GRIMM

Aerosol Technik

Environmental Dust Monitor EDM180

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Spectrometer Division Manager

www.GRIMM-aerosol.com

www.METS-Oman.com

AGENDA

technology

User benefits

Approvals & certifications

This presentation was brought to you by
Mazoon Environmental and Technological Services LLC
www.METS-Oman.com, info@METS-Oman.com

www.GRIMM-aerosol.com

EDM180 stationary ambient monitor

* Equivalent to EN12341, EN14907 and US-EPA
* 19“ rack mount
* Special NAFION dehumidification system
* GESYTEC MODE for networks
* Long time measurement
* Very low TCO‘s

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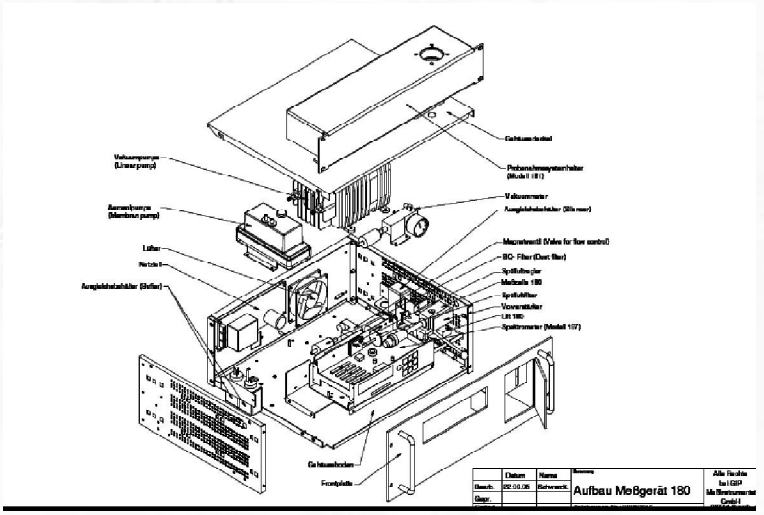

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General features

- 31 channel size distribution
- Different measurements simultaneously
- No probe heating only dehumidifiaction
- No loss of Semi-Volatile compounds
- Nano particles possible

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NAFION DRYER

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Sampling pipe with Nafion tube

Benefits of Nafion

- **Nafion transfers moisture quickly**
  Water transfers through Nafion as a first order kinetic reaction. Water transport is driven by partial vapor pressure differential.

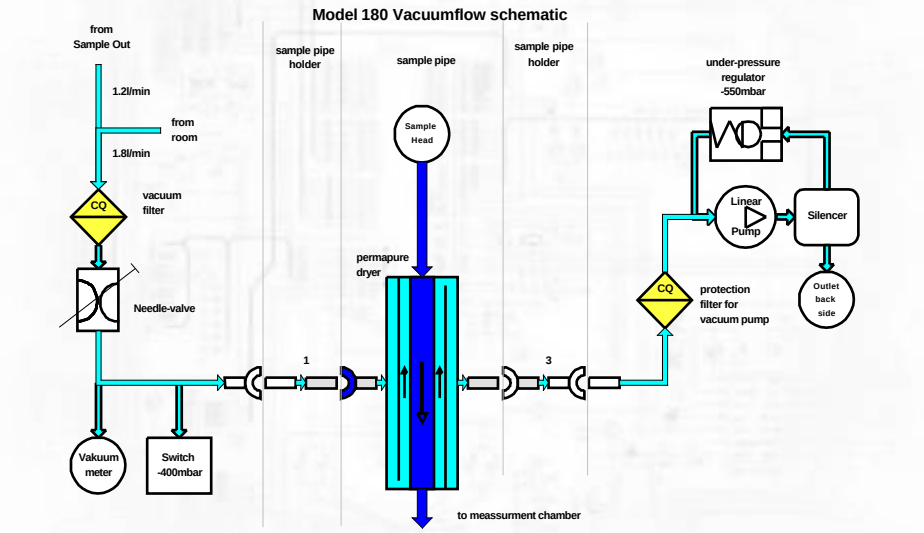
- **Nafion transfers water selectively**
  Water associates readily with sulfonic acid groups and permeates through the membrane wall.

- **Nafion needs no maintenance**

  By the working principle of the Nafion it has the big advantage that it doesn't need any cleaning and has a long life time (if used under normal ambient air conditions over 10years) without loss of performance.

