

# Software tools for the implementation of EN 14181

Talk given by  
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# BS EN14181

- BS EN 18141 is a complex quality assurance standard which requires a significant amount of calculation
- The QAL 3 part can involve the operator in a significant amount of work to generate zero and span data and calculating Control Charts
- Envirosoft created CEMQual to reduce all these requirements to a few key strokes.

# CEMSuite CEMQual

- CEMQual is a software package that comes in two forms
  - A stand-alone program that accepts manually entered data
  - As part of CEMSuite Plus, a data logging program compliant with WID Or CEMSuite Power which is compliant with LCPD
- It contains all the tools to perform all EN14181 calculations
- It can be used by Test houses to perform QAL2 and AST calculations and by operators to generate QAL 3 Control charts

# CEMSuite CEMQual

- It accepts data input manually or retrieved from the CEMForm database automatically
- It can perform all the key calculations for QAL2, AST and QAL3 and Linearity
- It can produce CUSUM, CUSUM precision, Shewart and moving median graphs
- All graphs and spreadsheet data can be printed or output as a JPEG picture.
- Fully compliant with EN 14181 and validated by AEA Technology
- With the addition of CEMCAL software and an Envirosoft supplied valve system, automatic zero and span tests can be undertaken at pre-determined intervals.

# QAL 2 calculations

- The QAL2 module can generate all the functions required such as calibration and variability as well as producing linear regression graphs.
- It also has the capability of bringing in data from Excel to upload SRM and AMS data
- It can be used in a manual mode

# QAL2/ AST data entry

**CemQAL** Unit 1, measurement channel NO

Test data | QAL2 / AST analysis | QAL3, CUSUM analysis | Linearity | Configuration

**Envirosoft**

Select the measurement to analyse

Unit 1  
Unit 2

NO  
NO2  
NOx  
CO  
SO2  
HCl  
HF  
TOC  
O2  
H2O

Select from the saved files found for Unit 1

<input checked="" type="checkbox"/>	ES1.csv	<input checked="" type="checkbox"/>	ES10.csv
<input checked="" type="checkbox"/>	ES11.csv	<input checked="" type="checkbox"/>	ES12.csv
<input checked="" type="checkbox"/>	ES13.csv	<input checked="" type="checkbox"/>	ES14.csv
<input checked="" type="checkbox"/>	ES15.csv	<input checked="" type="checkbox"/>	ES16.csv
<input checked="" type="checkbox"/>	ES2.csv	<input checked="" type="checkbox"/>	ES3.csv
<input checked="" type="checkbox"/>	ES4.csv	<input checked="" type="checkbox"/>	ES5.csv
<input checked="" type="checkbox"/>	ES6.csv	<input checked="" type="checkbox"/>	ES7.csv
<input checked="" type="checkbox"/>	ES8.csv	<input checked="" type="checkbox"/>	ES9.csv

16 data sets have been selected

Restrict file search

27/01/2007 - 28/03/2007

AMS  SRM

Data only

Get file data

Import data from other files

CSV  Excel

AMS  SRM

"C:\Documents and Settings\Steve Wright\My Documents\Enviro"

Column start: 1 | Row start: 0 | Number of tests: 16

Import

Manual data entry

Open grid for editing

Number of tests: 15

Enter root text: Test

Clear grid | Make frame

Select from files found for NO

- 20-03-2007.csv
- CUS11-10-2005.csv
- LAFCO.csv
- LAFHCL.csv
- LAFNH3.csv
- LAFNO.csv
- LAFNO2.csv
- LAFO2.csv
- LAFSO2.csv

