Standard Operating Procedure

Continuous Air Quality Monitoring

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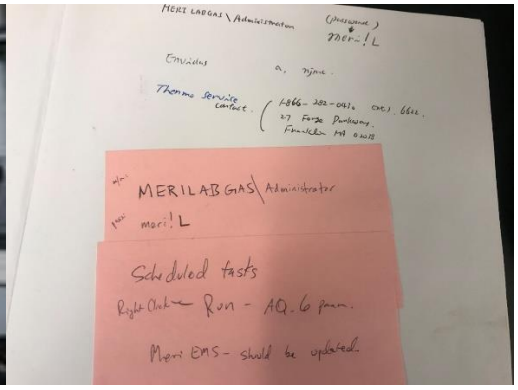
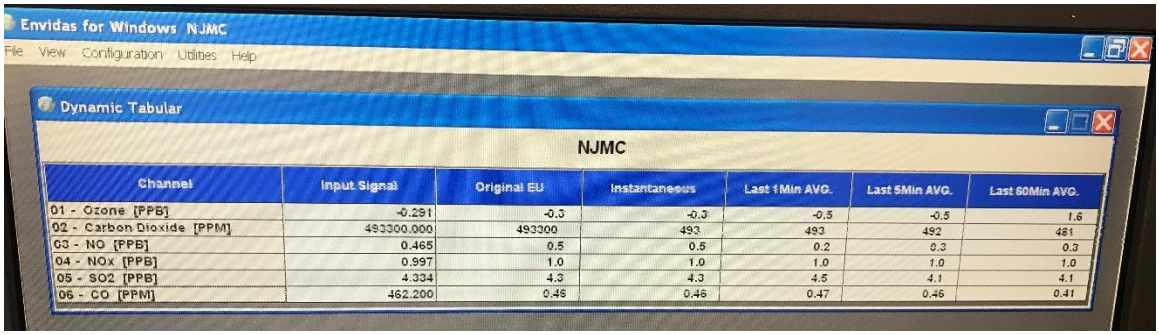
Meadowlands Research and Restoration Institute (MRRI)

New Jersey Sports and Exposition Authority (NJSEA)

Thermo gas analyzer calibration procedure

In Meadowlands Research and Restoration Institute (MRRI) laboratory, ENVIDAS, the environmental data acquisition system, is used for instrument calibration and data management and sharing. ENVIDAS is an intelligent, multi-function, high-performance data acquisition system. It is designed with affordability and versatility in mind. ENVIDAS is a state-of-the-art system that uses nonproprietary desktop or industrial PC computer components to run flexible, environmental data acquisition software. ENVIDAS software features pull-down window based menus, and it is designed to help automate environmental data acquisition system.

