

# Quality System Training Module 4 Data Validation and Usability



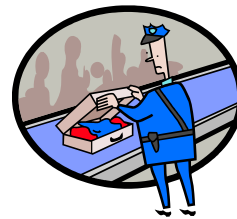
Dennis Mikel

EPA - Office of Air Quality Planning and Standards

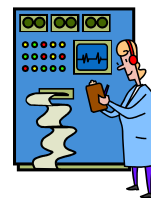
2008 Conference on Managing Environmental Quality Systems

## Some Definitions

- **Verification** — is the **process for evaluating the completeness, correctness, and conformance/compliance of a specific data set against the method**, procedural, or contractual specifications. It essentially evaluates performance against pre-determined specifications, for example, in an analytical method, or a software or hardware operations system.



**Validation** — is an analyte- and sample-specific process that extends the evaluation of data beyond method, procedure, or contractual compliance to **determine the quality of a specific data set relative to the end use. It focuses on the project's specifications or needs, designed to meet the needs of the decision makers/data users** and should note potentially unacceptable departures from the QA Project Plan. The potential effects of the deviation will be evaluated during the data quality assessment.

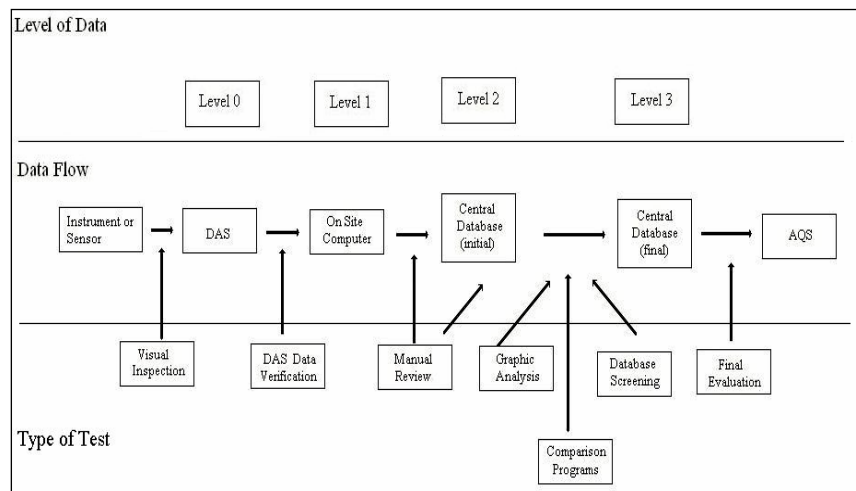


## Process Design

- Validation and Verification are part of a process
  - It should be performed at many different points
  - It should be performed by qualified staff
  - **It is the responsibility of QA and QC**
  - There are 4 levels of validated data
  
  - Verification takes place early in process
  - Validation takes place later in the process

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## The Process



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## Levels of Validation

- Level 0
  - Essentially raw data obtained from the DAS,
    - Data have been reduced, but are unedited and un-reviewed, nor adjusted.
- Level 1
  - Checks are performed by DAS software
    - screening programs
    - Qualitative checks are performed by field staff
    - Quality control flags are assigned

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## Levels of Validation

- Level 2
  - Comparisons with independent data sets, such as meteorological and ambient pollution data
  - Utilize database screening tools, SAS or SQL
- Level 3
  - Detailed analysis and final screening
  - Validate so there are no inconsistencies among the related data
  - Graphics programs used examine the overall consistency

**If you have met data use it to validate your pollution data!!!**

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## Step 1: Visual Inspection

Enviros for Windows (PDAQPS1)