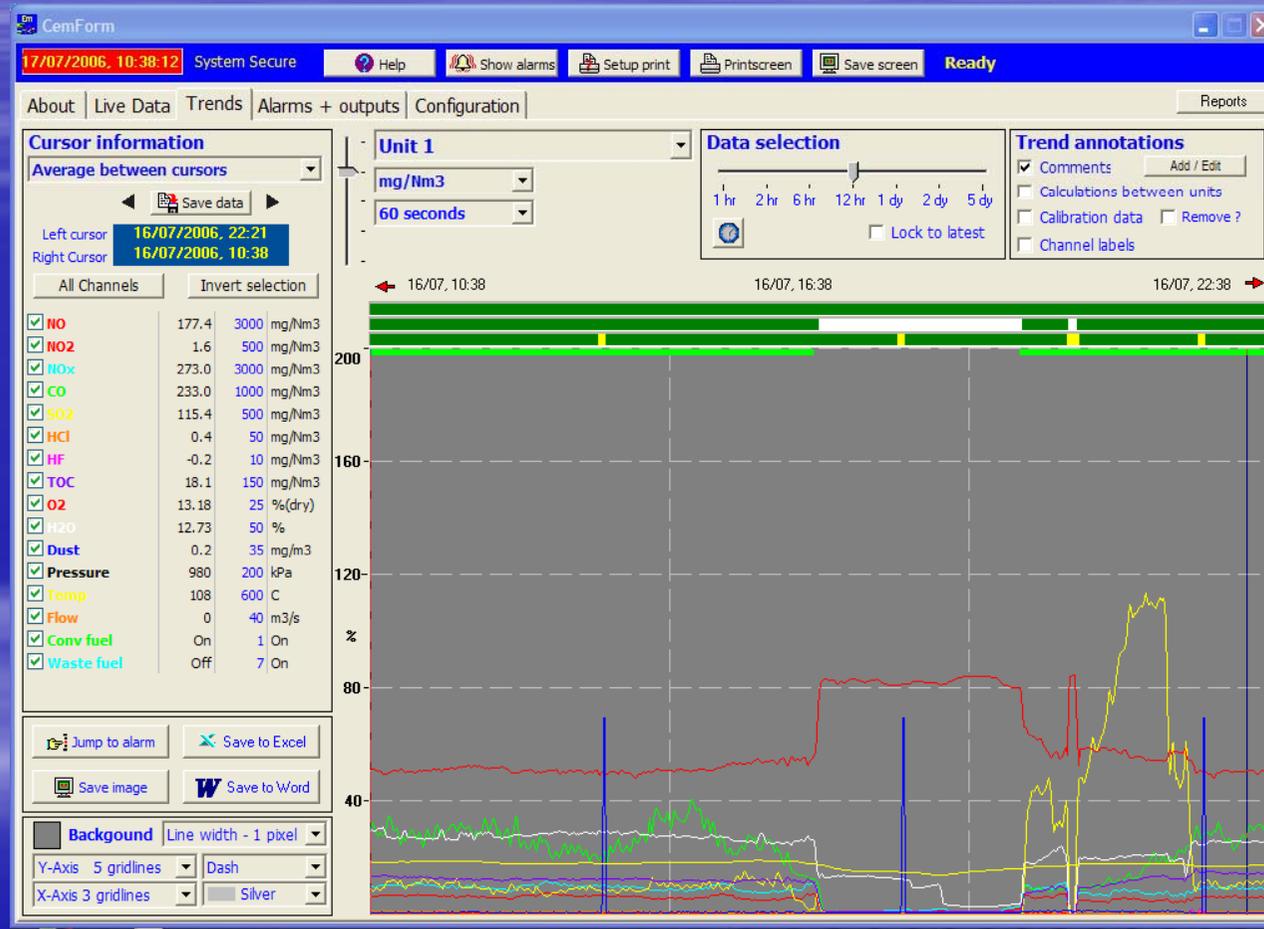
Save data | Load data

Test	Filename/ comments	Date time	AMS value	SRM value	Difference
1	Test 1				
2	Test 2				
3	Test 3				
4	Test 4				
5	Test 5				
6	Test 6				
7	Test 7				
8	Test 8				
9	Test 9				
10	Test 10				
11	Test 11				
12	Test 12				
13	Test 13				
14	Test 14				
15	Test 15				

