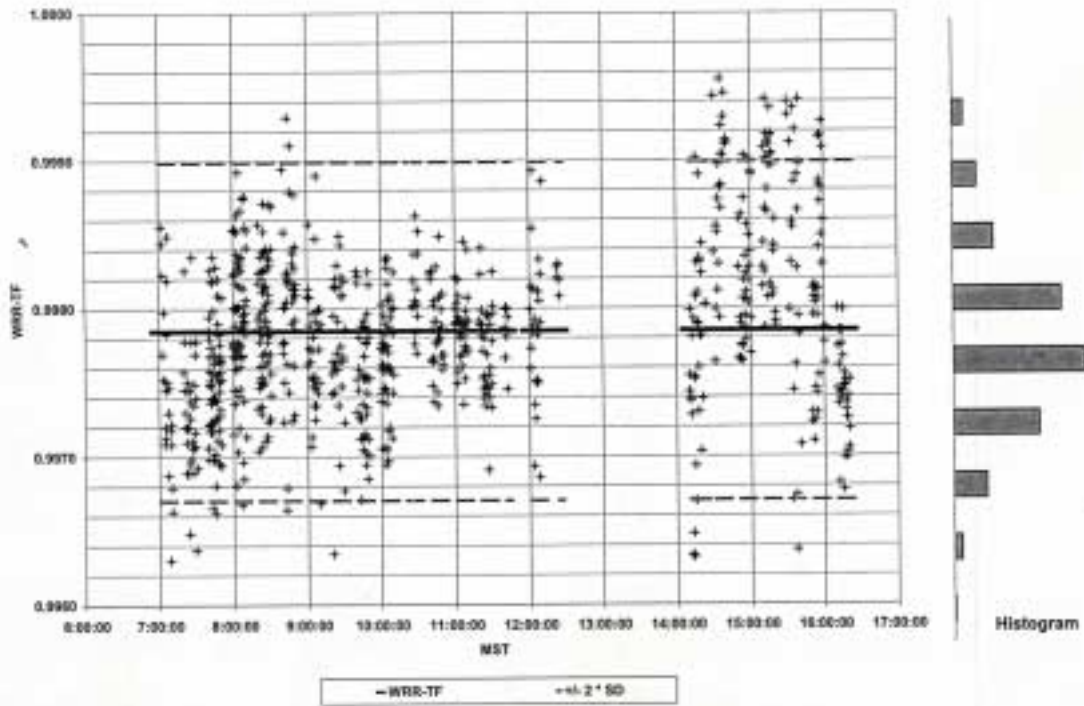
## History for 31041 Calibration

Calibration Event	Manufacturer Calibration Factor (MCF)	WRR-TF	Resultant Calibration Factor (RCF)*
NPC-1997	Not Provided	0.99961	-
NPC-1998	Not Provided	0.99833	-
NPC-1999	Not Provided	0.99827	-
NPC-2001	1.99992	0.99793	1.99578
NPC-2002	1.99992	0.99785	1.99562

\* RCF = MCF \* WRR-TF

Reda, 10/2/2002

WRR-Transfer Factor vs Mountain Standard Time for AHF31041 on September 23-27, 2002



**CALIBRATION CERTIFICATE for CAVITY 31105**

**National Renewable Energy Laboratory  
Solar Radiation Research Laboratory  
Metrology Laboratory**

**Calibration Certificate for Absolute Cavity Radiometer  
NREL Pyrheliometer Comparisons, NPC-2002**

<b>Organization:</b> NASA/LARC-AS&M	<b>Operator Name:</b> Fred Denn
<b>Model Number:</b> AHF	<b>Serial Number:</b> 31105
<b>Control Unit Serial Number:</b> US37030621	<b>Manufacturer Cal. Factor:</b> 1.9989
<b>Heater Resistance:</b> 155.4 $\Omega$	<b>Default Sensitivity:</b> 0.0105 $\mu\text{v}/\text{W}/\text{cm}^2$
<b>Lead Resistance:</b> 0.066 $\Omega$	<b>Circuit Resistance:</b> 2.55 $\Omega$
<b>Thermistor Coefficients:</b> 0.0010295, 0.0002391, and 0.0000001568	
<b>Calibration Date:</b> 09/27/2002	<b>Due Date:</b> 09/27/2003
<b>Environmental Conditions:</b> (see attached Figures)	
<b>Procedure:</b> NREL/TP-463-20619	

**Standards Used:**

Serial Number	Operator	WRR*	Calibration Date	Due Date
AHF28968	Reda	0.99866	October, 2000 *	October, 2005
AHF29220	Reda	0.99846	October, 2000 *	October, 2005
AHF30713	Reda	0.99861	October, 2000 *	October, 2005
TMI68018	Reda	0.99848	October, 2000 *	October, 2005

