GRIMM AEROSOL TECHNIK
Dorfstraße 9
D-83404 Ainring
+49 (0)8654-578-0
info@grimm.durag.com

SPECTROMETER DEPARTMENT
Vordere Aue 4
D-06774 Muldestausee
+49 (0)3493-51407-73
service@grimm.durag.com

Calibration Certificate

Model	180	Serial Number	18A19091	Firmware Version	7.80
Spectrometer	187	Serial Number	8HG19091	Revision	S
Channels	PM-10; PM-2.5				

Calibration Method:

The reference unit is calibrated with NIST certified PSL particles and the calibration is verified every year. This is a worldwide accepted standard method referring to PTB Braunschweig and we therefore guarantee the traceability of our calibration. The absolute size calibration of the reference unit is transferred to the candidate unit with a calibration procedure using polydisperse dolomite particles.

Instruments used for Calibration:

- Reference instrument class 3	Model	107GF
- Oscilloscope Hameg HM507	Serial Number	60210471
- Flow meter Defender 520-M	Serial Number	151168
- Calibration tower model		7851

Calibration Material:

- Reference unit: NIST certified monidisperse PSL particles with different diameters
- Candidate unit: Micro Dolomit DR90 polydisperse powder (0,10µm - 180µm)

Tolerance Ranges:

- Sample Flowe Rate:	1,2 l/min ± 5%
- Count Correlation:	± 3% at 1µm
- Count Calibration:	± 3% ≥ 500P/l
- Relative Mass Deviation:	± 3% **or** ± 2 µg/m³

Mass values of spectrometers at calibration tower:

Mean Value	Reference 7H100021	Test Unit	Deviation
PM-10	286,2 µg/m³	284,0 µg/m³	-2,2 µg/m³ = -0,8%
PM-2.5	132,4 µg/m³	132,8 µg/m³	0,4 µg/m³ = 0,3%
PM-1.0	46,1 µg/m³	45,8 µg/m³	-0,3 µg/m³ = -0,7%
Sample Volume: 0,0180 m³ / **Sample Time:** 15 min.			

Mass values of complete systems at ambient air:

Mean Value	Reference 87G09058	Test Unit	Deviation
PM-10	20,1 µg/m³	19,5 µg/m³	-0,6 µg/m³ = -3,0%
PM-2.5	18,5 µg/m³	17,9 µg/m³	-0,6 µg/m³ = -3,2%
PM-1.0	17,2 µg/m³	16,7 µg/m³	-0,5 µg/m³ = -2,9%
Sample Volume: 3,0232 m³ / **Sample Time:** 2519 min.			

We hereby confirm that this instrument has been successfully calibrated and passed the mass test. All work has been done by qualified and trained staff of GRIMM Aerosol Technik.

This calibration is valid until 31 December 2020

Date: 21.11.2019

Signature:

Aerosol Technik Pouch GmbH
OT Friedersdorf
Vordere Aue 4
06774 Muldestausee
Tel.: 03493 51407-0 Fax: 03493 51407-50

Note:
Customer Name: Organismo de Evaluación y Fiscalización Ambiental - OEFA

GRIMM AEROSOL TECHNIK
Dorfstraße 9
D-83404 Ainring
+49 (0)8654-578-0
info@grimm.durag.com

SPECTROMETER DEPARTMENT
Vordere Aue 4
D-06774 Muldestausee
+49 (0)3493-51407-73
service@grimm.durag.com

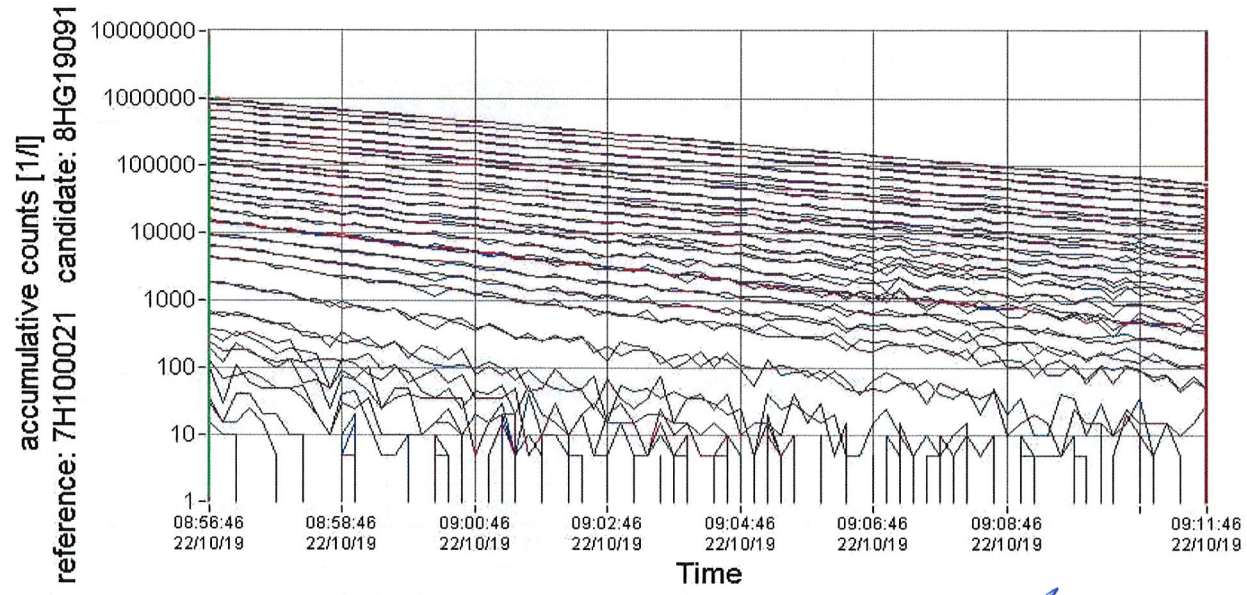
Calibration Certificate

Count values of spectrometers at calibration tower:

Channels		0	1	2	3	4	5	6	7
Diameter [µm]		> 0,25	> 0,28	> 0,30	> 0,35	> 0,40	> 0,45	> 0,50	> 0,58
Concentration [p/l]	Reference	327398	270339	212943	157422	113581	87100	72712	51834
	Test unit	324051	272565	216786	161274	116908	89508	73548	51895
Deviation [%]		-1,0	0,8	1,8	2,4	2,9	2,8	1,1	0,1
Channels		8	9	A	B	C	D	E	F
Diameter [µm]		> 0,65	> 0,70	> 0,80	> 1,00	> 1,30	> 1,60	> 2,00	> 2,50
Concentration [p/l]	Reference	38091	31153	22526	16286	11272	8815	5799	3833
	Test unit	38205	31588	22722	16324	11421	8883	5818	3848
Deviation [%]		0,3	1,4	0,9	0,2	1,3	0,8	0,3	0,4
Channels		G	H	I	J	K	L	M	N
Diameter [µm]		> 2,50	> 3,00	> 3,50	> 4,00	> 5,00	> 6,50	> 7,50	> 8,50
Concentration [p/l]	Reference	3792	2329	1489	955	346	107	53	27
	Test unit	3835	2331	1482	957	346	106	45	25
Deviation [%]		1,1	0,1	-0,5	0,2	0,0	-0,9	-15,1	-7,4
Channels		O	P	Q	R	S	T	U	V
Diameter [µm]		> 10,00	> 12,50	> 15,00	> 17,50	> 20,00	> 25,00	> 30,00	> 32,00
Concentration [p/l]	Reference	11	3	0	0	0	0	0	0
	Test unit	9	2	1	0	0	0	0	0
Deviation [%]		-18,2	-33,3	0,0	0,0	0,0	0,0	0,0	0,0

Sample Volume: 0,0180 m³ / **Sample Time:** 15 min.

Count validation graph of spectrometers at calibration tower:



Date: 21.11.2019

Signature:

Grimm Aerosol Technik Pouch GmbH
OT Friedersdorf
Vordere Aue 4
06774 Muldestausee
Tel.: 03493 51407-0 Fax: 03493 51407-73

Note:
Customer Name: Organismo de Evaluación y Fiscalización Ambiental - OEFA

GRIMM AEROSOL TECHNIK
Dorfstraße 9
D-83404 Ainring
+49 (0)8654-578-0
info@grimm.durag.com

SPECTROMETER DEPARTMENT
Vordere Aue 4
D-06774 Muldestausee
+49 (0)3493-51407-73
service@grimm.durag.com

Calibration Certificate

Model	180	Serial Number	18A19093	Firmware Version	7.80
Spectrometer	187	Serial Number	8HG19093	Revision	S
Channels	PM-10; PM-2.5				

Calibration Method:

The reference unit is calibrated with NIST certified PSL particles and the calibration is verified every year. This is a worldwide accepted standard method referring to PTB Braunschweig and we therefore guarantee the traceability of our calibration. The absolute size calibration of the reference unit is transferred to the candidate unit with a calibration procedure using polydisperse dolomite particles.

Instruments used for Calibration:

- Reference instrument class 3	Model	107GF
- Oscilloscope Hameg HM507	Serial Number	60210471
- Flow meter Defender 520-M	Serial Number	151168
- Calibration tower model		7851

Calibration Material:

- Reference unit: NIST certified monidisperse PSL particles with different diameters
- Candidate unit: Micro Dolomit DR90 polydisperse powder (0,10µm - 180µm)

Tolerance Ranges:

- Sample Flowe Rate:	1,2 l/min ± 5%
- Count Correlation:	± 3% at 1µm
- Count Calibration:	± 3% ≥ 500P/l
- Relative Mass Deviation:	± 3% **or** ± 2 µg/m³

Mass values of spectrometers at calibration tower:

Mean Value	Reference 7H100021	Test Unit	Deviation
PM-10	260,9 µg/m³	266,1 µg/m³	5,2 µg/m³ = 2,0%
PM-2.5	120,2 µg/m³	121,4 µg/m³	1,2 µg/m³ = 1,0%
PM-1.0	44,0 µg/m³	43,7 µg/m³	-0,3 µg/m³ = -0,7%
Sample Volume: 0,0181 m³ / **Sample Time:** 15 min.			

Mass values of complete systems at ambient air:

Mean Value	Reference 87G09058	Test Unit	Deviation
PM-10	20,1 µg/m³	20,6 µg/m³	0,5 µg/m³ = 2,5%
PM-2.5	18,5 µg/m³	19,0 µg/m³	0,5 µg/m³ = 2,7%
PM-1.0	17,2 µg/m³	17,7 µg/m³	0,5 µg/m³ = 2,9%
Sample Volume: 3,0232 m³ / **Sample Time:** 2519 min.			

We hereby confirm that this instrument has been successfully calibrated and passed the mass test. All work has been done by qualified and trained staff of GRIMM Aerosol Technik.

This calibration is valid until 31 December 2020

Date: 21.11.2019

Signature:

Grimm Aerosol Technik Pouch GmbH
OT Friedensdorf
Vordere Aue 4
06774 Muldestausee
Tel.: 03493 51407-0 Fax: 03493 51407-3

Note:
Customer Name: Organismo de Evaluación y Fiscalización Ambiental - OEFA

GRIMM AEROSOL TECHNIK
Dorfstraße 9
D-83404 Ainring
+49 (0)8654-578-0
info@grimm.durag.com

SPECTROMETER DEPARTMENT
Vordere Aue 4
D-06774 Muldestausee
+49 (0)3493-51407-73
service@grimm.durag.com

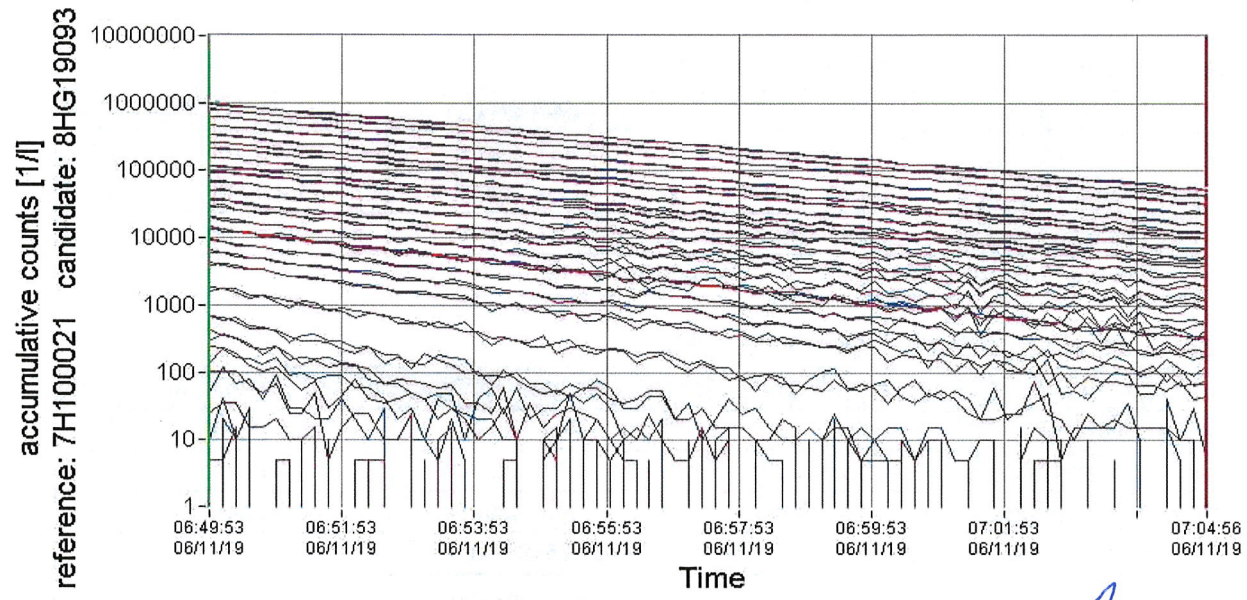
Calibration Certificate

Count values of spectrometers at calibration tower:

Channels		0	1	2	3	4	5	6	7
Diameter [µm]		> 0,25	> 0,28	> 0,30	> 0,35	> 0,40	> 0,45	> 0,50	> 0,58
Concentration [p/l]	Reference	322896	263136	204439	149365	106549	81104	67281	47446
	Test unit	319428	262425	204140	148747	106440	81292	66777	47869
Deviation [%]		-1,1	-0,3	-0,1	-0,4	-0,1	0,2	-0,7	0,9
Channels		8	9	A	B	C	D	E	F
Diameter [µm]		> 0,65	> 0,70	> 0,80	> 1,00	> 1,30	> 1,60	> 2,00	> 2,50
Concentration [p/l]	Reference	34606	28147	20218	14528	10050	7791	5156	3433
	Test unit	34926	28561	20464	14756	10236	7937	5214	3520
Deviation [%]		0,9	1,5	1,2	1,6	1,9	1,9	1,1	2,5
Channels		G	H	I	J	K	L	M	N
Diameter [µm]		> 2,50	> 3,00	> 3,50	> 4,00	> 5,00	> 6,50	> 7,50	> 8,50
Concentration [p/l]	Reference	3465	2155	1381	890	326	98	48	24
	Test unit	3448	2175	1420	913	337	104	48	27
Deviation [%]		-0,5	0,9	2,8	2,6	3,4	6,1	0,0	12,5
Channels		O	P	Q	R	S	T	U	V
Diameter [µm]		> 10,00	> 12,50	> 15,00	> 17,50	> 20,00	> 25,00	> 30,00	> 32,00
Concentration [p/l]	Reference	10	3	1	0	0	0	0	0
	Test unit	10	2	1	0	0	0	0	0
Deviation [%]		0,0	-33,3	0,0	0,0	0,0	0,0	0,0	0,0

Sample Volume: 0,0181 m³ / **Sample Time:** 15 min.