- **No loss of semi volatile compounds**

Dryer flow schematic



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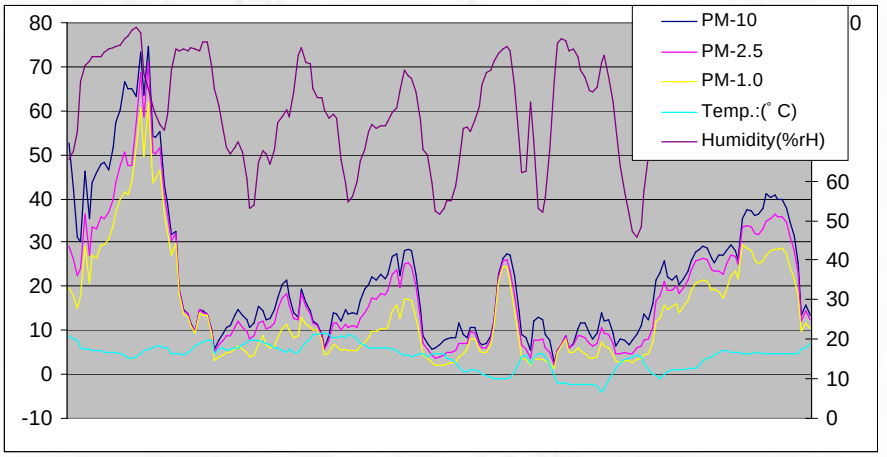
RAW Data – 15min average values



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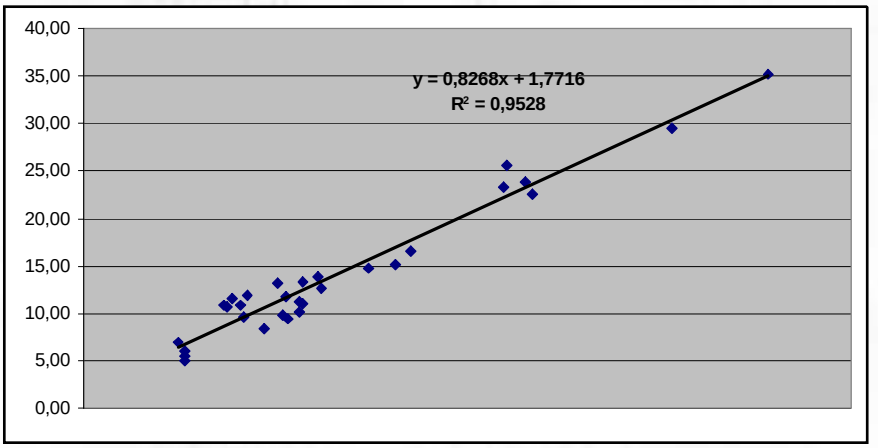
RAW Data – comparison to reference daily values



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General features

Results are :

- in real time – fast mode 6 seconds
- not location specific
- no seasonal mass corrections
- no radioactive source
- no sensitivity to vibrations.
- with RS-232 and enviro-protocoll
- data is reproducable
- instruments can be exactly calibrated

Quality control & calibration

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1. manual & electrical

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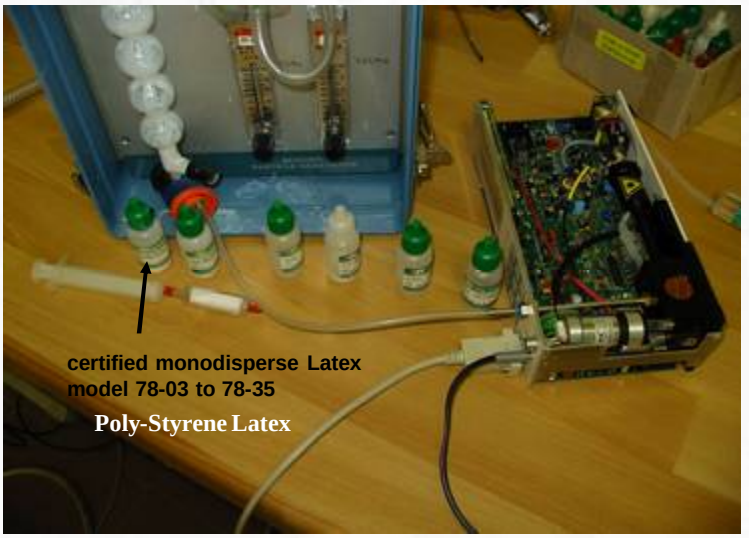
2. Single channel Calibration



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3. Calibration procedure

The calibration tower, model 7.851 permits powder injection (on demand) of aerosol particles in a wide size range
0.2µm - 30µm, dolomite dust model 7.856

The operation is fully computer controlled and permits the access of one to three spectrometers in comparison to one reference "mother unit"

