A Systematic Approach to Data Verification & Validation

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August 2016

EPA QA/G-8

Guidance on Environmental Data Verification and Data Validation

https://www.epa.gov/sites/production/files/2015-06/documents/g8-final.pdf

Data Verification

“Process of evaluating the completeness, correctness, and conformance/compliance of a specific data set against the method, procedural, or contractual requirements.”

Data Validation

"An analyte- and sample-specific process that extends the evaluation of data beyond method, procedural, or contractual compliance to determine the analytical quality of a specific data set."

Who Verifies Data?

- Air monitoring personnel
- Bench chemists
- Project leader
- QA manager
- Laboratory Director
- Everyone that plays a role in producing the data

Steps in Verification

1. Identify needs and location of records and documentation, technical specifications
    - Logbooks
    - Electronic data
    - Filter weights for $PM_{2.5}$

Steps in Verification

2. Compare records and documentation against the method or procedural requirements.
    - QA Handbook Vol II, Appendix D (my method - critical & operational criteria)
    - QAPP
    - SOP

Outputs of Verification

- Verified Data
- Data Verification Record
  - Certification statement that is signed by the responsible personnel
  - Should also identify any non-compliance issues and how this did or did not affect data

Example

Ozone Criteria – Alliance	Yes	No	Comments
1-point check done every 2 weeks?	☑	☐	
Zero/span check done every 2 weeks?	☑	☐	
QC points within +/- 7% of std value?	☑	☐	
Shelter temp maintained within 20-30 Degrees C?	☑	☐	
Shelter temp < +/- 2 Degrees C SD over 24 hrs?	☐	☑	6/3 & 6/4, temp varied by >2°
Maintenance performed as scheduled? (see maintenance checklist)	☑	☐	
Other comments:			

CO Criteria	Yes	No	Comments
1-point check done every 2 weeks?	☑	☐	
Zero/span check done every 2 weeks?	☑	☐	
QC points within +/- 10% of std value?	☑	☐	
Shelter temp maintained within 20-30 Degrees C?	☑	☐	
Shelter temp < +/- 2 Degrees C SD over 24 hrs?	☑	☐	
Maintenance performed as scheduled? (see maintenance checklist)	☑	☐	
Other comments:			

Other comments:				
XXXXXXX				
Signature:		Date:	7/20/2016	

Data Validation

- Based on ‘measurement quality objectives’ in the QAPP (overlap with verification)
- Reasons for any failures to meet method or procedural requirements and the impact on the overall set of data
- In my mind – the bigger picture…

Most Importantly…

Data validator must not be person producing the data!

Steps in Validation

1. Obtain verification records and other needed records
   - Instrument Calibrations
   - Certifications of ancillary equipment such as flow cells or orifice
   - Chain of custody forms?
   - Instrument and Site Logbooks

Steps in Validation

2. Review records to determine the quality of data.
   - Were project needs met?
     - Back to Appendix D – look at operational and systematic criteria (bigger picture)
   - Trends in data that could point to something else going on?

Outputs of Validation

- Validated Data
- Data Validation Report
  - Communication with data user
  - Emphasize any deficiencies and impact on overall data quality
  - Data qualifiers with reasons for assignment(s)

Example

CO Criteria	Yes	No	Comments
Flow cells certified in last 12 months?	☑	☐	
In past 6 months, was monitor cal'd?	☑	☐	
Does data fall within expected range of values? Address any outliers.	☑	☐	
Are any trends noticed in performance checks?	☐	☑	
Are any trends noticed in data?	☐	☑	
Was recent audit within acceptable range? Address trends.	☑	☐	
Other comments:			