Count validation graph of spectrometers at calibration tower:



Date: 21.11.2019

Signature:

Grimm Aerosol Technik Ronch GmbH
OT Friedersdorf
Vordere Aue 4
06774 Muldestausee
Tel.: 03493 51407-0 Fax: 03493 51407-50

Note:
Customer Name: Organismo de Evaluación y Fiscalización Ambiental - OEFA

GRIMM AEROSOL TECHNIK
Dorfstraße 9
D-83404 Ainring
+49 (0)8654-578-0
info@grimm.durag.com

SPECTROMETER DEPARTMENT
Vordere Aue 4
D-06774 Muldestausee
+49 (0)3493-51407-73
service@grimm.durag.com

Calibration Certificate

Model	180	Serial Number	18A19094	Firmware Version	7.80
Spectrometer	187	Serial Number	8HG19094	Revision	S
Channels	PM-10; PM-2.5				

Calibration Method:

The reference unit is calibrated with NIST certified PSL particles and the calibration is verified every year. This is a worldwide accepted standard method referring to PTB Braunschweig and we therefore guarantee the traceability of our calibration. The absolute size calibration of the reference unit is transferred to the candidate unit with a calibration procedure using polydisperse dolomite particles.

Instruments used for Calibration:

- Reference instrument class 3	Model	107GF
- Oscilloscope Hameg HM507	Serial Number	60210471
- Flow meter Defender 520-M	Serial Number	151168
- Calibration tower model		7851

Calibration Material:

- Reference unit: NIST certified monidisperse PSL particles with different diameters
- Candidate unit: Micro Dolomit DR90 polydisperse powder (0,10µm - 180µm)

Tolerance Ranges:

- Sample Flowe Rate:	1,2 l/min ± 5%
- Count Correlation:	± 3% at 1µm
- Count Calibration:	± 3% ≥ 500P/l
- Relative Mass Deviation:	± 3% **or** ± 2 µg/m³

Mass values of spectrometers at calibration tower:

Mean Value	Reference 7H100021	Test Unit	Deviation
PM-10	258,6 µg/m³	257,9 µg/m³	-0,7 µg/m³ = -0,3%
PM-2.5	118,9 µg/m³	119,1 µg/m³	0,2 µg/m³ = 0,2%
PM-1.0	42,7 µg/m³	43,2 µg/m³	0,5 µg/m³ = 1,2%
Sample Volume: 0,0180 m³ / **Sample Time:** 15 min.			

Mass values of complete systems at ambient air:

Mean Value	Reference 87G09058	Test Unit	Deviation
PM-10	20,1 µg/m³	20,8 µg/m³	0,7 µg/m³ = 3,5%
PM-2.5	18,5 µg/m³	19,4 µg/m³	0,9 µg/m³ = 4,9%
PM-1.0	17,2 µg/m³	18,2 µg/m³	1,0 µg/m³ = 5,8%
Sample Volume: 3,0232 m³ / **Sample Time:** 2519 min.			

We hereby confirm that this instrument has been successfully calibrated and passed the mass test. All work has been done by qualified and trained staff of GRIMM Aerosol Technik.

This calibration is valid until 31 December 2020

Date: 21.11.2019

Signature:

Grimm Aerosol Technik Pouch GmbH
OT Friedersdorf
Vordere Aue 4
06774 Muldestausee
Tel.: 03493 51407-0 Fax: 03493 51407-50

Note:
Customer Name: Organismo de Evaluación y Fiscalización Ambiental - OEFA

GRIMM AEROSOL TECHNIK
Dorfstraße 9
D-83404 Ainring
+49 (0)8654-578-0
info@grimm.durag.com

SPECTROMETER DEPARTMENT
Vordere Aue 4
D-06774 Muldestausee
+49 (0)3493-51407-73
service@grimm.durag.com

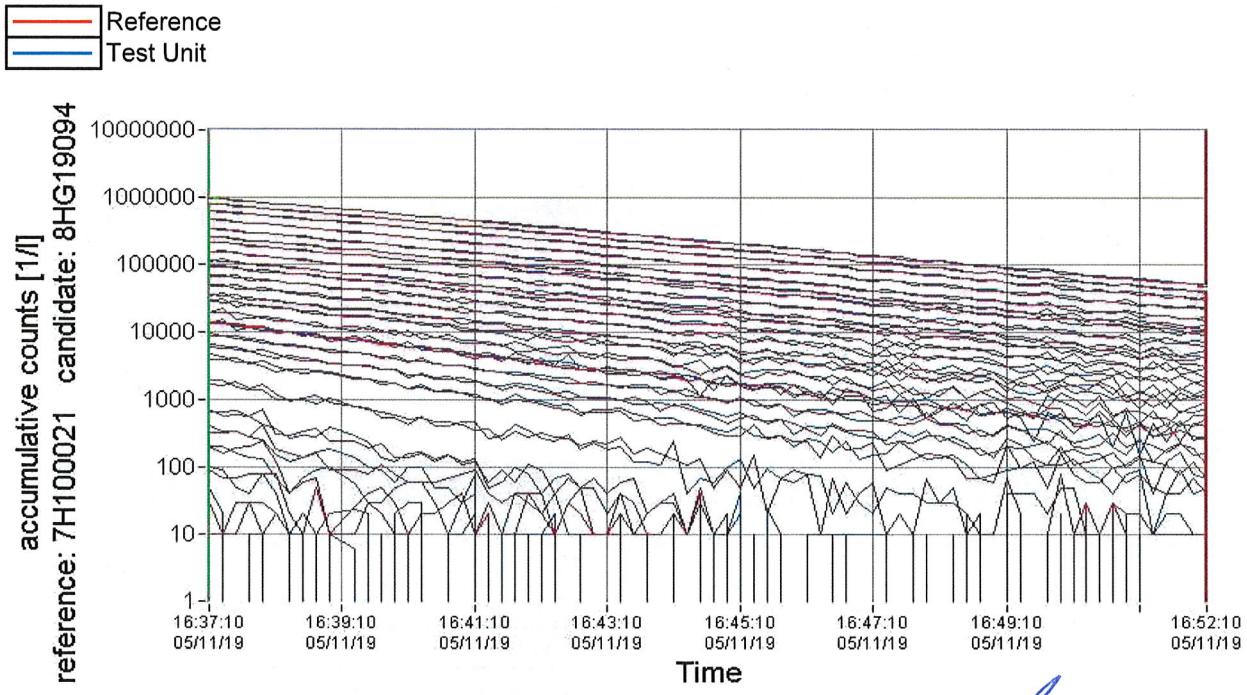
Calibration Certificate

Count values of spectrometers at calibration tower:

Channels		0	1	2	3	4	5	6	7
Diameter [µm]		> 0,25	> 0,28	> 0,30	> 0,35	> 0,40	> 0,45	> 0,50	> 0,58
Concentration [p/l]	Reference	312973	255482	198631	144877	103412	78907	65441	46466
	Test unit	314174	255403	199974	146226	104608	79693	66422	47164
Deviation [%]		0,4	0,0	0,7	0,9	1,2	1,0	1,5	1,5
Channels		8	9	A	B	C	D	E	F
Diameter [µm]		> 0,65	> 0,70	> 0,80	> 1,00	> 1,30	> 1,60	> 2,00	> 2,50
Concentration [p/l]	Reference	33780	27571	19918	14421	9966	7846	5123	3412
	Test unit	34341	27773	20070	14184	9923	7761	5158	3451
Deviation [%]		1,7	0,7	0,8	-1,6	-0,4	-1,1	0,7	1,1
Channels		G	H	I	J	K	L	M	N
Diameter [µm]		> 2,50	> 3,00	> 3,50	> 4,00	> 5,00	> 6,50	> 7,50	> 8,50
Concentration [p/l]	Reference	3369	2096	1348	875	325	101	49	24
	Test unit	3425	2131	1382	889	315	95	46	23
Deviation [%]		1,7	1,7	2,5	1,6	-3,1	-5,9	-6,1	-4,2
Channels		O	P	Q	R	S	T	U	V
Diameter [µm]		> 10,00	> 12,50	> 15,00	> 17,50	> 20,00	> 25,00	> 30,00	> 32,00
Concentration [p/l]	Reference	10	3	1	0	0	0	0	0
	Test unit	9	2	1	0	0	0	0	0
Deviation [%]		-10,0	-33,3	0,0	0,0	0,0	0,0	0,0	0,0

Sample Volume: 0,0180 m³ / **Sample Time:** 15 min.

Count validation graph of spectrometers at calibration tower:



Date: 21.11.2019

Signature: Grimm Aerosol Technik Pouch GmbH
OT Friedersdorf
Vordere Aue 4
06774 Muldestausee
Tel.: 03493 51407-0 Fax: 03493 51407-50

Note:
Customer Name: Organismo de Evaluación y Fiscalización Ambiental - OEFA

Thermo SCIENTIFIC

Air Quality Instruments
GAS ANALYZER TEST CERTIFICATION

Rev. # 3.0

INSTRUMENT MODEL: 43i-DZSAA

DATE TESTED: 2/14/2020

INSTRUMENT SERIAL#: 1200416204

TEST OPERATOR: Mike Regan

FINAL QC:

BASIC INSTRUMENT INFORMATION:

Instrument Application Software Ver.	43i 030000	PASS
Bench Pressure (mmHg)	719.06	PASS
Sample Flow (L/Min)	0.43	PASS
Internal Temperature (Degrees C)	31.91	PASS
Chamber Temperature (Degrees C)	45.05	PASS
PMT Voltage	-657.5	PASS
SO2 Zero Background	21.253	PASS
SO2 Span Coefficient	0.995	PASS
Zero Noise (ppb)	0.25	PASS
Span Noise(ppb)	1.84	PASS
Drift (ppb)	-0.02	PASS
Current Averaging Time (s)	60	PASS

108865-43 Rev B

END USER: OEFA ORGANISMO DE EVALUACION Y FISCALIZACION AMBIENTAL

Thermo SCIENTIFIC

Air Quality Instruments
GAS ANALYZER TEST CERTIFICATION

Rev # 3.0

INSTRUMENT MODEL: 42i-DZMSPAA DATE TESTED: 12/5/2019

INSTRUMENT SERIAL#: 1192914962

TEST OPERATOR: Mike Regan FINAL QC:

BASIC INSTRUMENT INFORMATION:

Instrument Application Software Ver.:	42i 020205	PASS
Sample Flow (L/Min):	0.672	PASS
Bench Pressure (mmHg):	249.97	PASS
Internal Temperature (Degrees C):	32.81	PASS
PMT Voltage:	-764.2	PASS
Bench Temperature (Degrees C):	50.11	PASS
Converter Temperature (Degrees C):	324.1	PASS
NO Zero Background (ppb):	4.5	PASS
NOx Zero Background (ppb):	4.7	PASS
NO Span Coefficient:	1.017	PASS
NOx Span Coefficient:	0.996	PASS
NO2 Span Coefficient:	1.013	PASS
Converter Efficiency:	101.3	PASS
Zero Noise (ppb):	0	PASS
Current Averaging Time (s):	10	PASS

END USER: OEFA ORGANISMO DE EVALUACION Y FISCALIZACION AMBIENTAL

Thermo SCIENTIFIC

Air Quality Instruments
GAS ANALYZER TEST CERTIFICATION

Rev. # NA

INSTRUMENT MODEL: 450I-DZHAA

INSTRUMENT SERIAL#: CM19490141 DATE TESTED: 12/10/2019

TEST OPERATOR: JUN WANG FINAL QC: Jwang

BASIC INSTRUMENT INFORMATION:

Instrument Application Software Ver.:	450i 02.02.08.318+	PASS
Bench Pressure (mmHg):	632.6	PASS
Sample Flow (L/Min):	0.979	PASS
Internal Temperature (Degrees C):	36.6	PASS
Converter Temperature (Degrees C):	324	PASS
Chamber Temperature (Degrees C):	44.9	PASS
PMT Voltage:	-621.2	PASS
SO2 Zero Background:	H2S Only	PASS
SO2 Span Coefficient:	H2S Only	PASS
CS Zero Background:	19.9	PASS
CS Span Coefficient:	1.01	PASS
H2S Span Coefficient:	1.01	PASS
Averaging Time (sec):	60	PASS
Scrubber Efficiency(%):	100	PASS
Zero Noise (ppb):	0.620299	PASS
Span Noise(ppb):	2.43831	PASS
Zero Drift(ppb):	0.554729	PASS
Span Drift (ppb):	-2.359227	PASS
SO2 Linearity at 400 (ppb):	H2S Only	PASS
SO2 Linearity at 200 (ppb):	H2S Only	PASS
SO2 Linearity at 100 (ppb):	H2S Only	PASS
H2S Linearity at 400 (ppb):	400.493333	PASS
H2S Linearity at 200 (ppb):	186.676667	PASS
H2S Linearity at 100 (ppb):	88.026	PASS
Converter Efficiency (%):	99	PASS

END USER: OEFA ORGANISMO DE EVALUACION Y FISCALIZACION AMBIENTAL

Thermo SCIENTIFIC

Air Quality Instruments
GAS ANALYZER TEST CERTIFICATION

Rev #3.0

INSTRUMENT MODEL: 48i-DZSAA

DATE TESTED: 1/15/2020

INSTRUMENT SERIAL#: 1193085163

TEST OPERATOR: Dave Armstrong

FINAL QC:

BASIC INSTRUMENT INFORMATION:

Instrument Application Software Ver.	48i 030000	PASS
Sample Flow (L/Min)	1.07	PASS
Internal Temperature (Degrees C)	33.11	PASS
Bench Pressure (mmHg)	760.9	PASS
Bench Temperature (Degrees C)	48.21	PASS
CO Gas Zero Background (ppb)	0.04	PASS
CO Gas Span Coefficient	1	PASS
Zero Noise (ppb)	0.01	PASS
Span Noise (ppb)	0.02	PASS
Drift (ppb)	-0.01	PASS
Automatic Gain Control Frequency	198959	PASS
Current Averaging Time (s)	30	PASS

END USER: OEFA ORGANISMO DE EVALUACION Y FISCALIZACION AMBIENTAL

Thermo SCIENTIFIC

Air Quality Instruments
GAS ANALYZER TEST CERTIFICATION

Rev. # 3.0

INSTRUMENT MODEL: 43i-DZSAA

DATE TESTED: 12/10/2019

INSTRUMENT SERIAL#: 1192914947

TEST OPERATOR: Caitlin Torpey

FINAL QC:

BASIC INSTRUMENT INFORMATION:

Instrument Application Software Ver.	43i 020208	PASS
Bench Pressure (mmHg)	713.94	PASS
Sample Flow (L/Min)	0.42	PASS
Internal Temperature (Degrees C)	31.7	PASS
Chamber Temperature (Degrees C)	44.96	PASS
PMT Voltage	-644.5	PASS
SO2 Zero Background	16.604	PASS
SO2 Span Coefficient	0.997	PASS
Zero Noise (ppb)	0.17	PASS
Span Noise(ppb)	1.18	PASS
Drift (ppb)	-0.12	PASS
Current Averaging Time (s)	60	PASS

108865-43 Rev B

END USER: OEFA ORGANISMO DE EVALUACION Y FISCALIZACION AMBIENTAL

Thermo SCIENTIFIC

Air Quality Instruments
GAS ANALYZER TEST CERTIFICATION

Rev # 3.0

INSTRUMENT MODEL: 42i-DZMSPAA

DATE TESTED: 12/5/2019

INSTRUMENT SERIAL#: 1192914960

TEST OPERATOR: Mike Regan

FINAL QC:

BASIC INSTRUMENT INFORMATION:

Instrument Application Software Ver.:	42i 020205	PASS
Sample Flow (L/Min):	0.648	PASS
Bench Pressure (mmHg):	223.53	PASS
Internal Temperature (Degrees C):	32.16	PASS
PMT Voltage:	-806.64	PASS
Bench Temperature (Degrees C):	50.41	PASS
Converter Temperature (Degrees C):	324.5	PASS
NO Zero Background (ppb):	2.7	PASS
NOx Zero Background (ppb):	2.7	PASS
NO Span Coefficient:	1.036	PASS
NOx Span Coefficient:	0.996	PASS
NO2 Span Coefficient:	0.991	PASS
Converter Efficiency:	99.1	PASS
Zero Noise (ppb):	0	PASS
Current Averaging Time (s):	10	PASS

END USER: OEFA ORGANISMO DE EVALUACION Y FISCALIZACION AMBIENTAL

Thermo SCIENTIFIC AirQuality Instruments

GAS ANALYZER TEST CERTIFICATION

Rev. # NA

INSTRUMENT MODEL: 450I-DZHAA

INSTRUMENT SERIAL#: CM19490139 DATE TESTED: 12/12/2019

TEST OPERATOR: JUN WANG FINAL QC: Junwang

BASIC INSTRUMENT INFORMATION:

Instrument Application Software Ver.:	450i 02.02.08.318+	PASS
Bench Pressure (mmHg):	643.1	PASS
Sample Flow (L/Min):	1.019	PASS
Internal Temperature (Degrees C):	36.5	PASS
Converter Temperature (Degrees C):	324	PASS
Chamber Temperature (Degrees C):	45	PASS
PMT Voltage:	-639.7	PASS
SO2 Zero Background:	H2S Only	PASS
SO2 Span Coefficient:	H2S Only	PASS
CS Zero Background:	29.4	PASS
CS Span Coefficient:	0.99	PASS
H2S Span Coefficient:	0.99	PASS
Averaging Time (sec):	60	PASS
Scrubber Efficiency(%):	100	PASS
Zero Noise (ppb):	0.447062	PASS
Span Noise(ppb):	5.028363	PASS
Zero Drift(ppb):	0.283506	PASS
Span Drift (ppb):	-5.375614	PASS
SO2 Linearity at 400 (ppb):	H2S Only	PASS
SO2 Linearity at 200 (ppb):	H2S Only	PASS
SO2 Linearity at 100 (ppb):	H2S Only	PASS
H2S Linearity at 400 (ppb):	400.223333	PASS
H2S Linearity at 200 (ppb):	184.636667	PASS
H2S Linearity at 100 (ppb):	84.126	PASS
Converter Efficiency (%):	99	PASS

END USER: OEFA ORGANISMO DE EVALUACION Y FISCALIZACION AMBIENTAL

Thermo SCIENTIFIC

Air Quality Instruments
GAS ANALYZER TEST CERTIFICATION

Rev # 3.0

INSTRUMENT MODEL: 48i-DZSAA DATE TESTED: 1/6/2020

INSTRUMENT SERIAL#: 1193085161

TEST OPERATOR: Mike Regan FINAL QC:

BASIC INSTRUMENT INFORMATION:

Instrument Application Software Ver.	48i 020204	PASS
Sample Flow (L/Min)	1.01	PASS
Internal Temperature (Degrees C)	33.59	PASS
Bench Pressure (mmHg)	747.56	PASS
Bench Temperature (Degrees C)	48.3	PASS
CO Gas Zero Background (ppb)	0.022	PASS
CO Gas Span Coefficient	1	PASS
Zero Noise (ppb)	0.01	PASS
Span Noise (ppb)	0.05	PASS
Drift (ppb)	0.02	PASS
Automatic Gain Control Frequency	197403	PASS
Current Averaging Time (s)	30	PASS

END USER: OEFA ORGANISMO DE EVALUACION Y FISCALIZACION AMBIENTAL

Thermo SCIENTIFIC

Air Quality Instruments
GAS ANALYZER TEST CERTIFICATION

Rev. # 3.0

INSTRUMENT MODEL: 43i-DZSAA

DATE TESTED: 12/29/2019

INSTRUMENT SERIAL#: 1192914948

TEST OPERATOR: Caitlin Torpey

FINAL QC:

BASIC INSTRUMENT INFORMATION:

Instrument Application Software Ver.	43i 020208	PASS
Bench Pressure (mmHg)	728.57	PASS
Sample Flow (L/Min)	0.44	PASS
Internal Temperature (Degrees C)	31.36	PASS
Chamber Temperature (Degrees C)	45.03	PASS
PMT Voltage	-600.5	PASS
SO2 Zero Background	21.36	PASS
SO2 Span Coefficient	1.006	PASS
Zero Noise (ppb)	0.18	PASS
Span Noise(ppb)	1.03	PASS
Drift (ppb)	0.03	PASS
Current Averaging Time (s)	60	PASS

108865-43 Rev B

END USER: OEFA ORGANISMO DE EVALUACION Y FISCALIZACION AMBIENTAL

Thermo SCIENTIFIC

Air Quality Instruments
GAS ANALYZER TEST CERTIFICATION

Rev # 3.0

INSTRUMENT MODEL: 42i-DZMSPAA

DATE TESTED: 12/5/2019

INSTRUMENT SERIAL#: 1192914961

TEST OPERATOR: Mike Regan

FINAL QC:

BASIC INSTRUMENT INFORMATION:

Instrument Application Software Ver.:	42i 020205	PASS
Sample Flow (L/Min):	0.683	PASS
Bench Pressure (mmHg):	242.46	PASS
Internal Temperature (Degrees C):	33.27	PASS
PMT Voltage:	-747	PASS
Bench Temperature (Degrees C):	50.45	PASS
Converter Temperature (Degrees C):	324	PASS
NO Zero Background (ppb):	4.1	PASS
NOx Zero Background (ppb):	4.2	PASS
NO Span Coefficient:	0.993	PASS
NOx Span Coefficient:	1.002	PASS
NO2 Span Coefficient:	1.012	PASS
Converter Efficiency:	101.2	PASS
Zero Noise (ppb):	0	PASS
Current Averaging Time (s):	10	PASS

END USER: OEFA ORGANISMO DE EVALUACION Y FISCALIZACION AMBIENTAL

Thermo SCIENTIFIC

Air Quality Instruments
GAS ANALYZER TEST CERTIFICATION

Rev. # NA

INSTRUMENT MODEL: 450I-DZHAA

INSTRUMENT SERIAL#: CM19490140 DATE TESTED: 12/6/2019

TEST OPERATOR: JUN WANG FINAL QC: Xuleng

BASIC INSTRUMENT INFORMATION:

Instrument Application Software Ver.:	450i 02.02.08.318+	PASS
Bench Pressure (mmHg):	644.6	PASS
Sample Flow (L/Min):	1.032	PASS
Internal Temperature (Degrees C):	35.2	PASS
Converter Temperature (Degrees C):	326	PASS
Chamber Temperature (Degrees C):	44.9	PASS
PMT Voltage:	-674.5	PASS
SO2 Zero Background:	H2S Only	PASS
SO2 Span Coefficient:	H2S Only	PASS
CS Zero Background:	29.3	PASS
CS Span Coefficient:	1.02	PASS
H2S Span Coefficient:	1.02	PASS
Averaging Time (sec):	60	PASS
Scrubber Efficiency(%):	100	PASS
Zero Noise (ppb):	0.610193	PASS
Span Noise(ppb):	4.204679	PASS
Zero Drift(ppb):	0.536677	PASS
Span Drift (ppb):	-4.283717	PASS
SO2 Linearity at 400 (ppb):	H2S Only	PASS
SO2 Linearity at 200 (ppb):	H2S Only	PASS
SO2 Linearity at 100 (ppb):	H2S Only	PASS
H2S Linearity at 400 (ppb):	399.793333	PASS
H2S Linearity at 200 (ppb):	187.1	PASS
H2S Linearity at 100 (ppb):	86.434333	PASS
Converter Efficiency (%):	98	PASS

END USER: OEFA ORGANISMO DE EVALUACION Y FISCALIZACION AMBIENTAL

Thermo SCIENTIFIC

Air Quality Instruments
GAS ANALYZER TEST CERTIFICATION

Rev #3.0

INSTRUMENT MODEL: 48i-DZSAA

DATE TESTED: 1/23/2020

INSTRUMENT SERIAL#: 1193085162

TEST OPERATOR: Mike Regan

FINAL QC:

BASIC INSTRUMENT INFORMATION:

Instrument Application Software Ver.	48i 030000	PASS
Sample Flow (L/Min)	1.11	PASS
Internal Temperature (Degrees C)	33.1	PASS
Bench Pressure (mmHg)	752.57	PASS
Bench Temperature (Degrees C)	48.02	PASS
CO Gas Zero Background (ppb)	0.002	PASS
CO Gas Span Coefficient	1	PASS
Zero Noise (ppb)	0.01	PASS
Span Noise (ppb)	0.03	PASS
Drift (ppb)	0	PASS
Automatic Gain Control Frequency	198940	PASS
Current Averaging Time (s)	30	PASS

108865-48 Rev B

END USER: OEFA ORGANISMO DE EVALUACION Y FISCALIZACION AMBIENTAL

BARANI DESIGN

Temperature/humidity sensor factory calibration report

The under-mentioned item has been calibrated at following points at the BARANI DESIGN Technologies facility against test equipment traceable to SMI(Slovak Metrological Institute) & CMI (Czech Metrological Institute) & Michell Instruments.

Unit S/N: 1663393889 Optical appearance : PASS

Reference temperature °C	Instrument temperature °C	Deviation
0,08	0,10	0,02

Reference humidity %RH	Instrument humidity %RH	Deviation
50,6	50,9	0,3

Humidity & Pressure measured at room temperature of 21 +/-1 °C.