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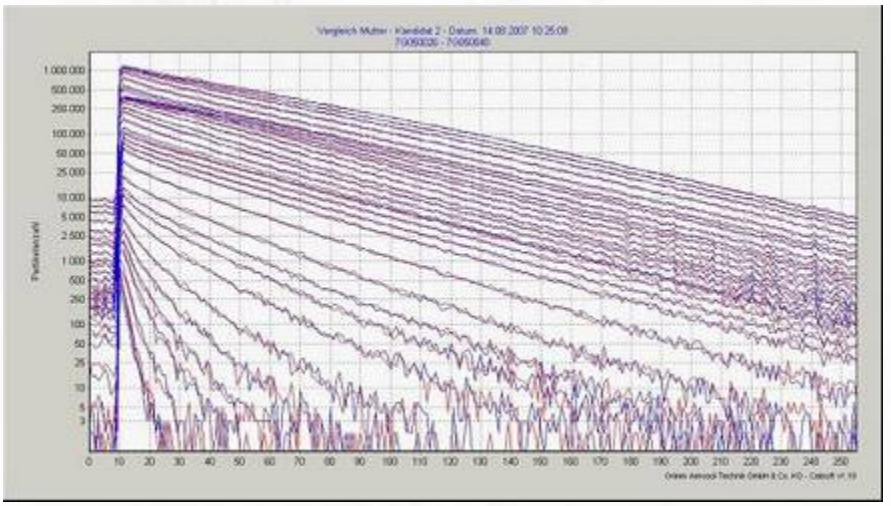
4. Single channel adjustment



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5. Outdoor control procedure

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Quality control by user

every 6 month

- leak test
- zero test
- flow control

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Quality control by user

K-Line

- permanent control of laser quality
- 24hour automatic self test system
- at every system start

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Quality control by user

every 12 – 18 months

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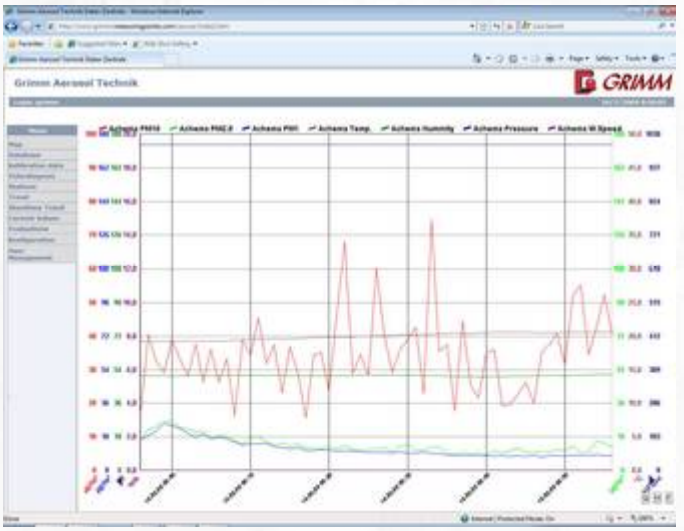
Data is real time available in the WWW



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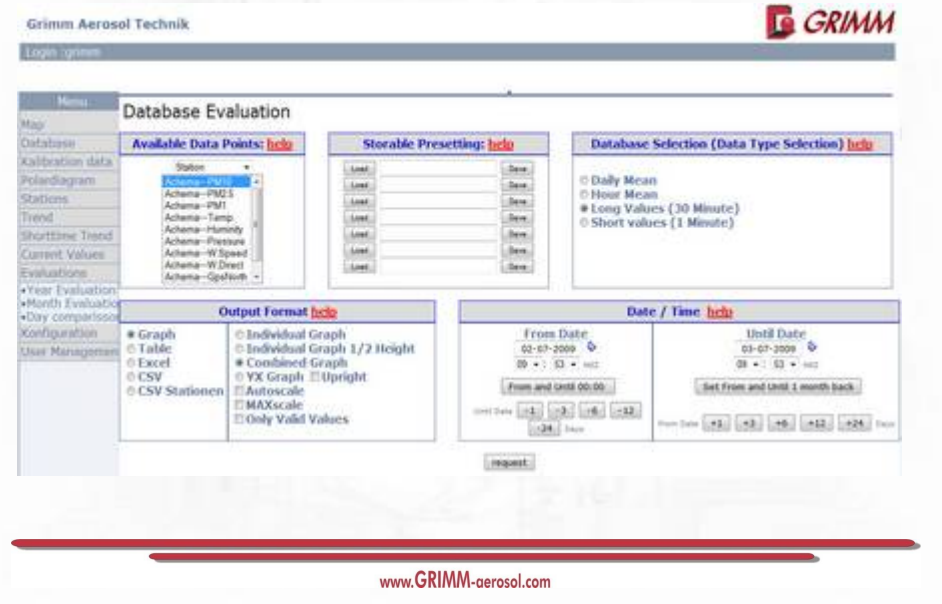