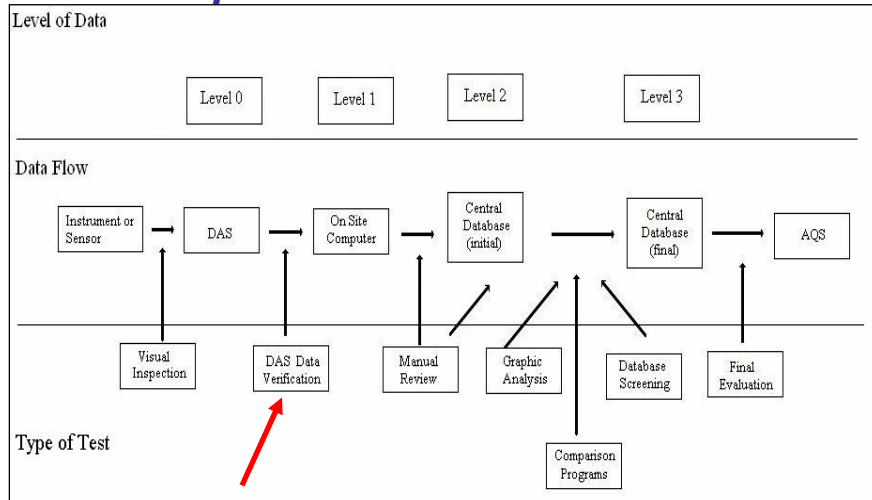
Dynamic Tabular

Channel	Input Signal	Instantaneous	Last 15Min AVG.	Last 15Min AVG.	Last 60Min AVG.
01 - CO - TEI [PPB]	287.000	287	287	231	239
02 - SO2 - TEI [PPB]	0.164	0.16	0.06	0.09	0.09
03 - NO-AGD [PPB]	HoData	HoData	HoData	HoData	HoData
04 - NOy-AGD [PPB]	HoData	HoData	HoData	HoData	HoData
05 - NOz-AGD [PPB]	HoData	HoData	HoData	HoData	HoData
06 - SITE TEMP [DEGC]	0.239	23.9	23.4	23.3	23.9
07 - CO - API [PPB]	232.000	232	219	241	249
08 - O3-API [PPB]	05232_0.000	05232_0.0	21.2	22.2	5.6
09 - WS Prop 10M [m/s]	1.000	1.5	1.6	2.3	1.0
10 - WD Vane 10M [deg]	39.000	39.0	1.3	23.5	17.6
11 - TEMP 3M [deg]	21.000	22.9	22.7	22.8	21.9
12 - RH [%]	93.000	93	95	94	100
13 - Precip. [MM]	0.000	0.0	0.0	0.0	0.0
14 - HO-API [PPB]	2.557	2.56	1.62	2.67	1.69
15 - HOy-API [PPB]	11.420	12.42	11.25	11.84	14.07
16 - HOz-API [PPB]	19.863	19.86	5.73	11.17	12.38
17 - Manifold Flow [PLMin]	0.905	362.00	367.23	368.36	376.55
18 - Solar Radiation [W/M2]	0.020	454	342	474	68
19 - WS Ultra 10M [m/s]	0.171	1.71	1.65	2.05	1.24
20 - WD Ultra 10M [deg/H]	3.580	26.6	342.0	42.1	3.5
21 - Elev Ultra 10M [deg]	2.779	6.7	5.5	-8.0	-2.1
22 - CO-DIFF [ppb]	HoData	25	3	11	7
23 - SO2-API [ppb]	0.240	0.24	0.15	0.24	0.22
24 - SO2-DIFF [PPB]	HoData	0.14	0.00	0.15	0.20
25 - HOy-Flow [l/m]	HoData	HoData	HoData	HoData	HoData
26 - HOy-Conv Temp [degrees C]	HoData	HoData	HoData	HoData	HoData
27 - HOz-AGD [ppb]	HoData	Invalid_0.00	Invalid_0.00	Invalid_0.00	Invalid_0.00

8/27/2007 7:59 AM

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## Step 2: DAS Data Verification