NOTE:
CUSTOMER NAME: Organismo de Evaluacion y Fiscalizacion Ambiental - OEFA

Note:
The calibration certificate supplied with the instrument is valid at the date of packing/shipment. Even though the manufacturing calibration certificate contains the calibration date, the instrument does not undergo any significant sensitivity changes when kept in the controlled environment of the manufacturer's production process up to a period of 6 months. Upon being taken out of the controlled environment to be shipped and exposed to variable atmospheric conditions, the sensitivity may deviate with time (% change in sensitivity per year) given in the sensor specifications.

Comments:
The results are within specification at the measured points.

Approved Signatory  On Date: 11.09.2019

BARANI DESIGN

Temperature/humidity sensor factory calibration report

The under-mentioned item has been calibrated at following points at the BARANI DESIGN Technologies facility against test equipment traceable to SMI(Slovak Metrological Institute) & CMI (Czech Metrological Institute) & Michell Instruments.

Unit S/N: 1665884185 Optical appearance : PASS

Reference temperature °C	Instrument temperature °C	Deviation
0,05	0,07	0,02

Reference humidity %RH	Instrument humidity %RH	Deviation
51,4	52,3	0,9

Humidity & Pressure measured at room temperature of 21 +/-1 °C.

NOTE:
CUSTOMER NAME: Organismo de Evaluacion y Fiscalizacion Ambiental - OEFA

Note:
The calibration certificate supplied with the instrument is valid at the date of packing/shipment. Even though the manufacturing calibration certificate contains the calibration date, the instrument does not undergo any significant sensitivity changes when kept in the controlled environment of the manufacturer's production process up to a period of 6 months. Upon being taken out of the controlled environment to be shipped and exposed to variable atmospheric conditions, the sensitivity may deviate with time (% change in sensitivity per year) given in the sensor specifications.

Comments:
The results are within specification at the measured points.

Approved Signatory  On Date: 11.09.2019

BARANI DESIGN

Temperature/humidity sensor factory calibration report

The under-mentioned item has been calibrated at following points at the BARANI DESIGN Technologies facility against test equipment traceable to SMI(Slovak Metrological Institute) & CMI (Czech Metrological Institute) & Michell Instruments.

Unit S/N: 1669292130 Optical appearance : PASS

Reference temperature °C	Instrument temperature °C	Deviation
0,11	0,18	0,07

Reference humidity %RH	Instrument humidity %RH	Deviation
50,3	51,9	1,6

Humidity & Pressure measured at room temperature of 21 +/-1 °C.

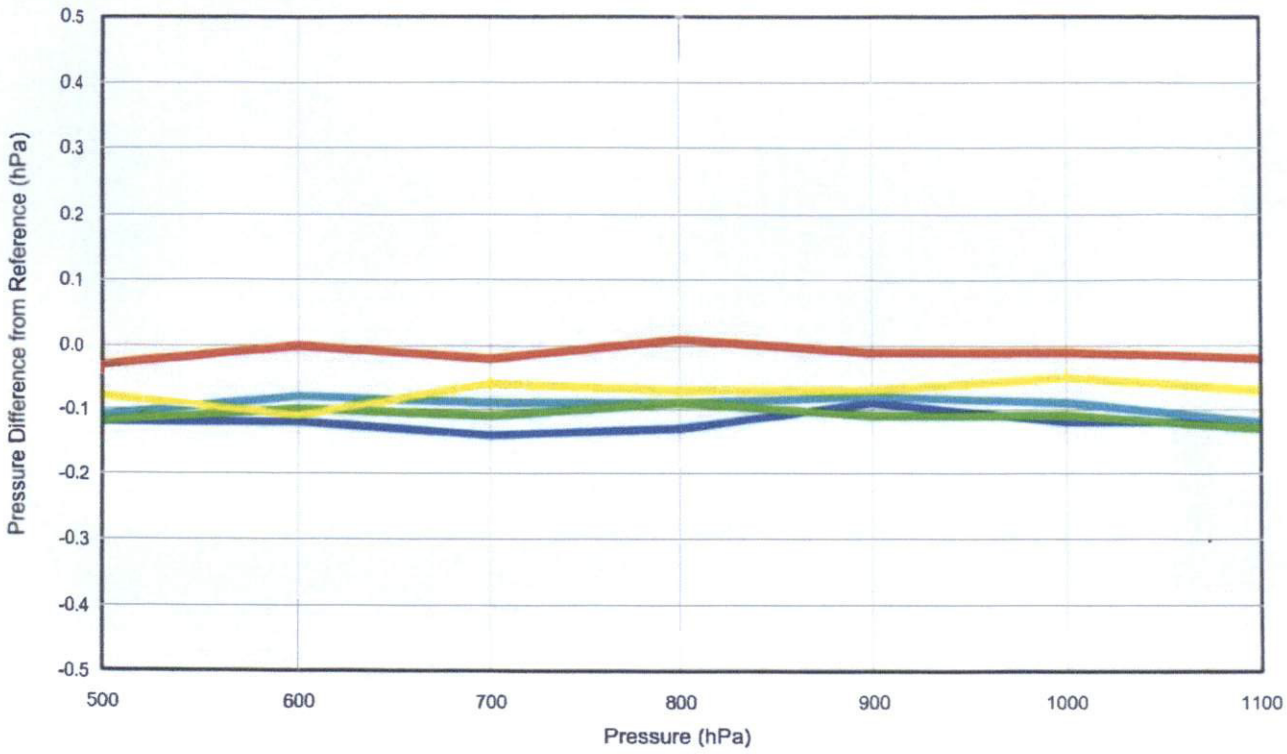
NOTE:
CUSTOMER NAME: Organismo de Evaluacion y Fiscalizacion Ambiental - OEFA

Note:
The calibration certificate supplied with the instrument is valid at the date of packing/shipment. Even though the manufacturing calibration certificate contains the calibration date, the instrument does not undergo any significant sensitivity changes when kept in the controlled environment of the manufacturer's production process up to a period of 6 months. Upon being taken out of the controlled environment to be shipped and exposed to variable atmospheric conditions, the sensitivity may deviate with time (% change in sensitivity per year) given in the sensor specifications.

Comments:
The results are within specification at the measured points.

Approved Signatory  On Date: 11.09.2019

R. M. Young Company
Barometric Pressure Sensor Calibration Record
Serial Number: BPA11350
Calibration Date: February 03, 2020



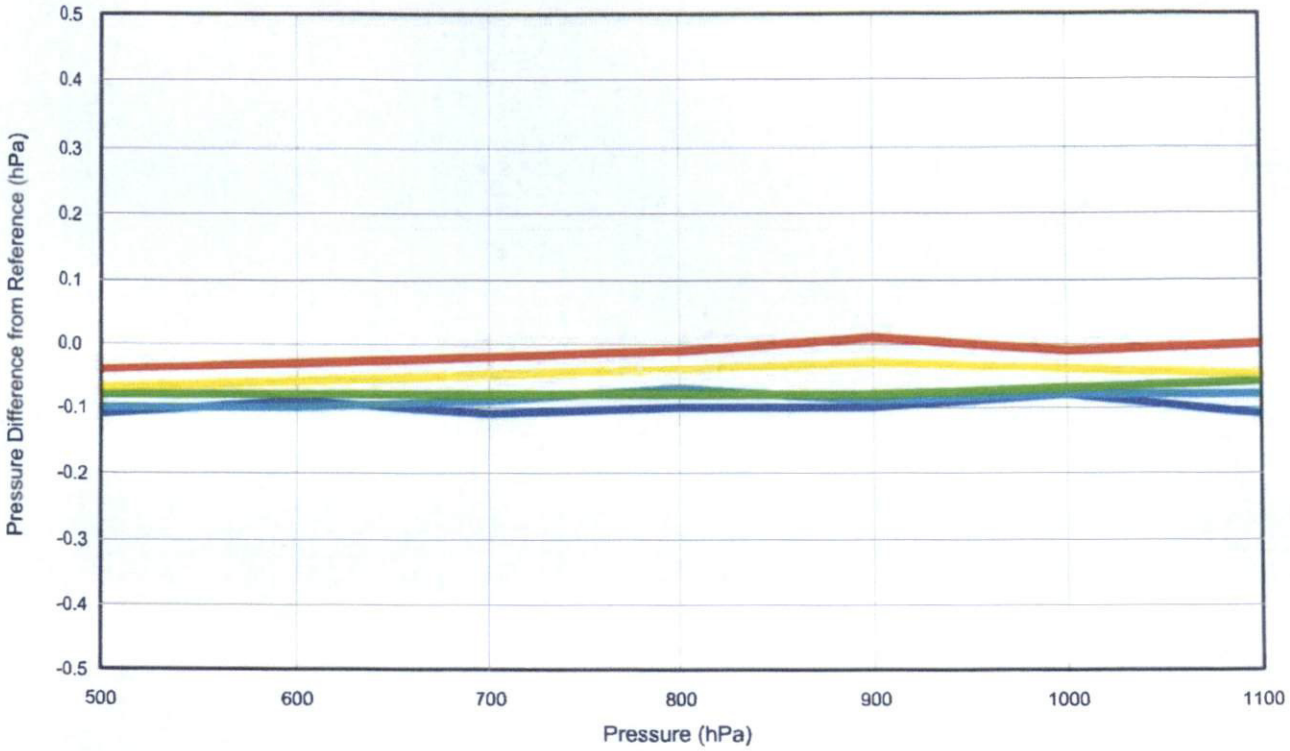
LEGEND:
-40°C
-25°C
0°C
25°C
60°C

Sensor calibration checked from 500 to 1100 hPa in 100 hPa increments at 5 temperatures.
Pressure reference traceable to NIST.

Average Difference from Pressure Reference: -0.08 hPa
Standard Deviation: 0.04 hPa

END USER: Organismo de Evaluacion y Fiscalizacion Ambiental -OEFA

R. M. Young Company
Barometric Pressure Sensor Calibration Record
Serial Number: BPA11351
Calibration Date: February 03, 2020



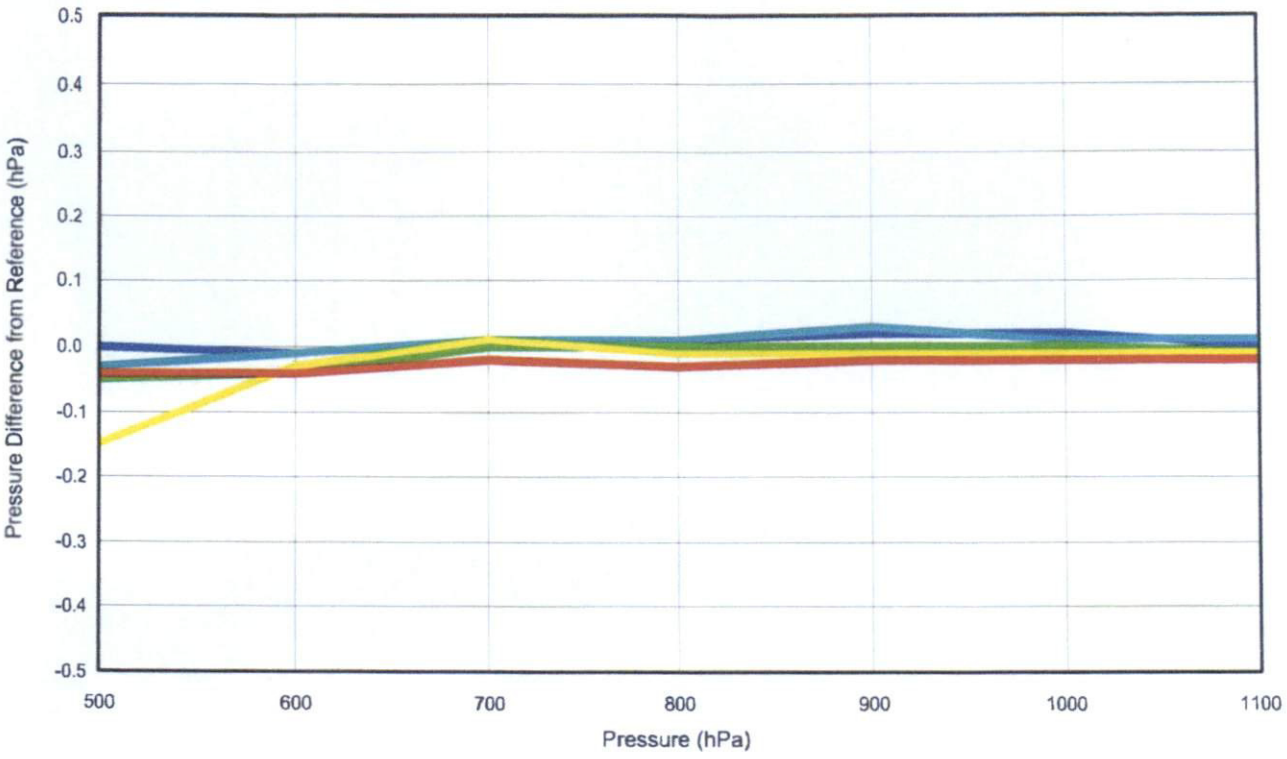
LEGEND:
-40°C
-25°C
0°C
25°C
60°C

Sensor calibration checked from 500 to 1100 hPa in 100 hPa increments at 5 temperatures.
Pressure reference traceable to NIST.

Average Difference from Pressure Reference: -0.07 hPa
Standard Deviation: 0.03 hPa

END USER: Organismo de Evaluacion y Fiscalizacion Ambiental -OEFA

R. M. Young Company
Barometric Pressure Sensor Calibration Record
Serial Number: BPA11352
Calibration Date: February 03, 2020



LEGEND:
-40°C
-25°C
0°C
25°C
60°C

Sensor calibration checked from 500 to 1100 hPa in 100 hPa increments at 5 temperatures.
Pressure reference traceable to NIST.