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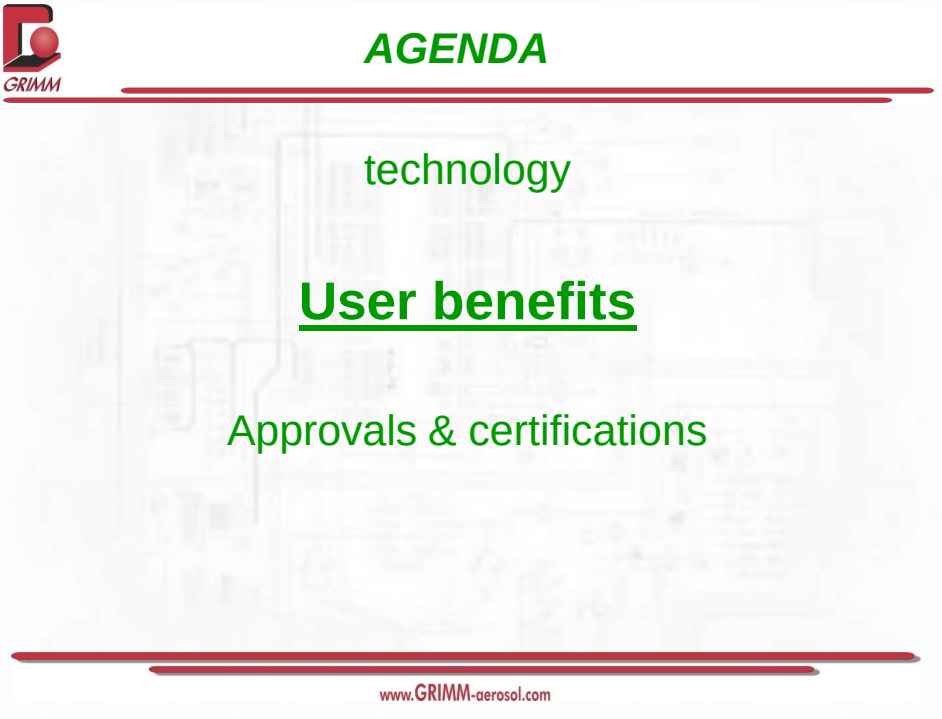

User benefits

Maintenance

The system is designed in such a way that only a minimum of maintenance is needed.
Every 6 months a system check with a easy to use test kit.
Calibration control every 12 –18
→ Reduction of life time costs

Automatically Check System

A complete automatically self test and control system is watching over the instruments quality and reports errors

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User Benefits

Consumables

No Consumables are needed (for example filter band)
→Reduction of costs
(at other instruments this could cost up to 3.000€ within 3 years)

Energy costs are lower

The maximum power consum is 50W/h
→ Reduction of energy costs
(example of Helsinki: 3 EDM180 – 150W, for the same number of values PM10 & PM2.5 – 6 TEOM – 3000W.
Cost save in Helsinki within 10 years 26.000€)

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User Benefits

Simultaneous three PM values

The only available fine dust monitor, EN approved for PM-10 witch the ability to measure simultaneously PM-10 and PM-2.5 and PM-1 in µg/m3

Count Values

Additional information of the total fine dust particle concentration will allow the understanding of the aerosol source measured. Data are in Particles / litre.

Risk Management

Fast data presentation, combined with the meteorological sensors will allow to identify the source direction and the possible risk associated. Distribution models can be feed with such information's.

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Differences to the competitors

(TEOM, SHARP, BAM,...)

- 4 different values simultaneously in real time
- No heating of the probe – therefor no loss of SEMI Volutiles – the only instrument that includes the SVC fraction in all PM values
- No radioactive source is in use
- No consumables (no change of filters, cardriges,....)
- No problems with sand storms or desert areas
- No external pump systems No specification of the measurement range by the probe pipe head (TSP head is used)
- Easily change of measurement if regulation changes by firmware update – no need of hardware change!