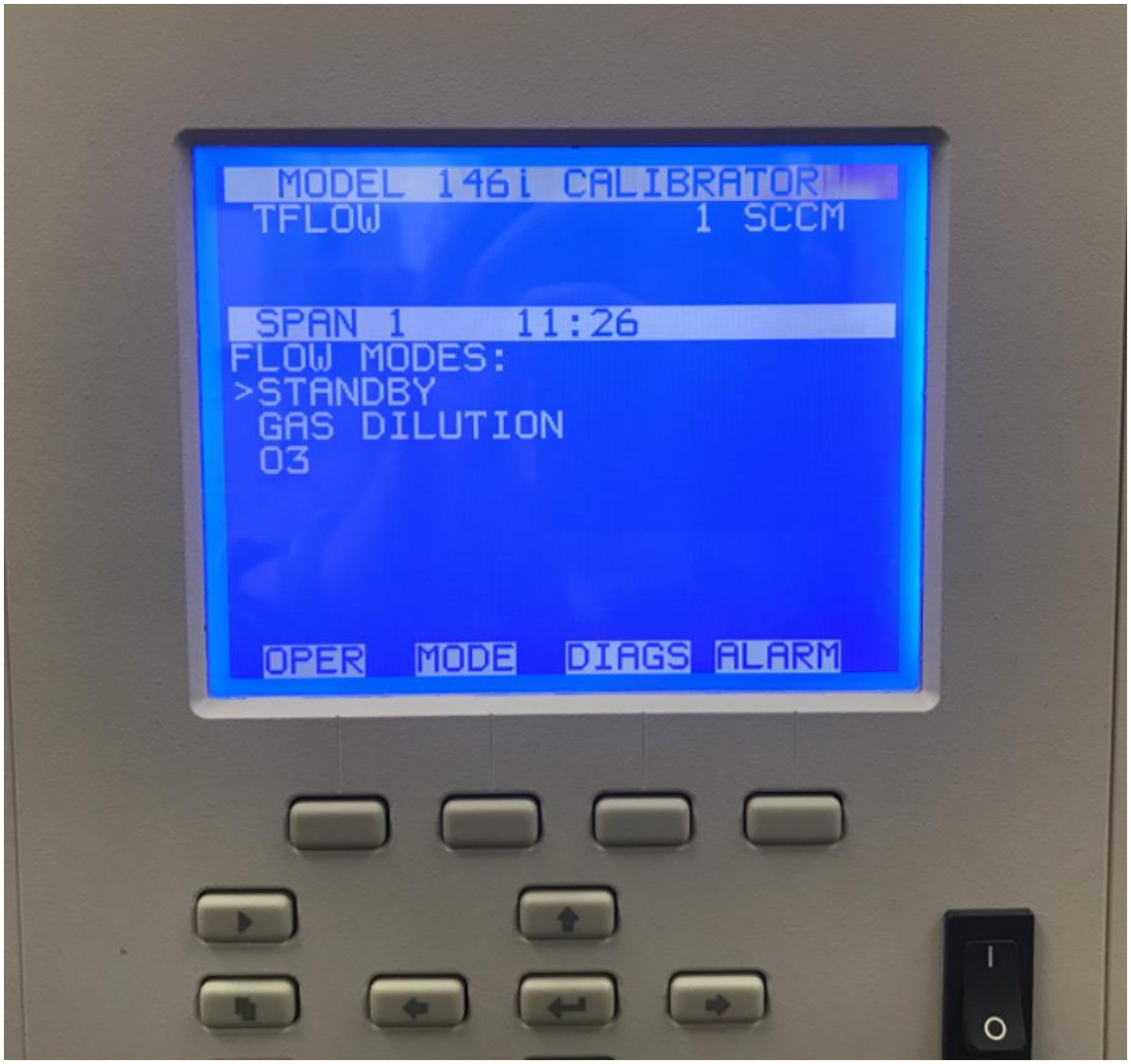




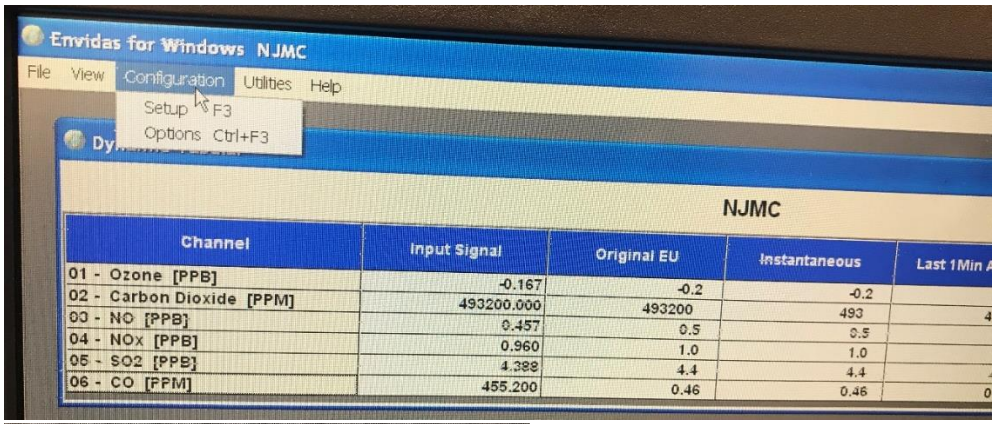
Channel	Input Signal	Original EU	Instantaneous	Last 1Min AVG.	Last 5Min AVG.	Last 60Min AVG.
01 - Ozone [PPB]	-0.291	-0.3	-0.3	-0.5	-0.5	1.6
02 - Carbon Dioxide [PPM]	493300.000	493300	493	493	492	481
03 - NO [PPB]	0.465	0.5	0.5	0.2	0.3	0.3
04 - NOx [PPB]	0.997	1.0	1.0	1.0	1.0	1.0
05 - SO2 [PPB]	4.334	4.3	4.3	4.5	4.1	4.1
06 - CO [PPM]	462.200	0.46	0.46	0.47	0.46	0.41