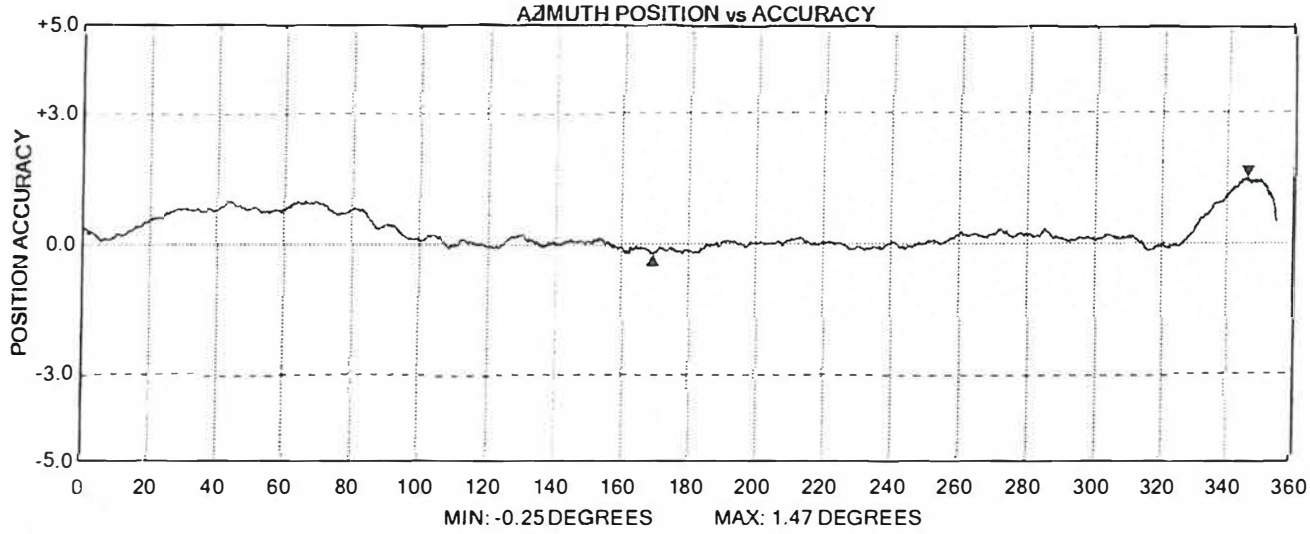
Average Difference from Pressure Reference: -0.01 hPa
Standard Deviation: 0.03 hPa

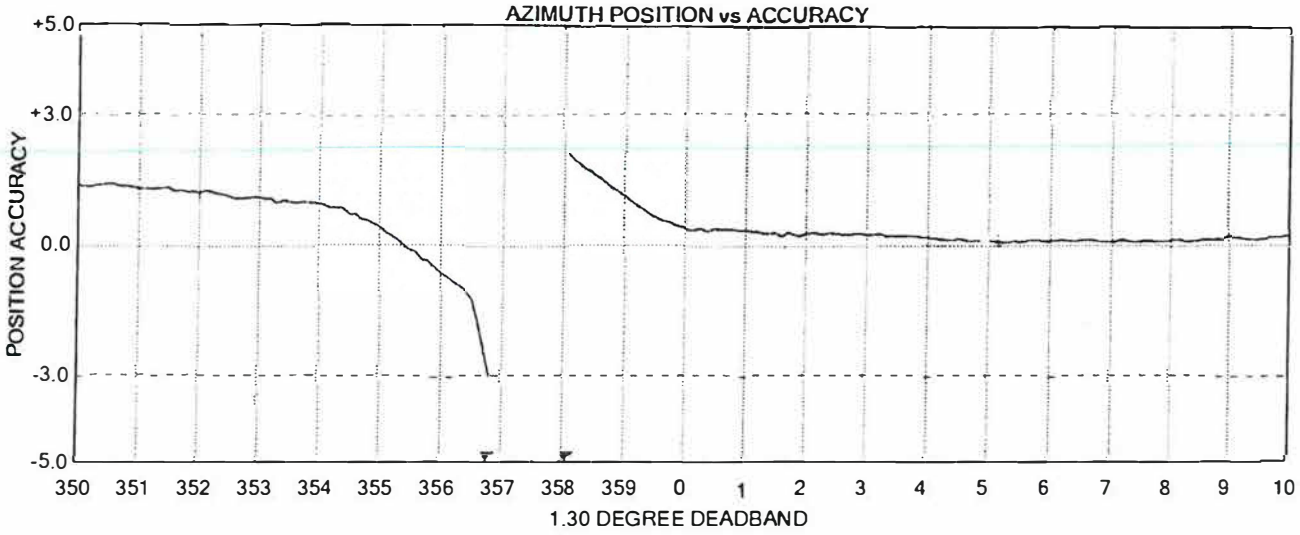
END USER: Organismo de Evaluacion y Fiscalizacion Ambiental -OEFA

R. M. YOUNG COMPANY WIND SENSOR CALIBRATION CERTIFICATE

SENSOR:	05305L WIND MONITOR-AQ
SENSOR SERIAL NUMBER:	WM174402
BEARINGS:	SHIELDED/OIL LUBE
DATE:	JANUARY 09, 2020
WIND SPEED THRESHOLD:	PASS
LOW WIND SPEED AMPLITUDE/FREQUENCY TEST:	PASS
HIGH WIND SPEED AMPLITUDE/FREQUENCY TEST:	PASS
VANE TORQUE TEST:	PASS
SPECIAL NOTES:	

Inspected By: TH





NOTE: Azimuth Position vs Accuracy graphs are accurate to within 0.5 degrees. The accuracy shown in the potentiometer deadband region between 355 and 0 degrees is the result of no resistance change while position changes. The gap represents the actual deadband (open circuit).

R.M. YOUNG COMPANY 2801 Aero Park Dr, Traverse City, MI 49686 USA
Tel: 231-946-3980 Fax: 231-946-4772 Email: met.sales@youngusa.com Website: www.youngusa.com

END USER: Organismo de Evaluacion y Fiscalizacion Ambiental - OEFA

BARANI DESIGN

Temperature/humidity sensor factory calibration report

The under-mentioned item has been calibrated at following points at the BARANI DESIGN Technologies facility against test equipment traceable to SMI(Slovak Metrological Institute) & CMI (Czech Metrological Institute) & Michell Instruments.

Unit S/N: 1663393889 Optical appearance : PASS

Reference temperature °C	Instrument temperature °C	Deviation
0,08	0,10	0,02

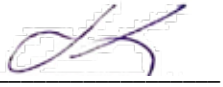
Reference humidity %RH	Instrument humidity %RH	Deviation
50,6	50,9	0,3

Humidity & Pressure measured at room temperature of 21 +/-1 °C.

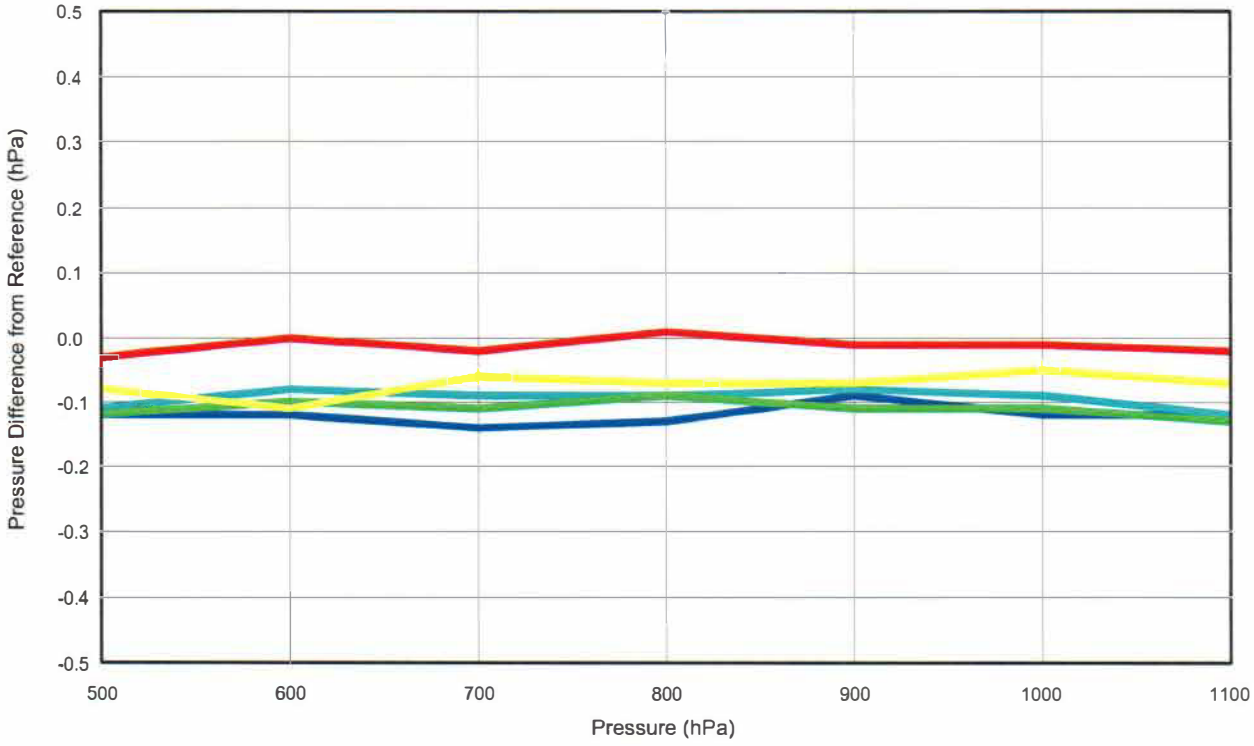
NOTE:
CUSTOMER NAME: Organismo de Evaluacion y Fiscalizacion Ambiental - OEFA

Note:
The calibration certificate supplied with the instrument is valid at the date of packing/shipment. Even though the manufacturing calibration certificate contains the calibration date, the instrument does not undergo any significant sensitivity changes when kept in the controlled environment of the manufacturer's production process up to a period of 6 months. Upon being taken out of the controlled environment to be shipped and exposed to variable atmospheric conditions, the sensitivity may deviate with time (% change in sensitivity per year) given in the sensor specifications.

Comments:
The results are within specification at the measured points.

Approved Signatory  On Date: 11.09.2019

R. M. Young Company
Barometric Pressure Sensor Calibration Record
Serial Number: BPA11350
Calibration Date: February 03, 2020



LEGEND:
-40°C
-25°C
0°C
25°C
60°C

Sensor calibration checked from 500 to 1100 hPa in 100 hPa increments at 5 temperatures.
Pressure reference traceable to NIST.

Average Difference from Pressure Reference: -0.08 hPa
Standard Deviation: 0.04 hPa

END USER: Organismo de Evaluacion y Fiscalizacion Ambiental -OEFA

CERTIFICATE OF CALIBRATION AND TESTING

SERIAL NUMBER:	**TB00015746**
CUSTOMER:	Organismo de Evaluacion y Fiscalizacion Ambiental -OEFA
P.O. NUMBER:	28992.14778
INV NUMBER:	154986
MODEL:	52203-20 TIPPING BUCKET RAIN GAUGE (UNHEATED)-SS

We hereby certify that the sensor serial number specified above has been inspected, tested, and found to comply with all process and material specifications established for the purpose of quality assurance of R. M. Young Company products. Engineering drawings, procedures, and specifications are maintained on file at our premises.

Standards established by R. M. Young Company for calibrating the measuring and test equipment used in controlling product quality are traceable to the National Institute of Standards and Technology (NIST).

Date of Certification: 07 Feb 2020

R. M. Young Company

Ed Chemosky
Quality Assurance

R. M. YOUNG COMPANY 2801 Aero Park Drive, Traverse City Michigan 49686-9171 USA
TEL: (231) 946-3980 FAX: (231) 946-4772 Email: met.sales@youngusa.com

CALIBRATION CERTIFICATE

Kipp & Zonen B.V. | Delftechpark 36 | 2628 XH Delft | The Netherlands | +31 15 2755 210 | info@kippzonen.com | www.kippzonen.com

Meteorology Division of OTT HydroMet

CERTIFICATE NUMBER	018445193237
PYRANOMETER MODEL	CMP 6
SERIAL NUMBER	193237
SENSITIVITY	13.51 µV/W/m² at normal incidence on horizontal pyranometer
IMPEDANCE	50 Ω
REFERENCE PYRANOMETER	Kipp & Zonen CM 6B sn 910012 active from 01 August 2018
CALIBRATION DATE	28 February 2019
CLASSIFICATION	ISO 9060, Class B (First Class)*

Calibration procedure

The indoor calibration procedure is based on a side-by-side comparison with a reference pyranometer under an artificial sun fed by an AC voltage stabiliser. It embodies a 150 W Metal-Halide high-pressure gas discharge lamp. Behind the lamp is a reflector with a diameter of 16.2 cm. The reflector is 1 m above the pyranometers producing a vertical beam. The reference and test pyranometers are mounted horizontally on a table, which can rotate. The irradiance at the pyranometers is approximately 500 W/m². During the calibration procedure the reference and test pyranometer are interchanged to correct for any non-homogeneity of the beam. Temperature of calibration: 22±2 °C.