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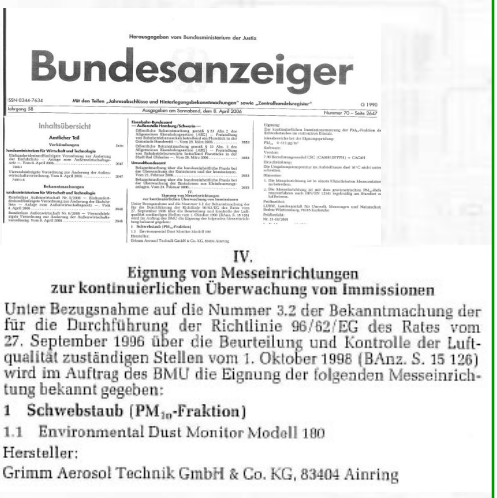
STEP1 - EN12341 – PM10



Bundesanzeiger

IV.

Eignung von Messeinrichtungen
zur kontinuierlichen Überwachung von Immissionen

Unter Bezugsnahme auf die Nummer 3.2 der Bekanntmachung der für die Durchführung der Richtlinie 96/62/EG des Rates vom 27. September 1996 über die Beurteilung und Kontrolle der Luftqualität zuständigen Stellen vom 1. Oktober 1998 (BAnz. S. 15 126) wird im Auftrag des BMU die Eignung der folgenden Messeinrichtung bekannt gegeben:

1 **Schwebstaub (PM_{10}-Fraktion)**

1.1 Environmental Dust Monitor Modell 180

Hersteller:

Grimm Aerosol Technik GmbH & Co. KG, 83404 Ainring

- Official publicated certification on the 8th of April 2006 by the German UMEG
- First time that a light scattering instrument passed EN standards for environmental monitoring

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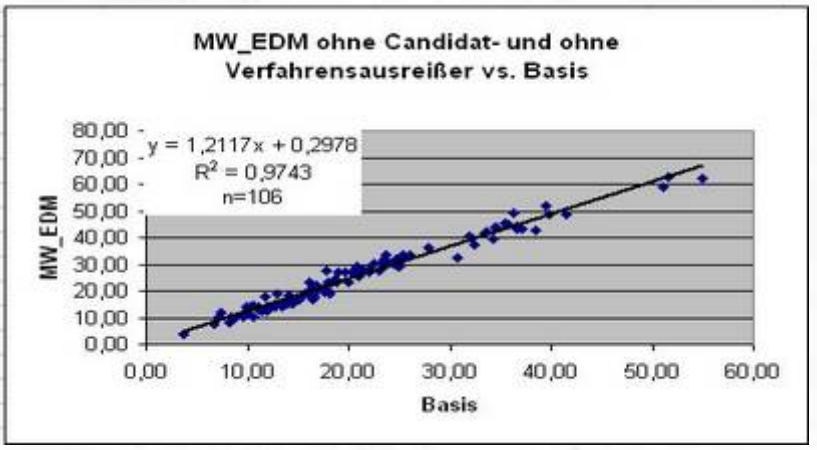
PM10 – Germany 106 days



Winter time comparison between Grimm and grafimatrical reference system Leckl filter collector
Correlation 0,974 and data quality 95%

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EN14907 – PM2.5

A LONG STORY

WITH A FINAL

APPROVED

END

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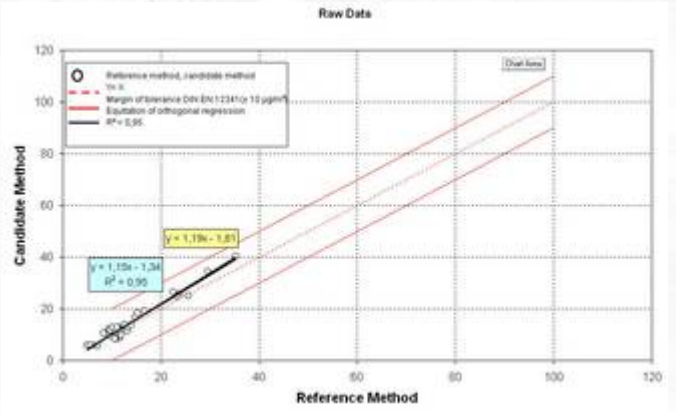
PM2.5 – Netherland

Raw data without any correction – 30days,
correlation to reference R^2 = 0,95, data quality 100%



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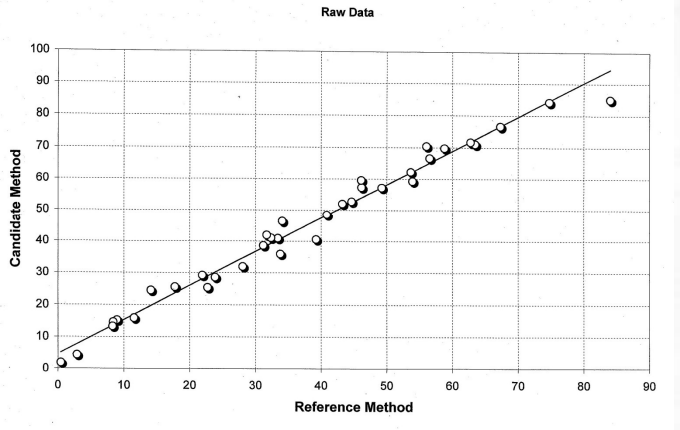
PM2.5 – Austria