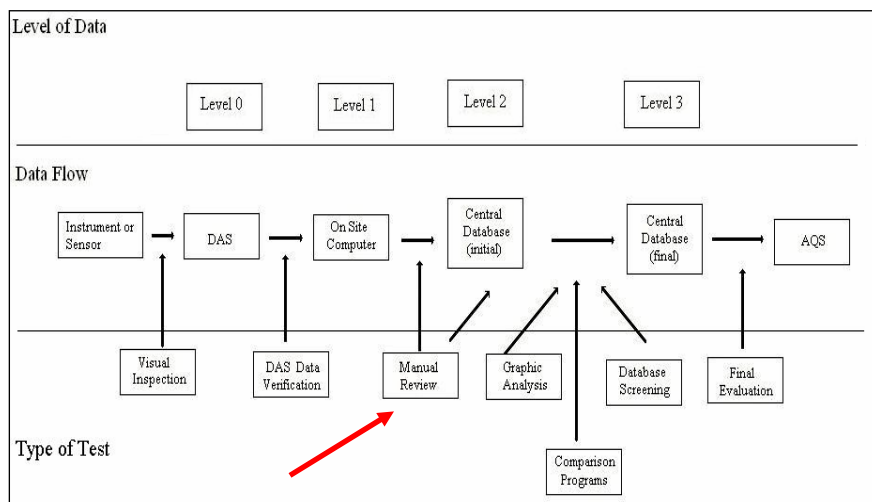


## Step 2: DAS Data Verification

- A few techniques
  - Did the value exceed the preset maximum limit?
  - Did the value exceed the preset minimum limit?
  - Did the value exceed a defined rate of change?
    - Fall time or rise time
  - Does the data need to have a percentage of valid readings to be considered valid?
  - DAS will flag any data if exceeds your limits!
  - This is performed as data are collected and is automated, how cool is that!

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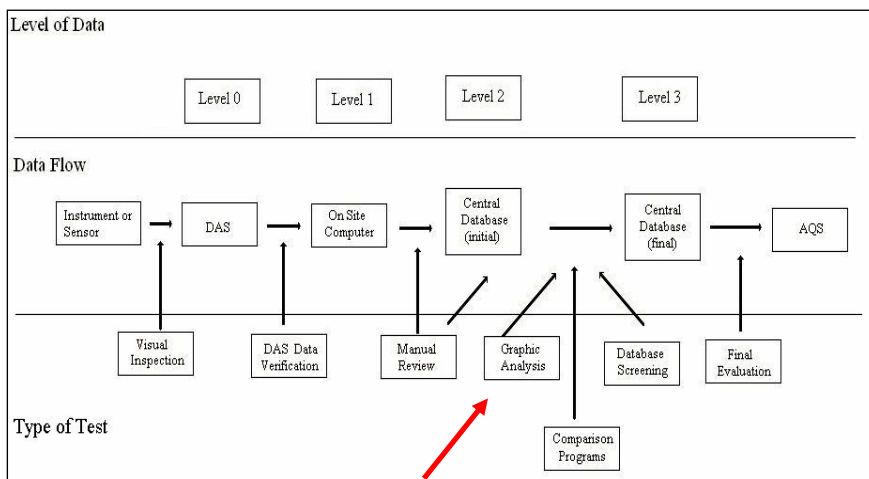
## Step 3: Manual Review