Hierarchy of traceability

The reference pyranometer was compared with the sun and sky radiation as source under clear sky conditions using the "alternating sun-and-shade method" ISO 9846 paragraph 5. The measurements were performed in Tabernas, Spain (latitude: 37.094°, longitude: -2.3547°, altitude: 503m above sea level). Dates of measurements: 2018, 8, 10-12 June.
The receiver surface was pointed directly at the sun using a solar tracker. During the comparisons, the instrument received tilted global radiation intensities from 849 to 1192 with a mean of 1036 W/m² and tilted diffuse radiation intensities from 98 to 199 with a mean of 141 W/m². The ambient temperature ranged from 22.7 to 29.7 with a mean of 27.3 °C.
The direct radiation on the reference pyranometer as obtained with the alternating-sun-shade method was compared to the DNI measured by the absolute cavity pyrheliometer PMO6 SN 103. The PMO6 is calibrated against the World Standard Group (WSG), maintained at the WRC Davos every International Pyrheliometer Comparison (IPC). The PMO6 participates every IPC since 2005 and it participates in the yearly NPC hosted by NREL in Golden, Colorado to verify its stability. WRR factor of PMO6: 0.99789 (from the last IPC, IPC-2015).

This calibration proved that the reference pyranometer has been stable and that the original sensitivity 12.02 ± 0.31 µV/W/m² is valid and will be applied (see PMOD calibration details). Observed sensitivity differences between the consecutive years are well within the calibration uncertainty.

PMOD calibration details: The reference pyranometer was compared with the sun and sky radiation as source under mainly clear sky conditions using the "continuous sun-and-shade method". The pyranometer was installed horizontally. During the comparisons, the global radiation ranged from 638 to 1195 with a mean of 874 W/m². The solar zenith angle varied from 23.5 to 49.8 with a mean of 32.9 degrees. The ambient temperature ranged from 12.6 to 26.2 with a mean of 23.7 °C. The sensitivity calculation is based on 435 individual measurements. The readings of the WSG are referred to the World Radiometric Reference (WRR). The estimated uncertainty of the WRR relative to SI is ±0.3%. The obtained sensitivity value and its expanded uncertainty (95% level of confidence) are valid for similar conditions and are: 12.02 ± 0.31 µV/W/m².
The measurements were performed in Davos (latitude: 46.8143°, longitude: -9.8458°, altitude: 1558m above sea level). Dates of measurements: June 24, 30 July 1, 2 2015.
Global radiation data were calculated from the direct solar radiation as measured with the absolute cavity pyrheliometer PMO2 (member of the WSG, WRR-Factor: 0.998623, based on the last IPC-2010) and from the diffuse radiation as measured with a continuous disk shaded pyranometer Kipp & Zonen CM22 SN 020059 (ventilated with heated air).

Justification of total instrument calibration uncertainty

The combined uncertainty of the result of the calibration is the positive "root sum square" of two uncertainties.
1. The expanded uncertainty due to random effects and instrumental errors during the calibration of the reference CM 6B is ± 0.31/12.02 = ± 2.58%. (See traceability text).
2. Based on experience, the expanded uncertainty of the transfer procedure (calibration by comparison) is estimated to be ±0.5%.
The estimated combined expanded uncertainty is the positive "root sum square" of these two uncertainties: $\sqrt{(2.58^2 + 0.5^2)} = \pm 2.63\%$.

Notice

The calibration certificate supplied with the instrument is valid at the date of first use. Even though the calibration certificate is dated relative to manufacture, or recalibration, the instrument does not undergo any sensitivity changes when kept in the original packing. From the moment the instrument is taken from its packaging and exposed to irradiance the sensitivity may deviate with time. See the 'non-stability' value (% change in sensitivity per year) given in the radiometer specifications.

* from October 2018 the classification conforms to ISO 9060:2018. Instruments issued before that date conform to ISO 9060:1990.

END USER: Organismo de Evaluacion y Fiscalizacion Ambiental - OEFA

Delft, The Netherlands, 28 February 2019

Joop Mes

J. Mes
(in charge of calibration facility)

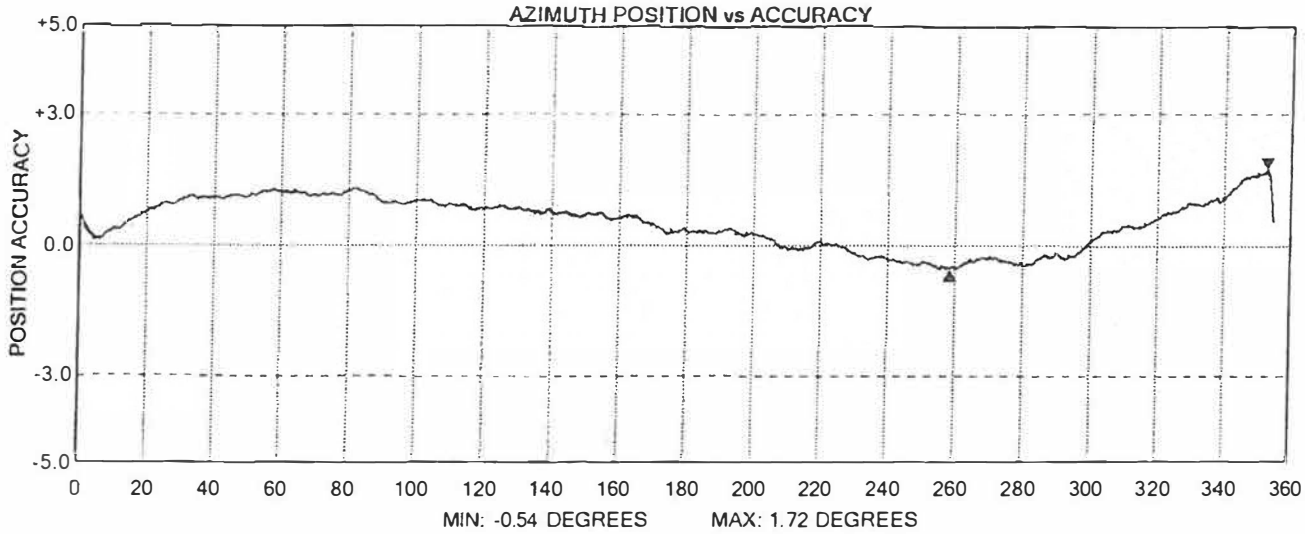
F. de Wit

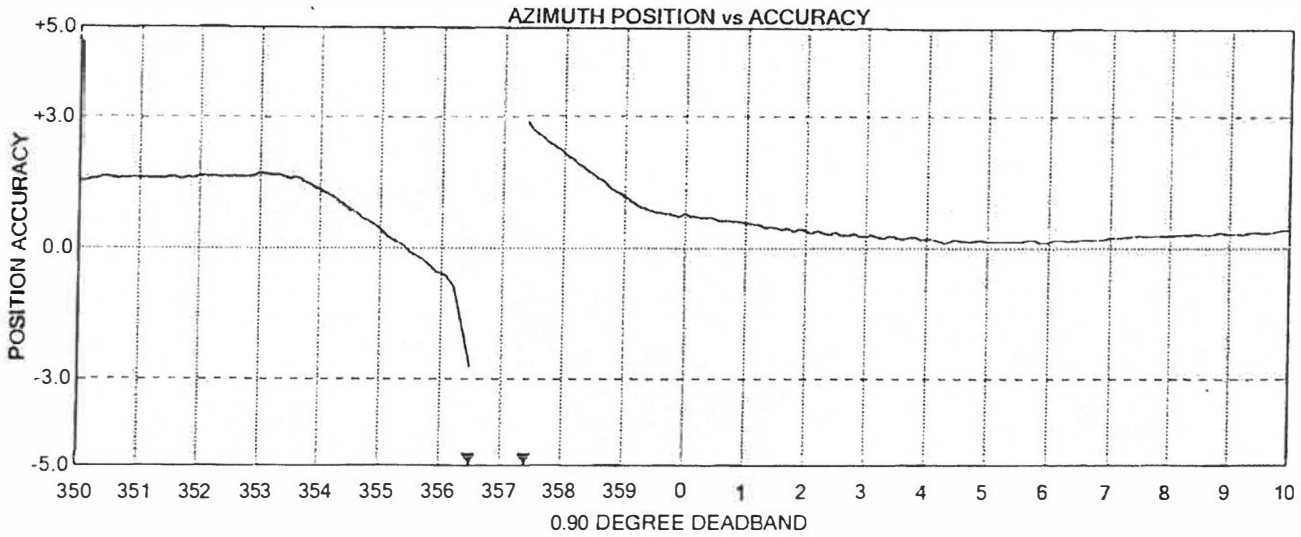
F. de Wit
(in charge of test)

R. M. YOUNG COMPANY WIND SENSOR CALIBRATION CERTIFICATE

SENSOR:	05305L WIND MONITOR-AQ
SENSOR SERIAL NUMBER:	WM174403
BEARINGS:	SHIELDED/OIL LUBE
DATE:	JANUARY 09, 2020
WIND SPEED THRESHOLD:	PASS
LOW WIND SPEED AMPLITUDE/FREQUENCY TEST:	PASS
HIGH WIND SPEED AMPLITUDE/FREQUENCY TEST:	PASS
VANE TORQUE TEST:	PASS
SPECIAL NOTES:	

Inspected By: TH





NOTE: Azimuth Position vs Accuracy graphs are accurate to within 0.5 degrees. The accuracy shown in the potentiometer deadband region between 355 and 0 degrees is the result of no resistance change while position changes. The gap represents the actual deadband (open circuit).

R.M. YOUNG COMPANY 2801 Aero Park Dr, Traverse City, MI 49686 USA

Tel: 231-946-3980 Fax: 231-946-4772 Email: met.sales@youngusa.com Website: www.youngusa.com

END USER: Organismo de Evaluacion y Fiscalizacion Ambiental - OEFA

BARANI DESIGN

Temperature/humidity sensor factory calibration report

The under-mentioned item has been calibrated at following points at the BARANI DESIGN Technologies facility against test equipment traceable to SMI(Slovak Metrological Institute) & CMI (Czech Metrological Institute) & Michell Instruments.

Unit S/N: 1665884185 Optical appearance : PASS

Reference temperature °C	Instrument temperature °C	Deviation
0,05	0,07	0,02

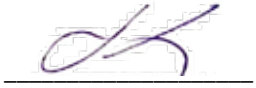
Reference humidity %RH	Instrument humidity %RH	Deviation
51,4	52,3	0,9

Humidity & Pressure measured at room temperature of 21 +/-1 °C.

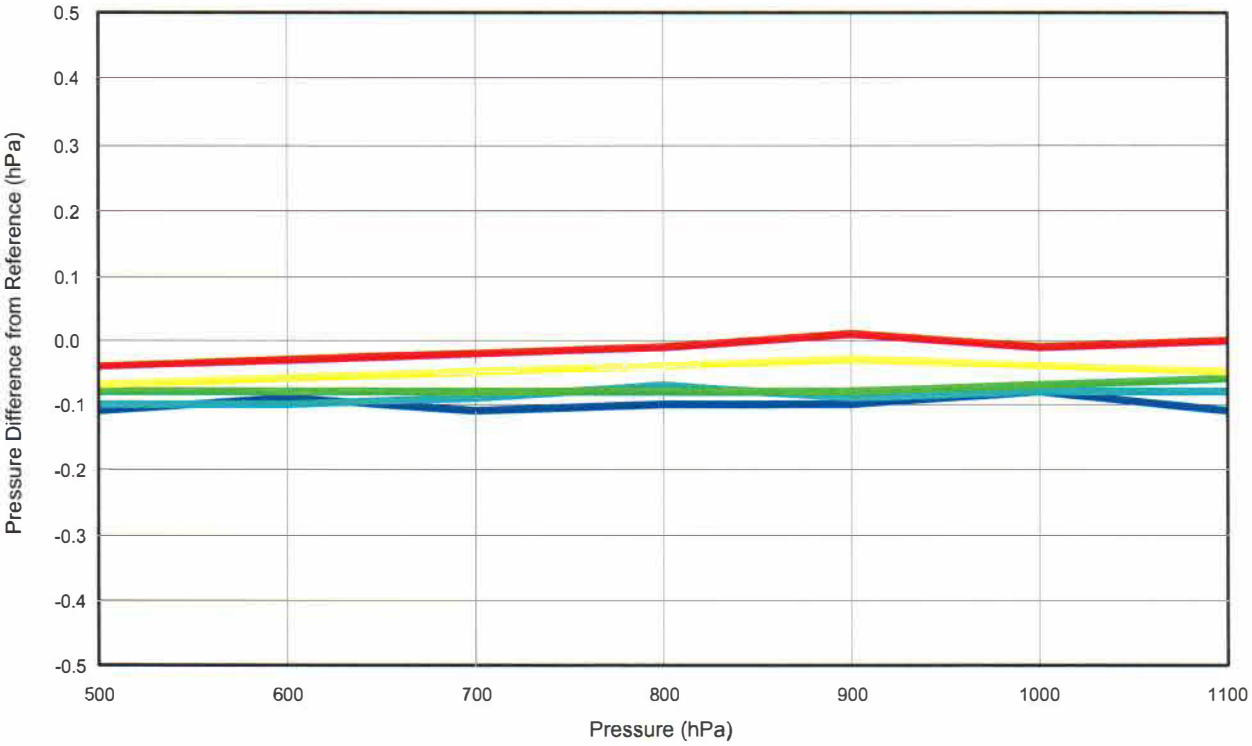
NOTE:
CUSTOMER NAME: Organismo de Evaluacion y Fiscalizacion Ambiental - OEFA

Note:
The calibration certificate supplied with the instrument is valid at the date of packing/shipment. Even though the manufacturing calibration certificate contains the calibration date, the instrument does not undergo any significant sensitivity changes when kept in the controlled environment of the manufacturer's production process up to a period of 6 months. Upon being taken out of the controlled environment to be shipped and exposed to variable atmospheric conditions, the sensitivity may deviate with time (% change in sensitivity per year) given in the sensor specifications.