Raw data without any correction – 34days,
correlation to reference R² = 0,93, data quality 98%



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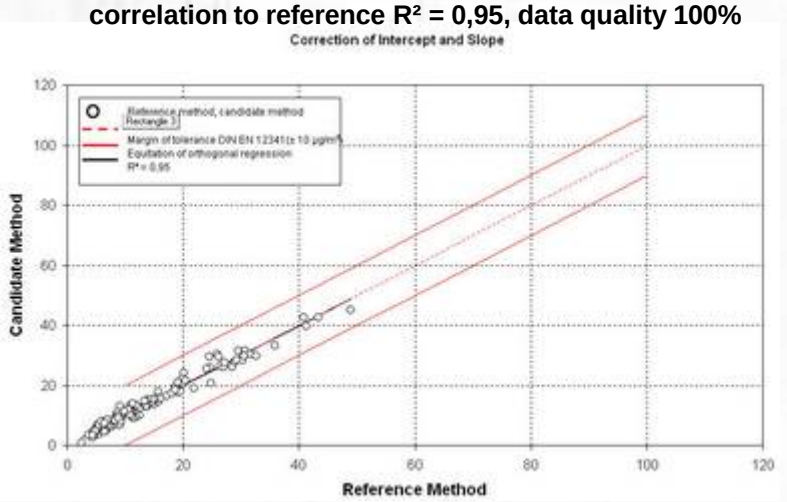
PM2.5 – Germany – 116 days

Corrected data – 116days,
correlation to reference R² = 0,95, data quality 100%



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PM2.5 – Germany – 116 days

SEQ 47/50 vs. EDM alle Daten o.V.	Equivalence field test		Number of data points:	116	
UNCORRECTED DATA			**INTERCEPT CORRECTION**		
REGRESSION OUTPUT			*REGRESSION OUTPUT*		
slope b	1,28	significant	slope b	1,28	significant
uncertainty of b	0,02		uncertainty of b	0,02	
intercept a	2,14	significant	intercept a	0,00	not significant
uncertainty of a	0,36		uncertainty of a	0,36	
EQUIVALENCE TEST RESULTS			*EQUIVALENCE TEST RESULTS*		
random term	1,53		random term	1,57	
bias at LV	9,07		bias at LV	6,94	
combined uncertainty	9,16		combined uncertainty	7,05	
exp. rel. comb.uncertainty (%) at LV	73,25	fail	exp. rel. comb.uncertainty (%) at LV	56,40	fail
RM between-sampler uncertainty	1,50		RM between-sampler uncertainty	1,50	
SLOPE CORRECTION			**INTERCEPT AND SLOPE CORRECTION**		
REGRESSION OUTPUT			*REGRESSION OUTPUT*		
slope b	1,00	not significant	slope b	1,00	not significant
uncertainty of b	0,02		uncertainty of b	0,02	
intercept a	1,72	significant	intercept a	0,05	not significant
uncertainty of a	0,28		uncertainty of a	0,28	
EQUIVALENCE TEST RESULTS			*EQUIVALENCE TEST RESULTS*		
random term	0,90		random term	0,97	
bias at LV	1,63		bias at LV	0,04	
combined uncertainty	1,89		combined uncertainty	0,98	
exp. rel. comb.uncertainty (%) at LV	15,12	pass	exp. rel. comb.uncertainty (%) at LV	7,87	pass
RM between-sampler uncertainty	1,50		RM between-sampler uncertainty	1,50	

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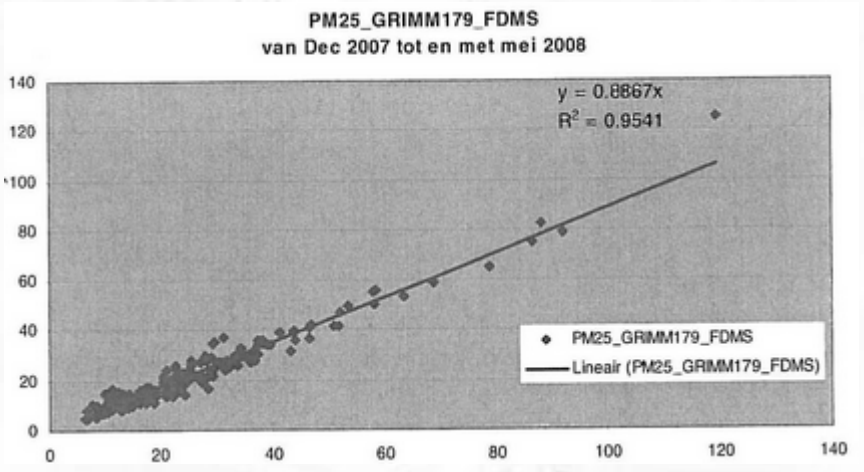
Comparison PM 2.5 Grimm – TEOM FDMS in Netherland by the DCMR