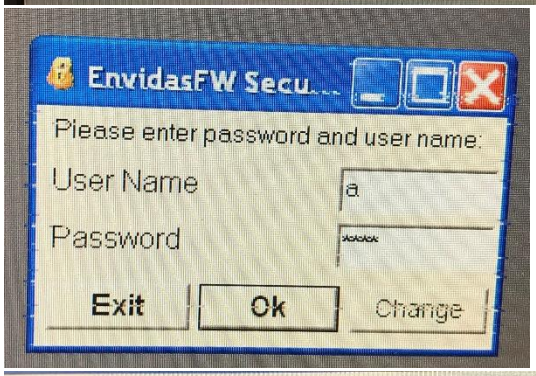
1. **Calibration Setting**

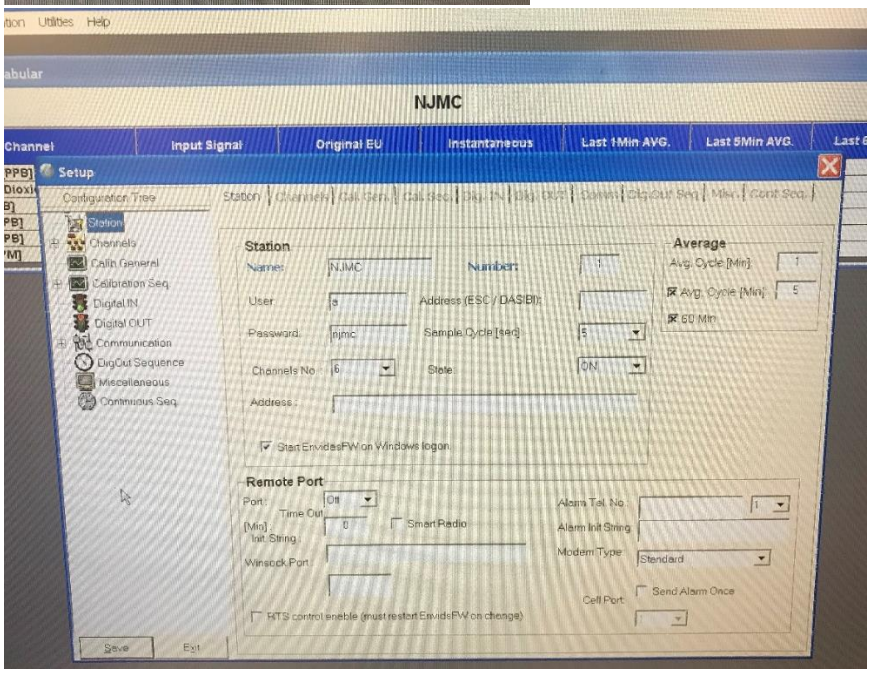
   Gas analyzers need to be calibrated every month, and the filters (Teflon filter, 5 µm pore size, 47 mm diameter) to clean the incoming samples need to be replaced every month. Calibration gas cylinders, including NO, SO_2, CO_2, CO, and air are always keeping on. Put the Model 146i Calibrator at Standby mode.