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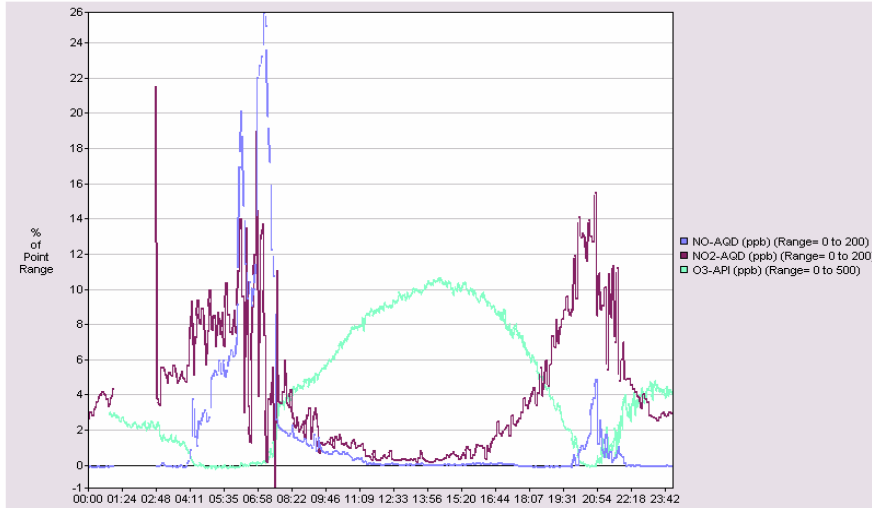
Time	NO (ppb)	NOy (ppb)	NO2	O3 (ppb)	2m Temp	RH (%)
00:00 AM	1.53	5.86	2.01	33.8	2.1	53
1:00:00 AM	1.34	4.88	1.8	35.2	1.3	55
2:00:00 AM	1.28	4.45	1.51	37.8	0.8	52
3:00:00 AM	6.32	3.15	-32.73	38.3	0.4	51
4:00:00 AM	1.17	4.14	1.9	33.5	-1.1	62
5:00:00 AM	1.66	4.79	1.54	31.4	-1.7	66
6:00:00 AM	1.47	4.55	1.51	32.2	-1.4	61
7:00:00 AM	1.76	5.42	2.37	31.5	-1.7	59
8:00:00 AM	2.86	6.85	1.96	32.3	-0.9	51
9:00:00 AM	2.12	4.01	-0.93	38.1	1	39
10:00:00 AM	2.03	3.62	-1.56	40.6	2.7	33
11:00:00 AM	1.83	3.26	-1.75	42.8	4.2	29
12:00:00 PM	1.83	3.22	-1.84	44	5.7	27
13:00:00 PM	1.59	3.45	-1.04	45	6.8	26