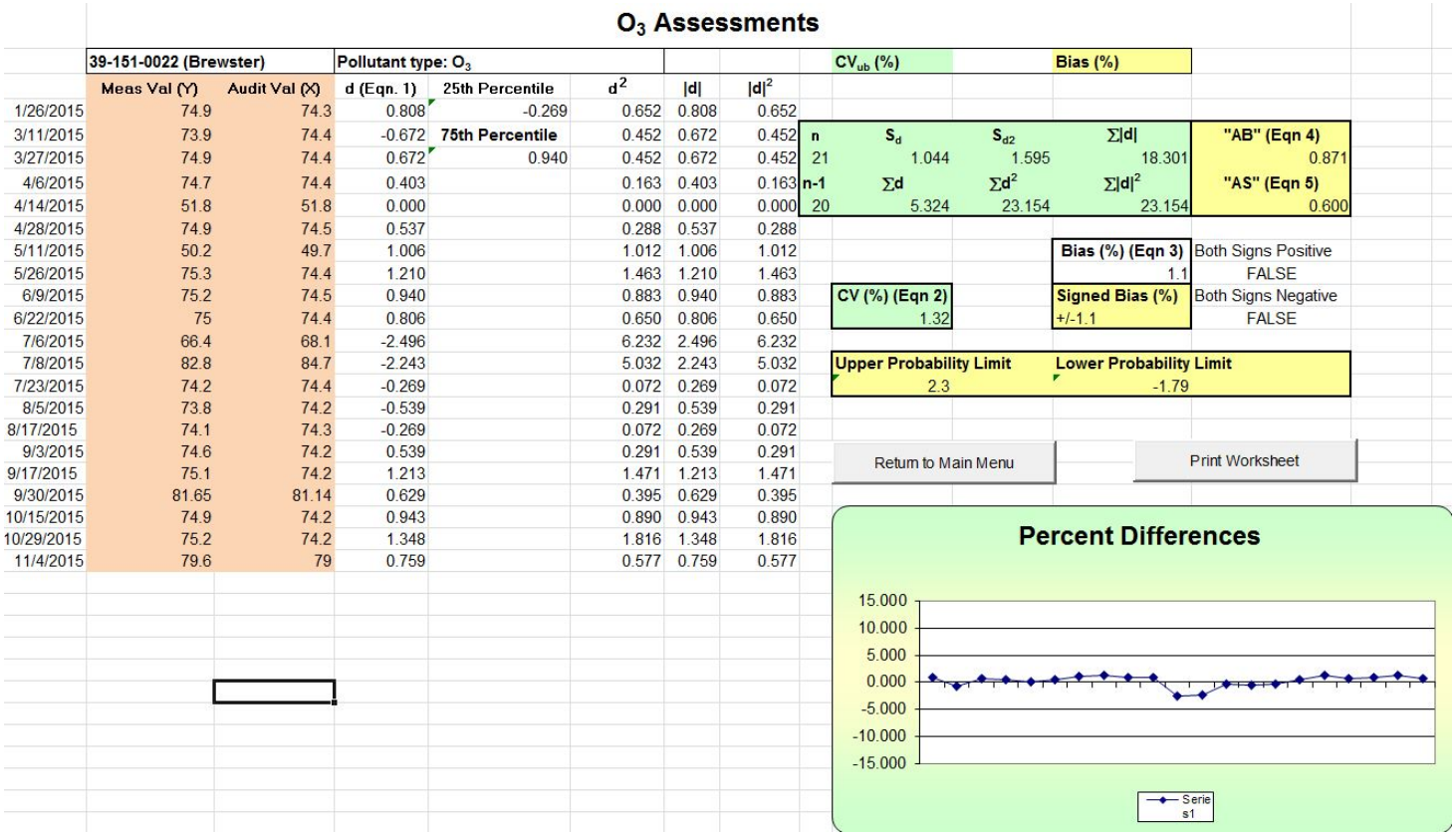
BGI Criteria – 17D	Yes	No	Comments
In past year, was temp multi-point verification or calibration done?	☐	☑	not multi-pt
In past year, was pressure verified or calibrated?	☑	☐	
In past year or after transport, was flow rate multi-point verification or calibration done?	☑	☐	
Does data fall within expected range of values? Address any outliers.	☑	☐	
Are any trends noticed in performance checks?	☐	☑	
Are any trends noticed in data?	☐	☑	
Was recent audit within acceptable range? Address trends.	☑	☐	
Other comments:			

XXXXXXXX

Signature: Date: 6/17/2016

Helpful Tools

- DASC – Data Assessment Statistical Calculator



O_3 Assessments

	39-151-0022 (Brewster)		Pollutant type: O_3				
	Meas Val (Y)	Audit Val (X)	d (Eqn. 1)	25th Percentile	d^2	|d|	$\|d\|^2$
1/26/2015	74.9	74.3	0.808	-0.269	0.652	0.808	0.652
3/11/2015	73.9	74.4	-0.672	**75th Percentile**	0.452	0.672	0.452
3/27/2015	74.9	74.4	0.672	0.940	0.452	0.672	0.452
4/6/2015	74.7	74.4	0.403		0.163	0.403	0.163
4/14/2015	51.8	51.8	0.000		0.000	0.000	0.000
4/28/2015	74.9	74.5	0.537		0.288	0.537	0.288
5/11/2015	50.2	49.7	1.006		1.012	1.006	1.012
5/26/2015	75.3	74.4	1.210		1.463	1.210	1.463
6/9/2015	75.2	74.5	0.940		0.883	0.940	0.883
6/22/2015	75	74.4	0.806		0.650	0.806	0.650
7/6/2015	66.4	68.1	-2.496		6.232	2.496	6.232
7/8/2015	82.8	84.7	-2.243		5.032	2.243	5.032
7/23/2015	74.2	74.4	-0.269		0.072	0.269	0.072
8/5/2015	73.8	74.2	-0.539		0.291	0.539	0.291
8/17/2015	74.1	74.3	-0.269		0.072	0.269	0.072
9/3/2015	74.6	74.2	0.539		0.291	0.539	0.291
9/17/2015	75.1	74.2	1.213		1.471	1.213	1.471
9/30/2015	81.65	81.14	0.629		0.395	0.629	0.395
10/15/2015	74.9	74.2	0.943		0.890	0.943	0.890
10/29/2015	75.2	74.2	1.348		1.816	1.348	1.816
11/4/2015	79.6	79	0.759		0.577	0.759	0.577