Comments:
The results are within specification at the measured points.

Approved Signatory  On Date: 11.09.2019

R. M. Young Company
Barometric Pressure Sensor Calibration Record
Serial Number: BPA11351
Calibration Date: February 03, 2020



LEGEND:
-40°C
-25°C
0°C
25°C
60°C

Sensor calibration checked from 500 to 1100 hPa in 100 hPa increments at 5 temperatures.
Pressure reference traceable to NIST.

Average Difference from Pressure Reference: -0.07 hPa
Standard Deviation: 0.03 hPa

END USER: Organismo de Evaluacion y Fiscalizacion Ambiental -OEFA

CERTIFICATE OF CALIBRATION AND TESTING

SERIAL NUMBER:	**TB00015747**
CUSTOMER:	Organismo de Evaluacion y Fiscalizacion Ambiental -OEFA
P.O. NUMBER:	28992.14778
INV NUMBER:	154986
MODEL:	52203-20 TIPPING BUCKET RAIN GAUGE (UNHEATED)-SS

We hereby certify that the sensor serial number specified above has been inspected, tested, and found to comply with all process and material specifications established for the purpose of quality assurance of R. M. Young Company products. Engineering drawings, procedures, and specifications are maintained on file at our premises.

Standards established by R. M. Young Company for calibrating the measuring and test equipment used in controlling product quality are traceable to the National Institute of Standards and Technology (NIST).

Date of Certification: 07 Feb 2020

R. M. Young Company

Ed Chemosky
Quality Assurance

R. M. YOUNG COMPANY 2801 Aero Park Drive, Traverse City Michigan 49686-9171 USA
TEL: (231) 946-3980 FAX: (231) 946-4772 Email: met.sales@youngusa.com

CALIBRATION CERTIFICATE

Meteorology Division of OTT HydroMet

Kipp & Zonen B.V. | Delftechpark 36 | 2628 XH Delft | The Netherlands | +31 15 2755 210 | info@kippzonen.com | www.kippzonen.com

CERTIFICATE NUMBER	018445193240
PYRANOMETER MODEL	CMP 6
SERIAL NUMBER	193240
SENSITIVITY	13.62 µV/W/m² at normal incidence on horizontal pyranometer
IMPEDANCE	49 Ω
REFERENCE PYRANOMETER	Kipp & Zonen CM 6B sn 910012 active from 01 August 2018
CALIBRATION DATE	28 February 2019
CLASSIFICATION	ISO 9060, Class B (First Class)*

Calibration procedure

The indoor calibration procedure is based on a side-by-side comparison with a reference pyranometer under an artificial sun fed by an AC voltage stabiliser. It embodies a 150 W Metal-Halide high-pressure gas discharge lamp. Behind the lamp is a reflector with a diameter of 16.2 cm. The reflector is 1 m above the pyranometers producing a vertical beam. The reference and test pyranometers are mounted horizontally on a table, which can rotate. The irradiance at the pyranometers is approximately 500 W/m². During the calibration procedure the reference and test pyranometer are interchanged to correct for any non-homogeneity of the beam. Temperature of calibration: 22±2 °C.

Hierarchy of traceability

The reference pyranometer was compared with the sun and sky radiation as source under clear sky conditions using the "alternating sun-and-shade method" ISO 9846 paragraph 5. The measurements were performed in Tabernas, Spain (latitude: 37.094°, longitude: -2.3547°, altitude: 503m above sea level). Dates of measurements: 2018, 8, 10-12 June.
The receiver surface was pointed directly at the sun using a solar tracker. During the comparisons, the instrument received tilted global radiation intensities from 849 to 1192 with a mean of 1036 W/m² and tilted diffuse radiation intensities from 98 to 199 with a mean of 141 W/m². The ambient temperature ranged from 22.7 to 29.7 with a mean of 27.3 °C.
The direct radiation on the reference pyranometer as obtained with the alternating-sun-shade method was compared to the DNI measured by the absolute cavity pyrheliometer PMO6 SN 103. The PMO6 is calibrated against the World Standard Group (WSG), maintained at the WRC Davos every International Pyrheliometer Comparison (IPC). The PMO6 participates every IPC since 2005 and it participates in the yearly NPC hosted by NREL in Golden, Colorado to verify its stability. WRR factor of PMO6: 0.99789 (from the last IPC, IPC-2015)

This calibration proved that the reference pyranometer has been stable and that the original sensitivity 12.02 ± 0.31 µV/W/m² is valid and will be applied (see PMOD calibration details). Observed sensitivity differences between the consecutive years are well within the calibration uncertainty.

PMOD calibration details: The reference pyranometer was compared with the sun and sky radiation as source under mainly clear sky conditions using the "continuous sun-and-shade method". The pyranometer was installed horizontally. During the comparisons, the global radiation ranged from 638 to 1195 with a mean of 874 W/m². The solar zenith angle varied from 23.5 to 49.8 with a mean of 32.9 degrees. The ambient temperature ranged from 12.6 to 26.2 with a mean of 23.7 °C. The sensitivity calculation is based on 435 individual measurements. The readings of the WSG are referred to the World Radiometric Reference (WRR). The estimated uncertainty of the WRR relative to SI is ±0.3%. The obtained sensitivity value and its expanded uncertainty (95% level of confidence) are valid for similar conditions and are:12.02 ± 0.31 µV/W/m². The measurements were performed in Davos (latitude: 46.8143°, longitude: -9.8458°, altitude: 1558m above sea level). Dates of measurements: June 24, 30 July 1, 2 2015.
Global radiation data were calculated from the direct solar radiation as measured with the absolute cavity pyrheliometer PMO2 (member of the WSG, WRR-Factor: 0.998623, based on the last IPC-2010) and from the diffuse radiation as measured with a continuous disk shaded pyranometer Kipp & Zonen CM22 SN 020059 (ventilated with heated air).

Justification of total instrument calibration uncertainty

The combined uncertainty of the result of the calibration is the positive "root sum square" of two uncertainties.
1. The expanded uncertainty due to random effects and instrumental errors during the calibration of the reference CM 6B is ± 0.31/12.02 = ± 2.58%. (See traceability text).
2. Based on experience, the expanded uncertainty of the transfer procedure (calibration by comparison) is estimated to be ±0.5%.
The estimated combined expanded uncertainty is the positive "root sum square" of these two uncertainties. $\sqrt{(2.58^2 + 0.5^2)} = \pm 2.63\%$.

Notice

The calibration certificate supplied with the instrument is valid at the date of first use. Even though the calibration certificate is dated relative to manufacture, or recalibration, the instrument does not undergo any sensitivity changes when kept in the original packing. From the moment the instrument is taken from its packaging and exposed to irradiance the sensitivity may deviate with time. See the 'non-stability' value (% change in sensitivity per year) given in the radiometer specifications.

* from October 2018 the classification conforms to ISO 9060:2018. Instruments issued before that date conform to ISO 9060:1990.

END USER: Organismo de Evaluacion y Fiscalizacion Ambiental - OEFA

Delft, The Netherlands, 28 February 2019

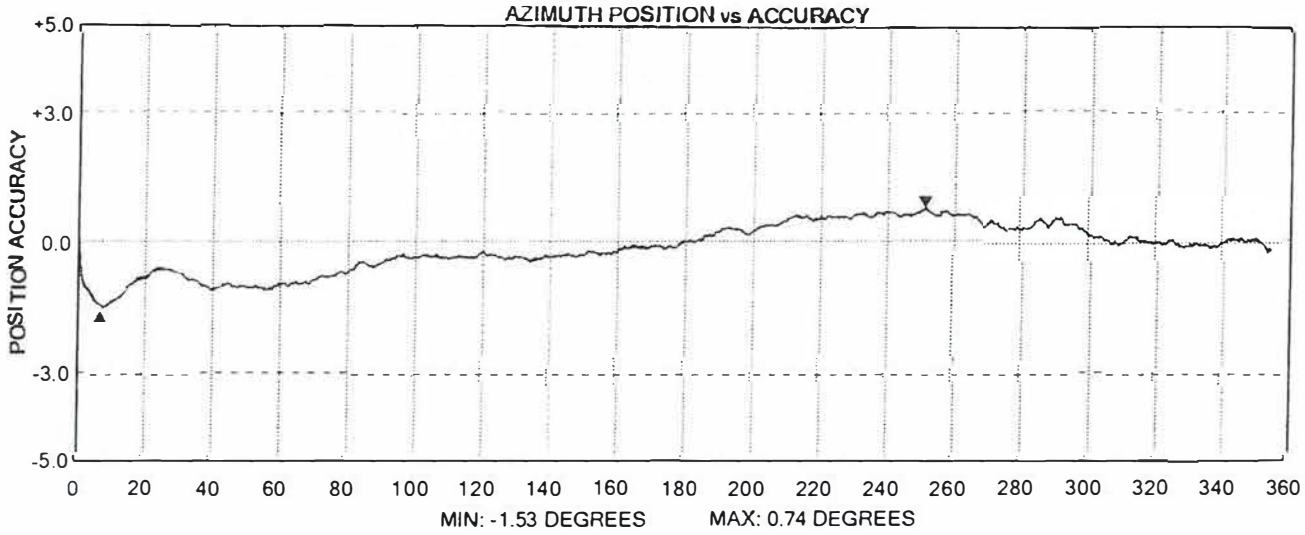
J. Mes
(in charge of calibration facility)

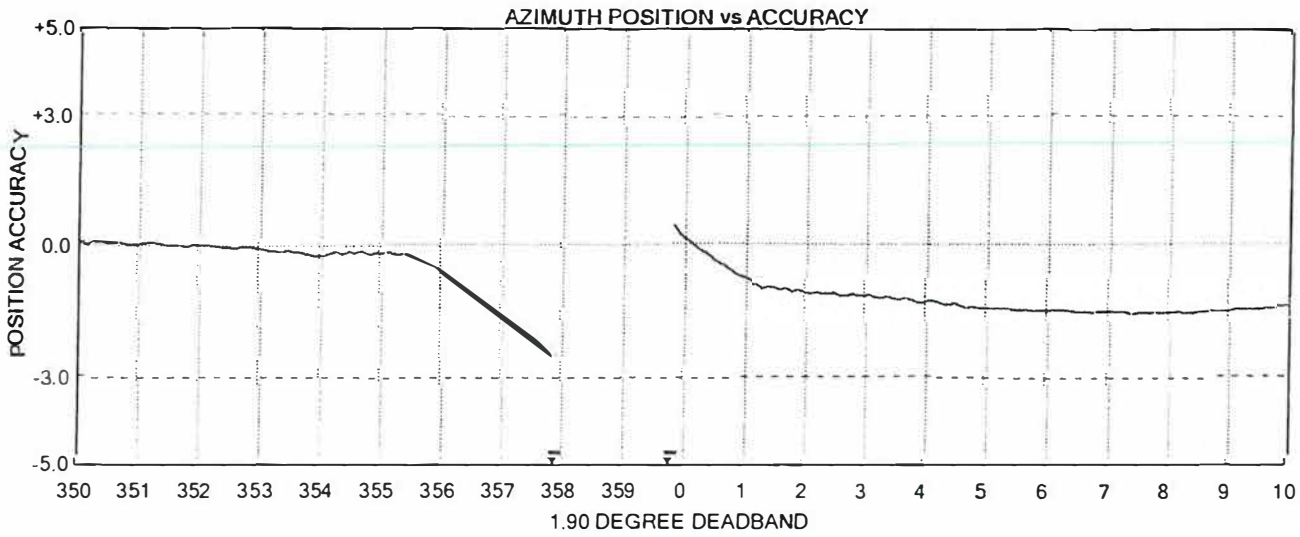
F. de Wit
(in charge of test)

R. M. YOUNG COMPANY WIND SENSOR CALIBRATION CERTIFICATE

SENSOR:	05305L WIND MONITOR-AQ
SENSOR SERIAL NUMBER:	WM174404
BEARINGS:	SHIELDED/OIL LUBE
DATE:	JANUARY 09, 2020
WIND SPEED THRESHOLD:	PASS
LOW WIND SPEED AMPLITUDE/FREQUENCY TEST:	PASS
HIGH WIND SPEED AMPLITUDE/FREQUENCY TEST:	PASS
VANE TORQUE TEST:	PASS
SPECIAL NOTES:	

Inspected By: TH





NOTE: Azimuth Position vs Accuracy graphs are accurate to within 0.5 degrees. The accuracy shown in the potentiometer deadband region between 355 and 0 degrees is the result of no resistance change while position changes. The gap represents the actual deadband (open circuit).

R.M. YOUNG COMPANY 2801 Aero Park Dr, Traverse City, MI 49686 USA
Tel: 231-946-3980 Fax: 231-946-4772 Email: met.sales@youngusa.com Website: www.youngusa.com

END USER: Organismo de Evaluacion y Fiscalizacion Ambiental - OEFA

BARANI DESIGN

Temperature/humidity sensor factory calibration report

The under-mentioned item has been calibrated at following points at the BARANI DESIGN Technologies facility against test equipment traceable to SMI(Slovak Metrological Institute) & CMI (Czech Metrological Institute) & Michell Instruments.

Unit S/N: 1669292130 Optical appearance : PASS

Reference temperature °C	Instrument temperature °C	Deviation
0,11	0,18	0,07

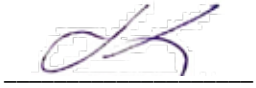
Reference humidity %RH	Instrument humidity %RH	Deviation
50,3	51,9	1,6

Humidity & Pressure measured at room temperature of 21 +/-1 °C.