### Step 4: Graphic Analysis



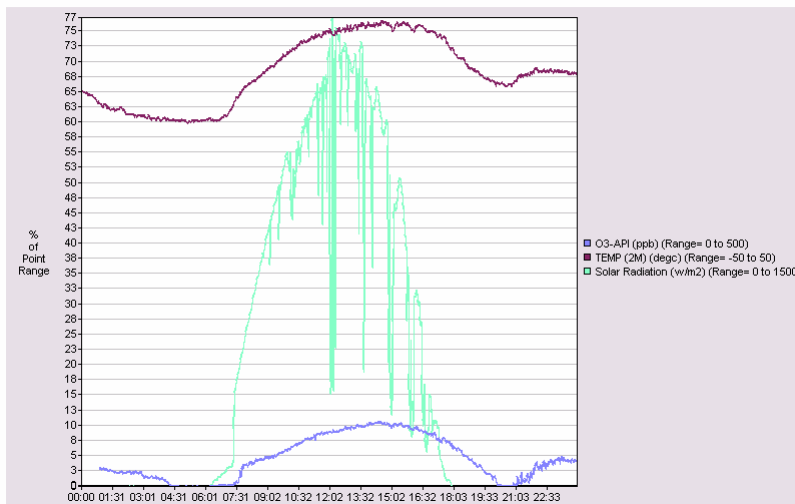
### Step 4: Graphic Analysis

Burden's Creek NCore 10.1.07



### Step 4: Graphic Analysis

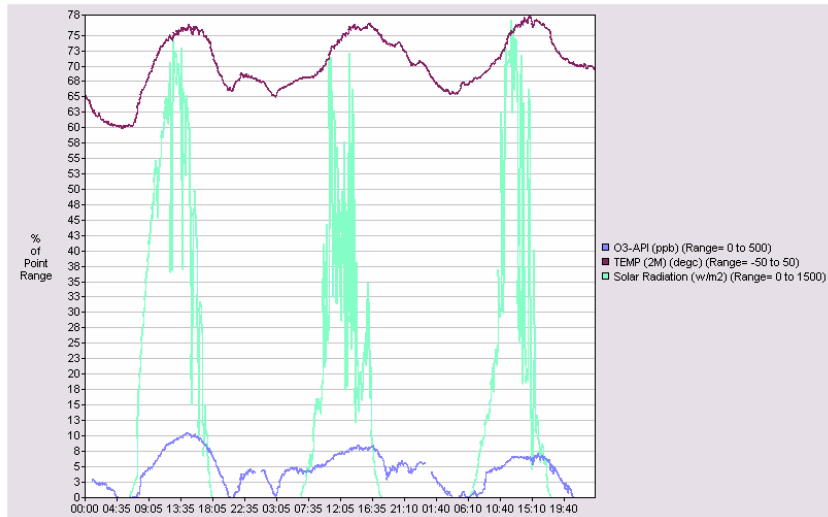
Burden's Creek NCore 10.1.07





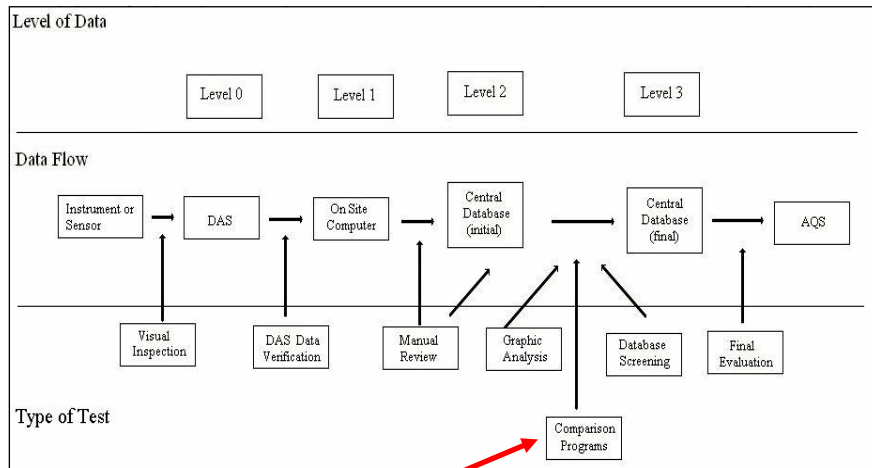
## Step 4: Graphic Analysis

Burden's Creek NCore 10.1 - 10.4.07



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## Step 5: Comparison Program



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**EPA** United States Environmental Protection Agency

**Ambient Air Quality System Training**  
QA Strategy Workgroup

**AIRNOW TECH**

Home Agencies Sites Navigator Data Forecasts Polling Notifier Resources

Tools Tool Options Site Info

Search, Pan, Back, Full Extent, Site Info, Print, Refresh, Home

Data Mode: Site Map, Hourly Data

Map Size: Small, Medium, Large

Default Map: Set as Default Map, Clear Default Map, Go to Default Map

Options Layers Legend

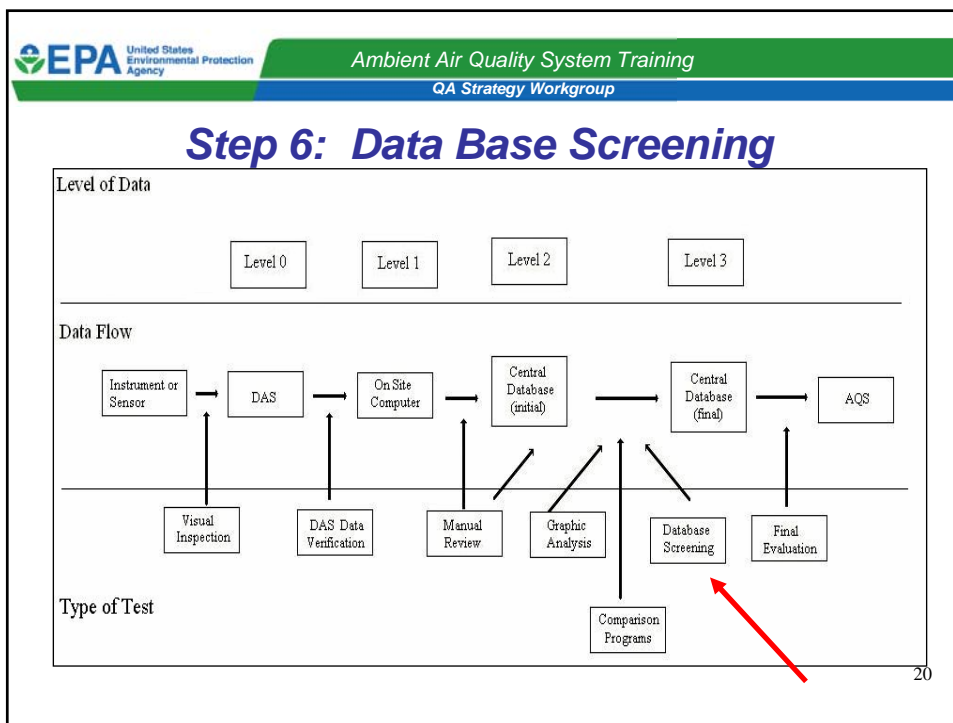
Select Data  
Air Quality Parameter: OZONE (PPB)  
Meteorology Parameter: WIND (BARBS)