# Capturing average AMS data

- CEMSuite Plus and Power have the capability to produce average measurand files between any two recorded points in time to correspond with SRM averages
- The files includes data for the measurands during the specified period
- These excel/csv files can be imported into the CEMqual module

# QAL 2 data capture from CEMForm



# QAL 3 Configuration

CemQAL

Test data | QAL2 / AST analysis | QAL3, CUSUM analysis | Linearity | Configuration | **GT 51, measurement channel NOx**

Select the measurement to analyse/ edit details

GT 51  
GT 52  
GT 61  
GT 62

NOx  
NO  
CO  
O2  
Pressure  
Temp  
NOx conv. OK

Log in details

Operator: steve Password: \*\*\*\* Log in

CemQAL/ EN14181 data

ELV	Sams (Span)	Sams (Zero)	Span gas value	Zero gas value	Confidence %
110	5	5	205	10	20

Save and apply

Parameters Delete all Copy to all Save

Parameter	Value	Units/ comments
Median value	4	No of points
ELV Divider	2	
ELV Multiplier	2	
Span delay	110	seconds
Span time	30	seconds
Zero delay	55	seconds
Zero time	25	seconds
Span cal. bit	7	bit no (1..8)
Zero cal. bit	5	bit no (1..8)
Cal. validity	2	Points for valid cal.
No of days	90	Default days to look back
n for Schwart	1	Used for initial QAL3

CEMSuite calibration data

Add and use new data

Modify existing data

Comments

Measurand	Coeff. a	Coeff. b
NOx	1.00000	0.0
NO	1.00000	0.0
CO	1.00000	0.0
O2	1.00000	0.0
Pressure	1.00000	0.0
Temp	1.00000	0.0
NOx conv. OK	1.00000	0.0
Cooler OK	1.00000	0.0
Cal. gas OK	1.00000	0.0
Local cal.	1.00000	0.0
Premix mode	1.00000	0.0
-	1.00000	0.0
Load	1.00000	0.0

Save this data

Calibration gas data

From date	Span	Value	Gas ID
28/01/2007	True	203	33526
01/08/2006	True	188	25522
13/04/2006	True	194.3	111949
20/01/2005	True	205	No 1
01/01/2005	False	0	Air

Save data

Email QAL3 settings  Active?

Add address Remove address

Interval  Weekly  Monthly

Start date and time 03/04/07 12:30 ...