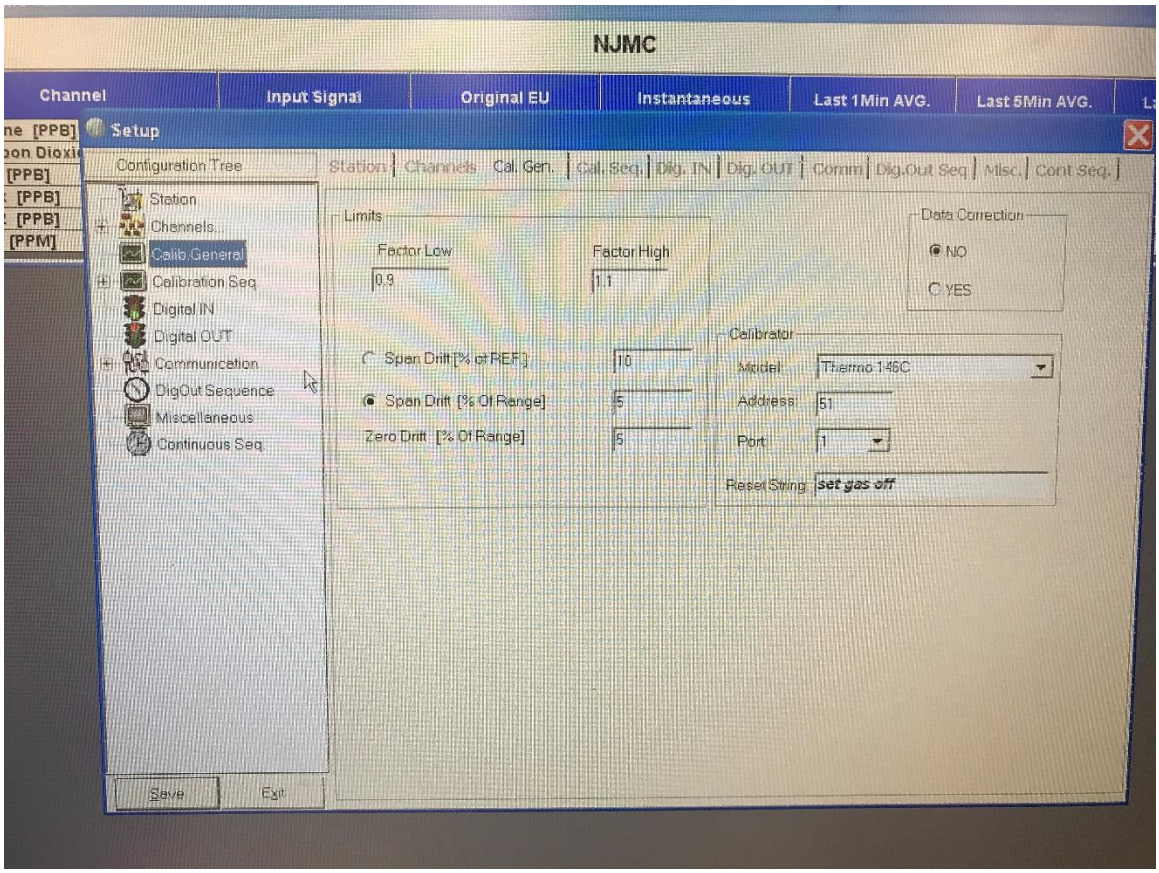
2. **NOx calibration**
   - First, open the Envidas software and go to the ‘Configuration’ and choose ‘Setup’. Input correct Username and Password, then login to the setting of system.