Time Select  
Date: 10/30/2006  
Hour: 12 EST

Advance Hour: -24, -8, -1, +1, +8, +24

Apply Changes

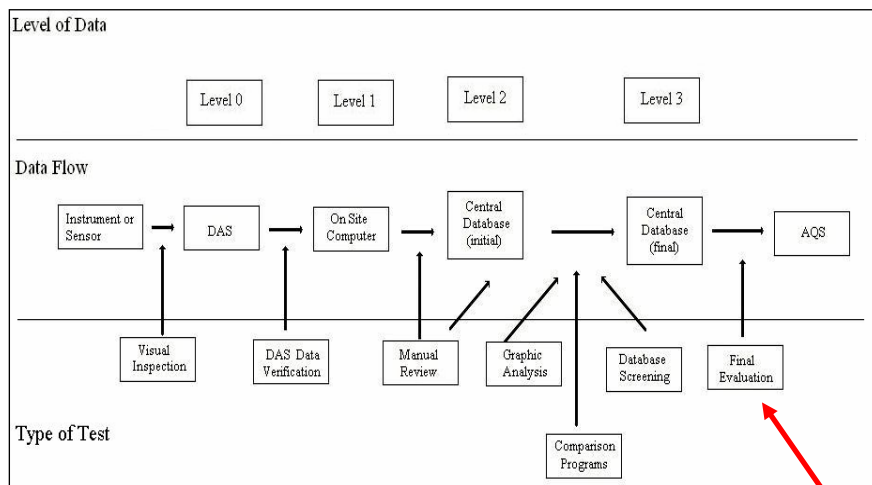
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## Step 6: Data Base Screening

- A few techniques
  - Does O3 rise when NO is dropping?
  - Are NO/NO2 high in morning and evening?
  - Are there any negative values?
  - Does O3 correspond to high/rising Temp or Solar Rad?
  - Did the Station temp exceed 30° C?
  - Does precipitation correspond to low Ozone, SO2, CO or NOy?

## Step 7: Final Evaluation



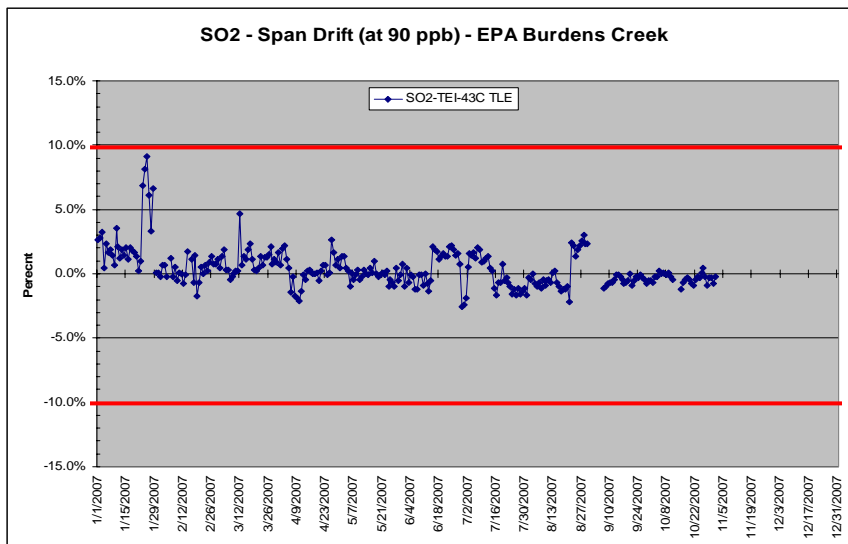
– Routinely collected instrument diagnostics