Save settings for Auto QAL3

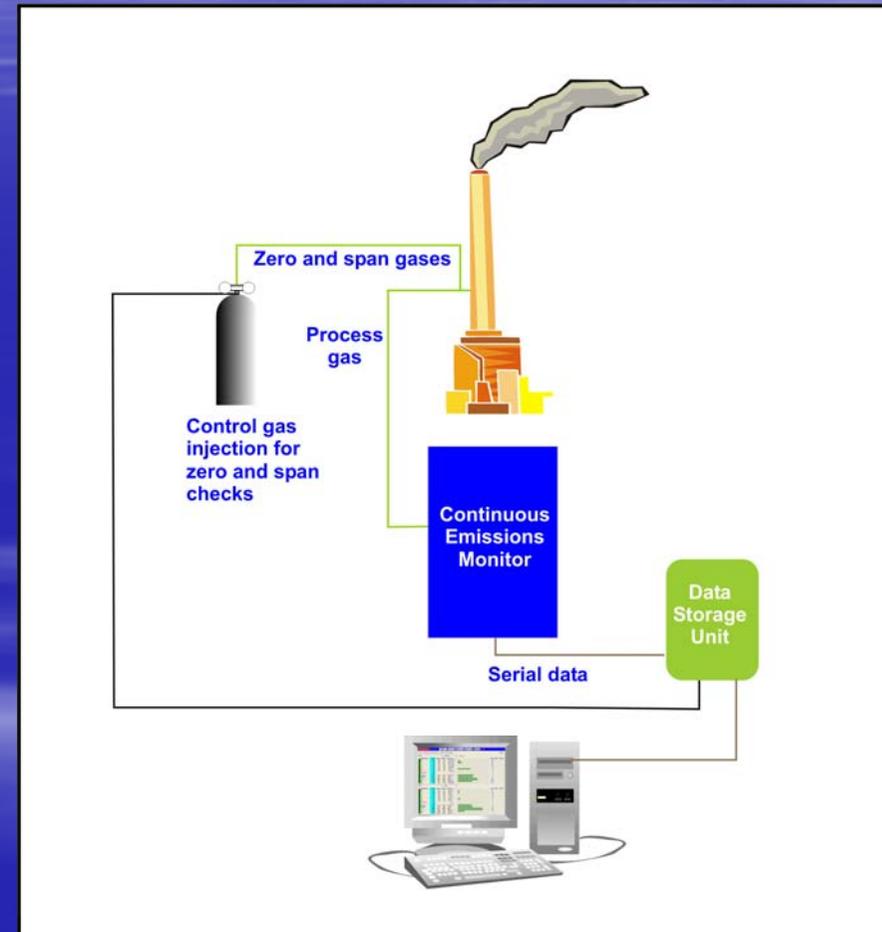
Messages

# QAL 3 data collection

- On many systems, the AMS initiates and collects zero and span data. CEMSuite Plus can usually collect this data via a serial link.
- On systems without these facilities, we can use the CEMCal module which is pre-programmed to open gas valves at pre-selected times.
- CEMCal allows the audit gas time to progress up to the probe and down to the AMS, settle in the measuring cell and then capture the gas concentration.
- The data is then stored in the database and flagged as calibration data.
- The data can then automatically downloaded in to the CEMQual QAL 3 module to create control charts.

# CEMCAL automatic gas injection system

- CEMCal module initiates routine at pre-determined time .
- Opens relevant gas bottle valve via a relay signal
- Gas travels up to probe and down to analyser.
- DSU waits until reading settles and then stores it. Flagged as a cal value.
- CEMQal module can then download the data into QAL module



# Control Chart manual data entry

The screenshot shows the CemQAL software interface. The title bar reads "CemQAL" and the window title is "Unit 1, measurement channel NO". The interface includes a menu bar with "Test data", "QAL2 / AST analysis", "QAL3, CUSUM analysis", "Linearity", and "Configuration". Below the menu bar is a toolbar with buttons for "Load data", "Save this data", "Import results", "Auto data find", "Skip calcs" (set to 0), "Start" (08/02/2007), "End" (10/04/2007), "Print", "New data", and "Lines" (set to 1).

On the left side, there are several configuration sections:

- Span/Zero:** Radio buttons for "Span" (selected) and "Zero".
- Drift factors:**
  - hx: 2.85
  - lx: 0.501
- Precision factors:**
  - hs: 6.90
  - ks: 1.85
- Standard Deviation:**
  - S\_ams: 10.00
- Zero/ span gas value:** A numeric input field set to 10.00 and a "Change" button.
- Graph type:** Radio buttons for "Spreadsheet" (selected) and "Graph".
- Graph select:** Radio buttons for "CUSUM - Drift" (selected), "CUSUM - Precision", "Shewhart", and "Moving median".
- Redraw graph:** A button.
- Scales:** Two numeric input fields for "Scale 1" (25) and "Scale 2" (400).
- Options:** Checkboxes for "Join points" (unchecked) and "Thick lines" (checked).
- Buttons:** "Delete rows" and "Save as JPEG".

The main area of the window is a large, empty grey rectangle, which is the control chart display area.