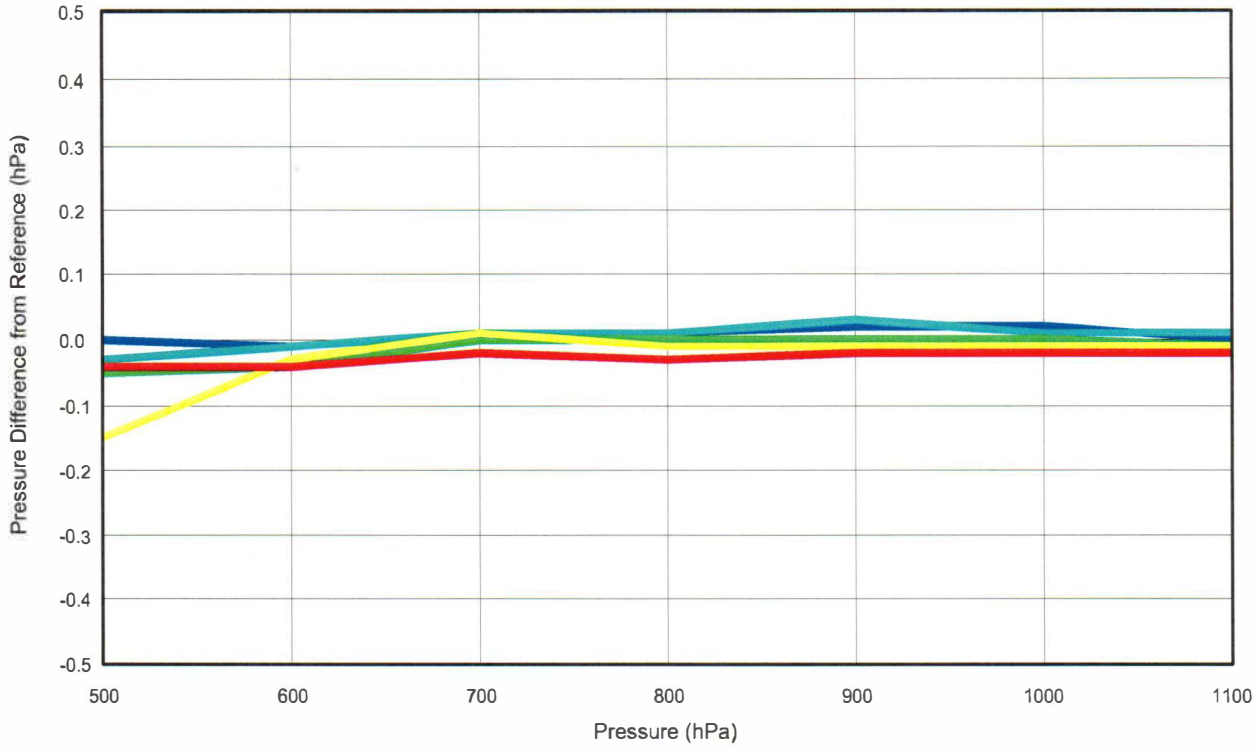
NOTE:
CUSTOMER NAME: Organismo de Evaluacion y Fiscalizacion Ambiental - OEFA

Note:
The calibration certificate supplied with the instrument is valid at the date of packing/shipment. Even though the manufacturing calibration certificate contains the calibration date, the instrument does not undergo any significant sensitivity changes when kept in the controlled environment of the manufacturer's production process up to a period of 6 months. Upon being taken out of the controlled environment to be shipped and exposed to variable atmospheric conditions, the sensitivity may deviate with time (% change in sensitivity per year) given in the sensor specifications.

Comments:
The results are within specification at the measured points.

Approved Signatory  On Date: 11.09.2019

R. M. Young Company
Barometric Pressure Sensor Calibration Record
Serial Number: BPA11352
Calibration Date: February 03, 2020



LEGEND:
-40°C
-25°C
0°C
25°C
60°C

Sensor calibration checked from 500 to 1100 hPa in 100 hPa increments at 5 temperatures.
Pressure reference traceable to NIST.

Average Difference from Pressure Reference: -0.01 hPa
Standard Deviation: 0.03 hPa

END USER: Organismo de Evaluacion y Fiscalizacion Ambiental -OEFA

CERTIFICATE OF CALIBRATION AND TESTING

SERIAL NUMBER:	**TB00015748**
CUSTOMER:	Organismo de Evaluacion y Fiscalizacion Ambiental -OEFA
P.O. NUMBER:	28992.14778
INV NUMBER:	154986
MODEL:	52203-20 TIPPING BUCKET RAIN GAUGE (UNHEATED)-SS

We hereby certify that the sensor serial number specified above has been inspected, tested, and found to comply with all process and material specifications established for the purpose of quality assurance of R. M. Young Company products. Engineering drawings, procedures, and specifications are maintained on file at our premises.

Standards established by R. M. Young Company for calibrating the measuring and test equipment used in controlling product quality are traceable to the National Institute of Standards and Technology (NIST).

Date of Certification: 07 Feb 2020

R. M. Young Company

Ed Chemosky
Quality Assurance

R. M. YOUNG COMPANY 2801 Aero Park Drive, Traverse City Michigan 49686-9171 USA
TEL: (231) 946-3980 FAX: (231) 946-4772 Email: met.sales@youngusa.com

OTT HydroMet

KIPP & ZONEN
Meteorology Division of OTT HydroMet

Kipp & Zonen B.V. | Delftechpark 36 | 2628 XH Delft | The Netherlands | +31 15 2755 210 | info@kippzonen.com | www.kippzonen.com

CALIBRATION CERTIFICATE

CERTIFICATE NUMBER	018756193287
PYRANOMETER MODEL	CMP 6
SERIAL NUMBER	193287
SENSITIVITY	14.97 µV/W/m² at normal incidence on horizontal pyranometer
IMPEDANCE	47 Ω
REFERENCE PYRANOMETER	Kipp & Zonen CM 6B sn 910012 active from 01 August 2018
CALIBRATION DATE	30 April 2019
CLASSIFICATION	ISO 9060, Class B (First Class)*

Calibration procedure

The indoor calibration procedure is based on a side-by-side comparison with a reference pyranometer under an artificial sun fed by an AC voltage stabiliser. It embodies a 150 W Metal-Halide high-pressure gas discharge lamp. Behind the lamp is a reflector with a diameter of 16.2 cm. The reflector is 1 m above the pyranometers producing a vertical beam. The reference and test pyranometers are mounted horizontally on a table, which can rotate. The irradiance at the pyranometers is approximately 500 W/m². During the calibration procedure the reference and test pyranometer are interchanged to correct for any non-homogeneity of the beam. Temperature of calibration: 22±2 °C.

Hierarchy of traceability

The reference pyranometer was compared with the sun and sky radiation as source under clear sky conditions using the "alternating sun-and-shade method" ISO 9846 paragraph 5. The measurements were performed in Tabernas, Spain (latitude: 37.094°, longitude: -2.3547°, altitude: 503m above sea level). Dates of measurements: 2018, 8, 10-12 June.
The receiver surface was pointed directly at the sun using a solar tracker. During the comparisons, the instrument received tilted global radiation intensities from 849 to 1192 with a mean of 1036 W/m² and tilted diffuse radiation intensities from 98 to 199 with a mean of 141 W/m². The ambient temperature ranged from 22.7 to 29.7 with a mean of 27.3 °C.
The direct radiation on the reference pyranometer as obtained with the alternating-sun-shade method was compared to the DNI measured by the absolute cavity pyrheliometer PMO6 SN 103. The PMO6 is calibrated against the World Standard Group (WSG), maintained at the WRC Davos every International Pyrheliometer Comparison (IPC). The PMO6 participates every IPC since 2005 and it participates in the yearly NPC hosted by NREL in Golden, Colorado to verify its stability. WRR factor of PMO6: 0.99789 (from the last IPC, IPC-2015).

This calibration proved that the reference pyranometer has been stable and that the original sensitivity 12.02 ± 0.31 µV/W/m² is valid and will be applied (see PMOD calibration details). Observed sensitivity differences between the consecutive years are well within the calibration uncertainty.

PMOD calibration details: The reference pyranometer was compared with the sun and sky radiation as source under mainly clear sky conditions using the "continuous sun-and-shade method". The pyranometer was installed horizontally. During the comparisons, the global radiation ranged from 638 to 1195 with a mean of 874 W/m². The solar zenith angle varied from 23.5 to 49.8 with a mean of 32.9 degrees. The ambient temperature ranged from 12.6 to 26.2 with a mean of 23.7 °C. The sensitivity calculation is based on 435 individual measurements. The readings of the WSG are referred to the World Radiometric Reference (WRR). The estimated uncertainty of the WRR relative to SI is ±0.3%. The obtained sensitivity value and its expanded uncertainty (95% level of confidence) are valid for similar conditions and are:12.02 ± 0.31 µV/W/m². The measurements were performed in Davos (latitude: 46.8143°, longitude: -9.8458°, altitude: 1558m above sea level). Dates of measurements: June 24, 30 July 1, 2 2015.
Global radiation data were calculated from the direct solar radiation as measured with the absolute cavity pyrheliometer PMO2 (member of the WSG, WRR-Factor: 0.998623, based on the last IPC-2010) and from the diffuse radiation as measured with a continuous disk shaded pyranometer Kipp & Zonen CM22 SN 020059 (ventilated with heated air).

Justification of total instrument calibration uncertainty

The combined uncertainty of the result of the calibration is the positive "root sum square" of two uncertainties.
1. The expanded uncertainty due to random effects and instrumental errors during the calibration of the reference CM 6B is ± 0.31/12.02 = ± 2.58%. (See traceability text).
2. Based on experience, the expanded uncertainty of the transfer procedure (calibration by comparison) is estimated to be ±0.5%.
The estimated combined expanded uncertainty is the positive "root sum square" of these two uncertainties: $\sqrt{(2.58^2 + 0.5^2)} = \pm 2.63\%$.

Notice

The calibration certificate supplied with the instrument is valid at the date of first use. Even though the calibration certificate is dated relative to manufacture, or recalibration, the instrument does not undergo any sensitivity changes when kept in the original packing. From the moment the instrument is taken from its packaging and exposed to irradiance the sensitivity may deviate with time. See the 'non-stability' value (% change in sensitivity per year) given in the radiometer specifications.

* from October 2018 the classification conforms to ISO 9060:2018. Instruments issued before that date conform to ISO 9060:1990.

END USER: Organismo de Evaluacion y Fiscalizacion Ambiental - OEFA

Delft, The Netherlands, 30 April 2019

Joop Mes

J. Mes
(in charge of calibration facility)

F. de Wit
(in charge of test)

YOUNG

CERTIFICATE OF CALIBRATION AND TESTING

SERIAL NUMBER:	**TB00015746**
CUSTOMER:	Organismo de Evaluacion y Fiscalizacion Ambiental -OEFA
P.O. NUMBER:	28992.14778
INV NUMBER:	154986
MODEL:	52203-20 TIPPING BUCKET RAIN GAUGE (UNHEATED)-SS

We hereby certify that the sensor serial number specified above has been inspected, tested, and found to comply with all process and material specifications established for the purpose of quality assurance of R. M. Young Company products. Engineering drawings, procedures, and specifications are maintained on file at our premises.

Standards established by R. M. Young Company for calibrating the measuring and test equipment used in controlling product quality are traceable to the National Institute of Standards and Technology (NIST).

Date of Certification: 07 Feb 2020

R. M. Young Company

Ed Chemosky
Quality Assurance

R. M. YOUNG COMPANY 2801 Aero Park Drive, Traverse City Michigan 49686-9171 USA
TEL: (231) 946-3980 FAX: (231) 946-4772 Email: met.sales@youngusa.com

YOUNG

CERTIFICATE OF CALIBRATION AND TESTING

SERIAL NUMBER:	**TB00015747**
CUSTOMER:	Organismo de Evaluacion y Fiscalizacion Ambiental -OEFA
P.O. NUMBER:	28992.14778
INV NUMBER:	154986
MODEL:	52203-20 TIPPING BUCKET RAIN GAUGE (UNHEATED)-SS

We hereby certify that the sensor serial number specified above has been inspected, tested, and found to comply with all process and material specifications established for the purpose of quality assurance of R. M. Young Company products. Engineering drawings, procedures, and specifications are maintained on file at our premises.

Standards established by R. M. Young Company for calibrating the measuring and test equipment used in controlling product quality are traceable to the National Institute of Standards and Technology (NIST).

Date of Certification: 07 Feb 2020

R. M. Young Company

Ed Chemosky
Quality Assurance

R. M. YOUNG COMPANY 2801 Aero Park Drive, Traverse City Michigan 49686-9171 USA
TEL: (231) 946-3980 FAX: (231) 946-4772 Email: met.sales@youngusa.com

YOUNG

CERTIFICATE OF CALIBRATION AND TESTING

SERIAL NUMBER:	**TB00015748**
CUSTOMER:	Organismo de Evaluacion y Fiscalizacion Ambiental -OEFA
P.O. NUMBER:	28992.14778
INV NUMBER:	154986
MODEL:	52203-20 TIPPING BUCKET RAIN GAUGE (UNHEATED)-SS

We hereby certify that the sensor serial number specified above has been inspected, tested, and found to comply with all process and material specifications established for the purpose of quality assurance of R. M. Young Company products. Engineering drawings, procedures, and specifications are maintained on file at our premises.

Standards established by R. M. Young Company for calibrating the measuring and test equipment used in controlling product quality are traceable to the National Institute of Standards and Technology (NIST).

Date of Certification: 07 Feb 2020

R. M. Young Company

Ed Chemosky
Quality Assurance

R. M. YOUNG COMPANY 2801 Aero Park Drive, Traverse City Michigan 49686-9171 USA
TEL: (231) 946-3980 FAX: (231) 946-4772 Email: met.sales@youngusa.com