CV_{ub} (%) | Bias (%)

n	S_d	S_{d2}	$\sum\|d\|$	"AB" (Eqn 4)
21	1.044	1.595	18.301	0.871
n-1	**$\sum d$**	**$\sum d^2$**	**$\sum\|d\|^2$**	**"AS" (Eqn 5)**
20	5.324	23.154	23.154	0.600

Bias (%) (Eqn 3)	Both Signs Positive
1.1	FALSE
CV (%) (Eqn 2)	**Signed Bias (%)**	Both Signs Negative
1.32	+/-1.1	FALSE

Upper Probability Limit	Lower Probability Limit
2.3	-1.79

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Percent Differences

Helpful Tools

- Excel

Date	Leak Init	Leak Final	Leak Δ	A^0 Meas	A^0 Std	A^0 Δ	F^0 Meas	F^0 Std	F^0 Δ	Flow Samp	Flow Std	Δ Flow	% Diff
1/15/14	98	97	1	-1.2	0.7	-1.9			0.0	16.74	16.56	0.18	1.09
2/24/14	97	96	1	23.9	22.8	1.1	22.8	23.1	-0.3	16.71	16.72	-0.01	-0.06
3/11/14	99	98	1	18.5	18.3	0.2	19.1	19.2	-0.1	16.74	16.60	0.14	0.82
4/4/14	99	98	1	19.6	19.3	0.3	18.6	19.7	-1.1	16.75	16.75	0.00	0.00
11/3/14	98	96	2	16.0	15.7	0.3	16.3	16.6	-0.3	16.70	16.40	0.30	1.83
11/17/14	98	95	3	-0.5	-0.6	0.1	-1.3	-0.4	-0.9	16.69	16.44	0.25	1.52
12/5/14	95	92	3	3.1	3.3	-0.2	2.6	3.7	-1.1	16.69	16.53	0.16	0.97
12/23/14	97	96	1	9.9	9.9	0.0	9.1	10.3	-1.2	16.68	16.49	0.19	1.15
1/16/15	98	97	1	0.04	-0.10	0.1	-0.18	0.6	-0.8	16.70	16.49	0.21	1.27
2/3/15			0			0.0			0.0	16.70	16.72	-0.02	-0.12
2/10/15	97	95	2	-0.5	0.3	-0.8	4.1	2.9	1.2	16.71	16.78	-0.07	-0.42
3/2/15	95	95	0	-1.4	-1.3	-0.1	-0.1	0.9	-1.0	16.70	16.46	0.24	1.46
3/2/15			0			0.0			0.0	16.70	16.67	0.03	0.18
3/5/15	100	99	1			0.0			0.0	16.71	16.64	0.07	0.42
3/5/15			0			0.0			0.0	16.69	16.55	0.14	0.85
3/23/15	97	96	1	2.5	3.2	-0.7	3.3	4.5	-1.2	16.71	17.08	-0.37	-2.17
4/23/15	97	95	2	5.2	5.3	-0.1	5.4	5.9	-0.5	16.71	16.96	-0.25	-1.47
5/19/15	104	102	2	17.5	17.5	0.0	18.1	19.2	-1.1	16.70	16.98	-0.28	-1.65
5/20/15	95	94	1	12.7	12.9	-0.2	14.3	15.4	-1.1	16.71	17.05	-0.34	-1.99
6/12/15	102	101	1	30.0	30.0	0.0	30.6	31.5	-0.9	16.71	17.08	-0.37	-2.17
7/7/15	99	98	1	25.1	25.0	0.1	25.1	26.2	-1.1	16.69	16.98	-0.29	-1.71
7/24/15	97	96	1	26.2	26.2	0.0	26.6	27.7	-1.1	16.69	17.03	-0.34	-2.00
7/30/15	100	98	2	25.7	26.2	-0.5	26.7	27.5	-0.8	16.72	17.20	-0.48	-2.79
7/30/15			0						0.0	16.71	16.67	0.04	0.24
8/18/15	97	96	1	28.9	28.9	0.0	29.9	30.9	-1.0	16.69	16.73	-0.04	-0.24
9/14/15	96	94	2	19.2	19.3	-0.1	20.5	21.2	-0.7	16.71	16.59	0.12	0.72
10/20/15	94	92	2	15.9	15.9	0.0	16.7	17.8	-1.1	16.70	16.42	0.28	1.71

Questions?

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