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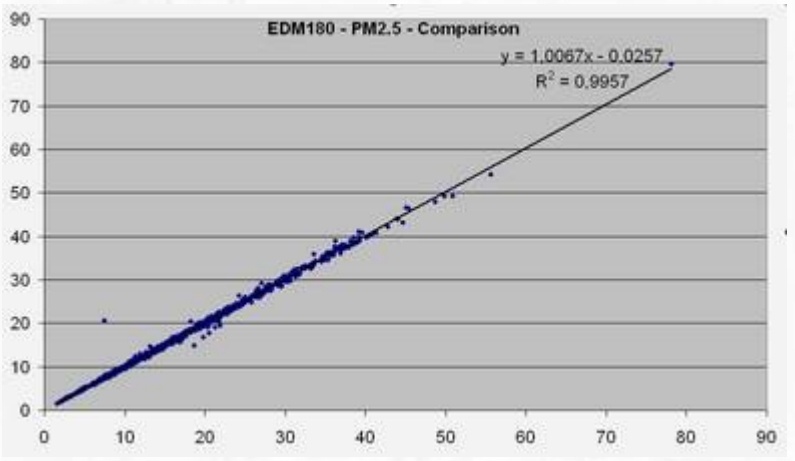
PM2.5 – Turkey



2 EDM180 compared over 90days

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EN14907 – PM2.5

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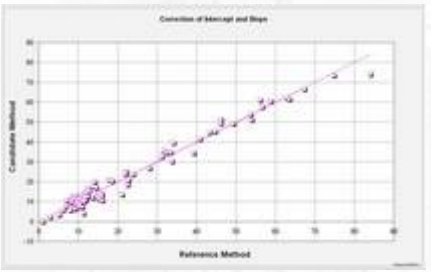
Step 2 - EN14907 – PM2.5



umweltbundesamt

Umweltbundesamt GmbH
Spittelauer Lände 5
1090 Wien/Österreich

Der kontinuierliche Staubmonitor GRIMM Modell 180 wurde entsprechend der Vorgaben des Leitfadens „Demonstration of Equivalence of Ambient Air Monitoring Methods" an vier Messstellen in Österreich gegen die Referenzmethoden für PM_{10} und $PM_{2.5}$ getestet und die dabei gewonnenen Messdaten nach den Regeln des Leitfadens ausgewertet.

Die Äquivalenz des GRIMM Modell 180 konnte sowohl für PM_{10} als auch für $PM_{2.5}$ nachgewiesen werden.

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Winter 2009 - EN14907 – PM2.5

PERSPEKTIVEN FÜR UMWELT & GESELLSCHAFT umweltbundesamt

Zusammenfassung der Ergebnisse des Äquivalenztests GRIMM Modell 180

Der kontinuierliche Staubmonitor GRIMM Modell 180 wurde entsprechend der Vorgaben des Leitfadens „Demonstration of Equivalence of Ambient Air Monitoring Methods" an vier Messstellen in Österreich gegen die Referenzmethoden für PM_{10} und $PM_{2.5}$ getestet und die dabei gewonnenen Messdaten nach den Regeln des Leitfadens ausgewertet.

Die Äquivalenz des GRIMM Modell 180 konnte sowohl für PM_{10} als auch für $PM_{2.5}$ nachgewiesen werden.

Die Messungen wurden an folgenden vier Messstellen durchgeführt:

- Messstelle 1: Graz Süd (städtischer Hintergrund, hohes Konzentrationsniveau) Dezember 2007 – März 2008
- Messstelle 2: Steyregg (locker verbautes Wohngebiet mit Industrieeinfluss) Juni 2008 – August 2008
- Messstelle 3: Wieselsfeld bei Hollabrunn (ländlich) Dezember 2008 – März 2009
- Messstelle 4: Klagenfurt (städtischer Hintergrund, niedriges Konzentrationsniveau) Juni 2009 – August 2009

Sowohl für PM_{10} als auch für $PM_{2.5}$ ist die Anwendung einer Kalibrierfunktion erforderlich.