# QAL3 analysis

CemQAL

Test data | QAL2 / AST analysis | QAL3, CUSUM analysis | Linearity | Configuration | **GT 51, measurement channel NOx**

Skip calcs: 
 Start: 
 End: 


 Lines

Span
  Zero

**Drift factors**  
 hx 2.85  
 kx 0.501

**Precision factors**  
 hs 6.90  
 ks 1.85

**Standard Deviation**  
 S ams 5.00

Zero/ span gas value:

Spreadsheet  
 Graph

Graph select:

CUSUM - Drift  
 CUSUM - Precision  
 Shewhart  
 Moving median

Scale 1  
 Scale 2

Join points  
 Thick lines

No.	Name	Date	Time	v t	x t	d t	ΣPos	ΣNeg	Sp	CUSUM	+D Adi.	-D Adi.	Mov. Av.
1.	Test 1	27/03/2007	14:56						205				
2.	Test 2	27/03/2007	14:56						205				
3.	Test 3	27/03/2007	14:56						205				
4.	Test 4	27/03/2007	14:56						205				
5.	Test 5	27/03/2007	14:56						205				
6.	Test 6	27/03/2007	14:56						205				
7.	Test 7	27/03/2007	14:56						205				
8.	Test 8	27/03/2007	14:56						205				
9.	Test 9	27/03/2007	14:56						205				
10.	Test 10	27/03/2007	14:56						205				
11.	Test 11	27/03/2007	14:56						205				
12.	Test 12	27/03/2007	14:56						205				
13.	Test 13	27/03/2007	14:56						205				
14.	Test 14	27/03/2007	14:56						205				
15.	Test 15	27/03/2007	14:56						205				
16.	Test 16	27/03/2007	14:56						205				
17.	Test 17	27/03/2007	14:56						205				
18.	Test 18	27/03/2007	14:56						205				
19.	Test 19	27/03/2007	14:56						205				
20.	Test 20	27/03/2007	14:56						205				
21.	Test 21	27/03/2007	14:56						205				
22.	Test 22	27/03/2007	14:56						205				
23.	Test 23	27/03/2007	14:56						205				
24.	Test 24	27/03/2007	14:56						205				
25.	Test 25	27/03/2007	14:56						205				
26.	Test 26	27/03/2007	14:56						205				
27.	Test 27	27/03/2007	14:56						205				
28.	Test 28	27/03/2007	14:56						205				
29.	Test 29	27/03/2007	14:56						205				
30.	Test 30	27/03/2007	14:56						205				
31.	Test 31	27/03/2007	14:56						205				
32.	Test 32	27/03/2007	14:56						205				
33.	Test 33	27/03/2007	14:56						205				
34.	Test 34	27/03/2007	14:56						205				
35.	Test 35	27/03/2007	14:56						205				
36.	Test 36	27/03/2007	14:56						205				
37.	Test 37	27/03/2007	14:56						205				
38.	Test 38	27/03/2007	14:56						205				
39.	Test 39	27/03/2007	14:56						205				

# Linearity check

CemQAL

Test data | QAL2 / AST analysis | QAL3, CUSUM analysis | **Linearity** | Configuration | **Unit 1, measurement channel NO**

Clear | Load data | Save this data

Nominal	Actual	Date	#1	#2	#3	#4	#5	#6	#7	#8	#9	#10	Av.	dc	dc rel.	OK?
0 %	0	12/03/07	-	-	-	-	-	-	-	-	-	-	1E+0269	1E+0269	1E+0268	NO
20 %	8	12/03/07	-	-	-	-	-	-	-	-	-	-	0.00	0.000	0.000	YES
40 %	16	12/03/07	-	-	-	-	-	-	-	-	-	-	1E+0269	1E+0269	1E+0268	NO
60 %	24	12/03/07	-	-	-	-	-	-	-	-	-	-	1E+0269	1E+0269	1E+0268	NO
80 %	32	12/03/07	-	-	-	-	-	-	-	-	-	-	0.00	0.000	0.000	YES
0 %	0	12/03/07	-	-	-	-	-	-	-	-	-	-	0.00	0.000	0.000	YES

Param.	Value	Comments
n	0	Number of readings
Xz	0.0	Average ref. measurement
a	0.0	Average AMS reading
B	0.000	Coefficient "B"
A	0.000	Coefficient "A"