\* Ninth International Pyrheliometer Comparisons (IPC-IX), PMOD, Davos, Switzerland

**Results with traceability to the World Radiometric Reference (WRR):**

- **WRR Transfer Factor (WRR-TF)** : 1.00357
- **Uncertainty,  $U_{95}$**  : 0.35 %
- **Coverage Factor** : 2

**Data Analysis by** : Ibrahim Reda  
**Signature** : *I. Reda*  
**Date** : 10/02/2002

**QA by** : Tom Stoffel  
**Signature** : *Tom Stoffel*  
**Date** : 10/02/2002

*This calibration certificate applies only to the item identified above and shall not be reproduced other than in full, without specific written approval by the calibration facility. Calibration certificates without signatures are not valid.*

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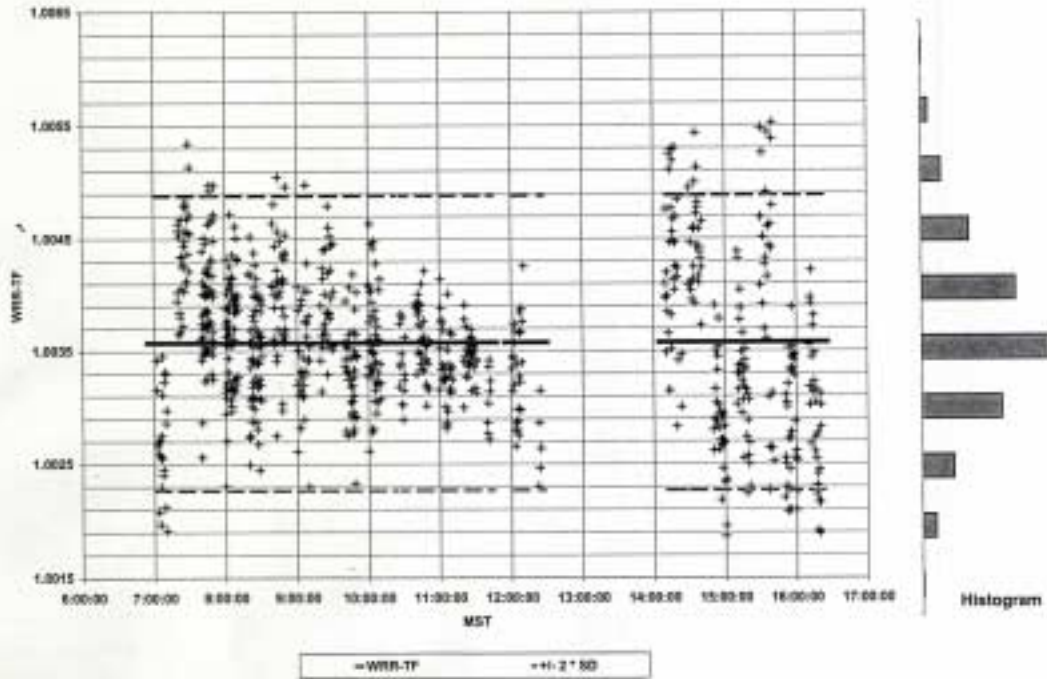
## History for 31105 Calibration

Calibration Event	Manufacturer Calibration Factor (MCF)	WRR-TF	Resultant Calibration Factor (RCF)*
NPC-1997	Not Provided	0.99776	-
NPC-1999	Not Provided	1.00021	-
NPC-2001	1.9989	1.00327	2.00544
NPC-2002	1.9989	1.00357	2.00804

\* RCF = MCF \* WRR-TF

Reda, 10/2/2002

WRR-Transfer Factor vs Mountain Standard Time for AHF31105 on September 23-27, 2002



## REFERENCES

- Reda, I., Stoffel, T., "Results of NREL Pyrheliometer Comparisons NPC2001", National Renewable Energy Laboratory, Center for Renewable Energy Resources, Measurements & Instrumentation Team, 2001.
- Swiss Meteorological Institute, (May 2001). "International Pyrheliometer Comparison IPC-IX." Working Report No. 197, Davos and Zurich.
- Reda, I., Stoffel, Wilcox, S., "Results of NREL Pyrheliometer Comparisons NPC1999", National Renewable Energy Laboratory, Center for Renewable Energy Resources, Measurements & Instrumentation Team, 21 September 1999.
- Reda, I., Stoffel, T., Treadwell, J., "Results of NREL Pyrheliometer Comparisons NPC1998", National Renewable Energy Laboratory, Center for Renewable Energy Resources, Measurements & Instrumentation Team, 11 November 1998.
- Reda, I., Stoffel, T., Treadwell, J., "Results of NREL Pyrheliometer Comparisons NPC1997", National Renewable Energy Laboratory, Center for Renewable Energy Resources, Measurements & Instrumentation Team, 11 November 1997.



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