Für PM_{10} beträgt die Kalibrierfunktion

$$c_{Equivalence} = c_{Kan\,korr} = (c_{Kan} - 0{,}37) / 1{,}155$$

Die maximale kombinierte Messunsicherheit wurde an der Messstelle Wieselsfeld beobachtet und betrug 9,6%.

Für $PM_{2.5}$ beträgt die Kalibrierfunktion

$$c_{Equivalence} = c_{Kan\,korr} = (c_{Kan} - 3{,}3) / 1{,}085$$

Die maximale kombinierte Messunsicherheit wurde an der Messstelle Wieselsfeld beobachtet und betrug 12,2%

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US-EPA

Applicant:	GRIMM USA
Candidate method:	Model 180 - PM2.5 Class III
Test site:	BAKERSFIELD, CALIFORNIA, - (Site location: A)

Data sets	Number
Valid data sets available:	46
Number of valid data sets required for Class III, location A:	46
Number of valid data sets for this test is:	OK
Additional data sets needed:	--

Precision	Data set mean, µg/m³		Data set precision, µg/m³		Relative precision (CV)	
	FRM	Candidate	FRM	Candidate	FRM	Candidate
Mean:	24,9	24,2	0,8	0,4	3,5%	1,7%
Maximum:	75,1	74,8	2,8	6,3	9,4%	11,3%
Minimum:	5,3	5,1	0,1	0,1	0,6%	0,1%
Candidate / FRM Ratio:		97,4%		45,4%		49,1%
RMS Relative Precision for this site:					3,8%	2,6%
Test requirements - PM2.5 Class III:					10,0%	15,0%
Precision Test Results for site:					OK	PASS

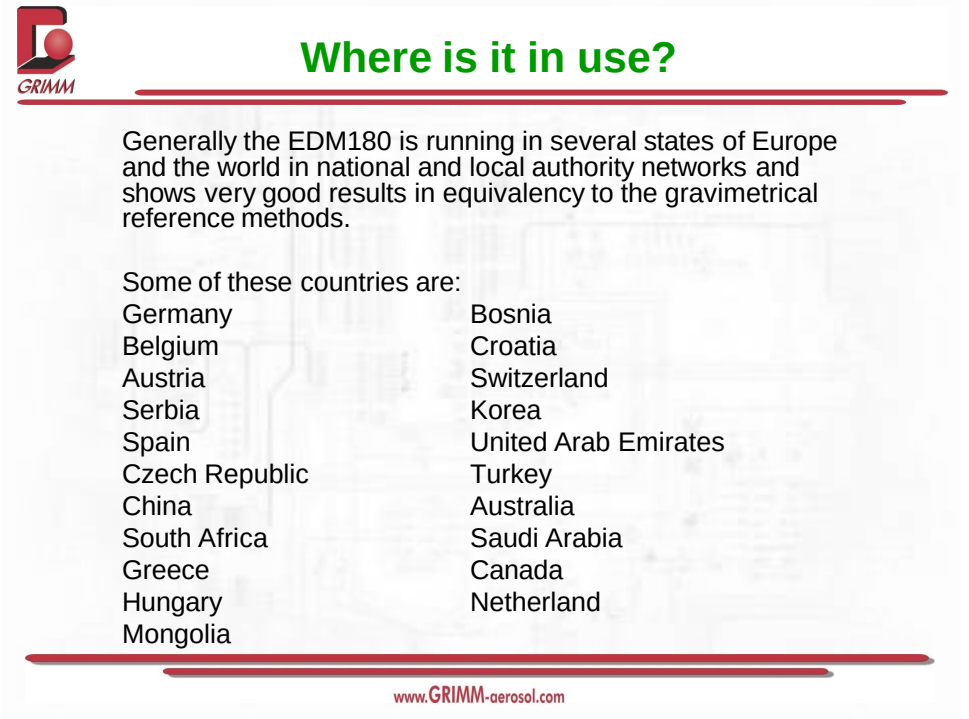
Regression statistics		Slope[1]	Intercept[2]	Correlation (r)
Statistics for this test site:		0,977	-0,089	0,99059
Limits for PM2.5 Class III	Upper:	1,100	2,000	
	Lower:	0,900	-1,873	0,95000
Test Results (Pass/Fail):		PASS	PASS	PASS

[1]Multiplicative bias [2]Additive bias

* **Finished fall 2009**

GRIMM Environmental Dust Monitor EDM180

- 2006 for PM10 according to EN12341
- 2009 for PM10 new EN regulations
- 2009 for PM2.5 according to EN12341
- 2010 US-EPA papers are published
- 2010 Russian Approval finished in summer



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