## Step 7: Final Evaluation

- Validation tables
  - State the MQOs of your system
  - Give you a reference to the needs of the data users
  - Three different types:
    - Critical
    - Operational
    - Systematic



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Span drift MQO Goal =  $\pm 10\%$

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## Step 7: Final Evaluation

Ozone Validation Template			
Requirement	Frequency	Acceptance Criteria	Information /Action
<b>CRITICAL CRITERIA-Ozone</b>			
One Point QC Check Single analyzer	1/ 2 weeks	$\pm 7\%$ (percent difference)	0.01 - 0.10 ppb Relative to routine concentrations 40 CFR Part 58 App A Sec 3.2
Zero/span check	1/ 2 weeks	Zero drift $\pm 2\%$ of full scale Span drift $\pm 1\%$	
<b>OPERATIONAL CRITERIA - Ozone</b>			
<b>Shelter Temperature</b>			
Temperature range	Daily (hourly values)	20 to 30° C. (Hourly ave) or per manufacturers specifications if designated to a wider temperature range	Generally the 20-30° C range will apply but the most restrictive useable range of the instruments in the shelter may also be used as guidance
Temperature Control	Daily (hourly values)	$\pm 2^{\circ}$ C SD over 24 hours	
Temperature Device Check	2/year	$\pm 2^{\circ}$ C of standard	
Precision(using 1-point QC checks)	Calculated annually and as appropriate for design value estimates	90% CL CV $\leq 7\%$	90% Confidence Limit of coefficient of variation: 40 CFR Part 58 App A sec 4.1.2
Bias (using 1-point QC checks)	Calculated annually and as appropriate for design value estimates	95% CL $\leq \pm 1\%$	95% Confidence Limit of absolute bias estimate: 40 CFR Part 58 App A sec 4.1.3
<b>Annual Performance Evaluation</b>			
Single analyzer	Every site 1/year 25 % of sites quarterly	Percent difference of each audit level $\leq 15\%$	3 consecutive audit concentrations not including zero: 40 CFR Part 58 App A sec 3.2.2
Primary QA Organization (PQAO)	annually	95% of audit percent differences fall within the one point QC check 95% probability intervals at PQAO level of aggregation	40 CFR Part 58 App A sec 4.1.4
Federal Audit (NFAP)	1/year at selected sites 20% of sites audited	Mean absolute difference = 10%	40 CFR Part 58 App A sec 2.4
<b>State audits</b>			
Calibration	1/year Upon receipt of instrument repair and 1/6 months if manual zero/span performed biweekly 1/year if continuous zero/span performed daily	Site requirements All points within $\pm 2\%$ of full scale of best-fit straight line Linearity error $\leq 5\%$	Multipoint calibration (0 and 4 upscale points) 40 CFR Part 50 App D sec 5.2.3
<b>Zero Air</b>			
Gaseous Standards		Concentrations below LDL NIST Traceable (e.g. EPA Protocol Gas)	40 CFR Part 58 App A sec 2.6.1
Zero Air Check	1/year	Concentrations below L.D.L.	
Ozone Local primary standard			

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## Summary

- Verification and Validation are a process!
- This process is used to make sure the data collected are for its intended use!
- Utilize all of your tools!!!
  - Collected instrument diagnostics
  - Use of DAS screening techniques
  - Manually review of data
  - Use graphic displays
  - Use central database tools
  - Use validation MQO tables

Data are ready to go into AQS!!

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