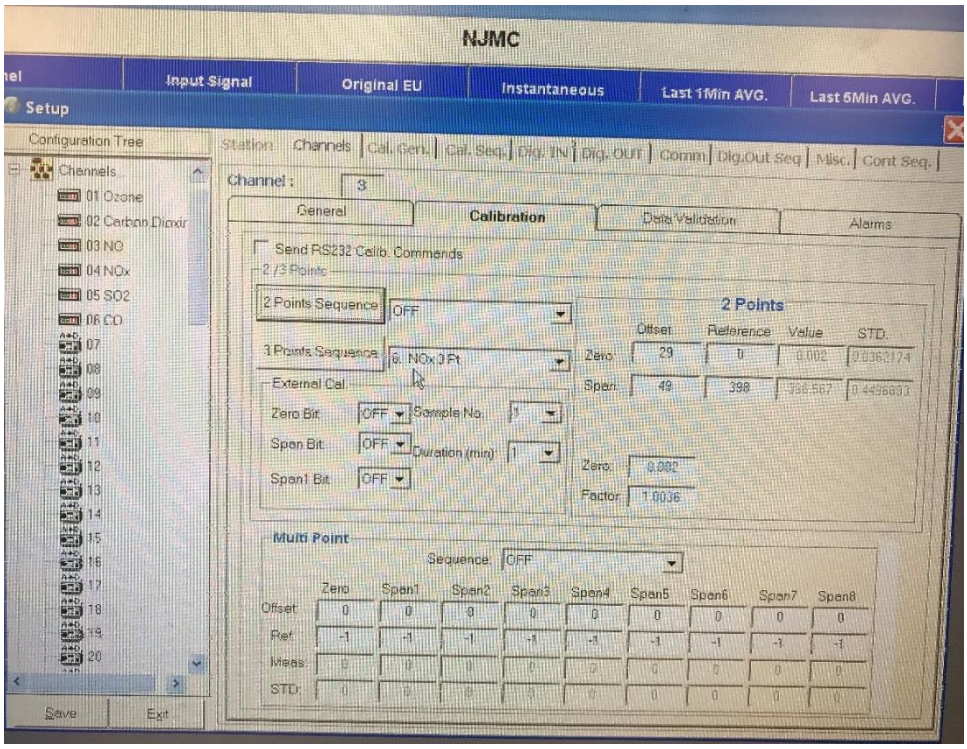


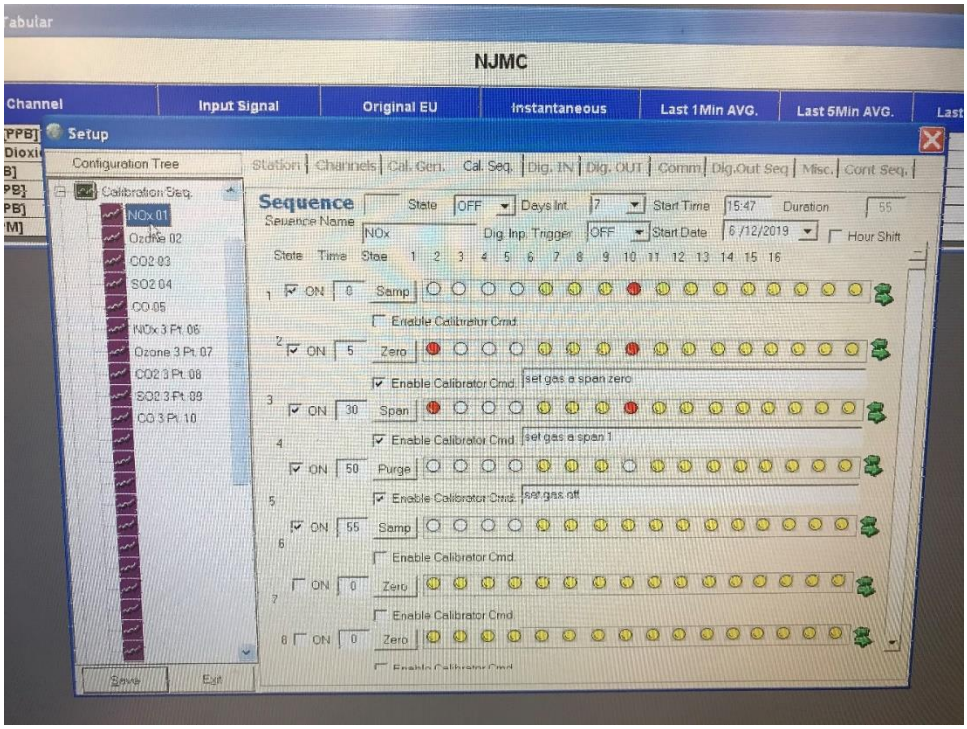


- Choose the ‘Calibration general’ for ‘Configuration type”, then the general options of calibration could be set up over here.

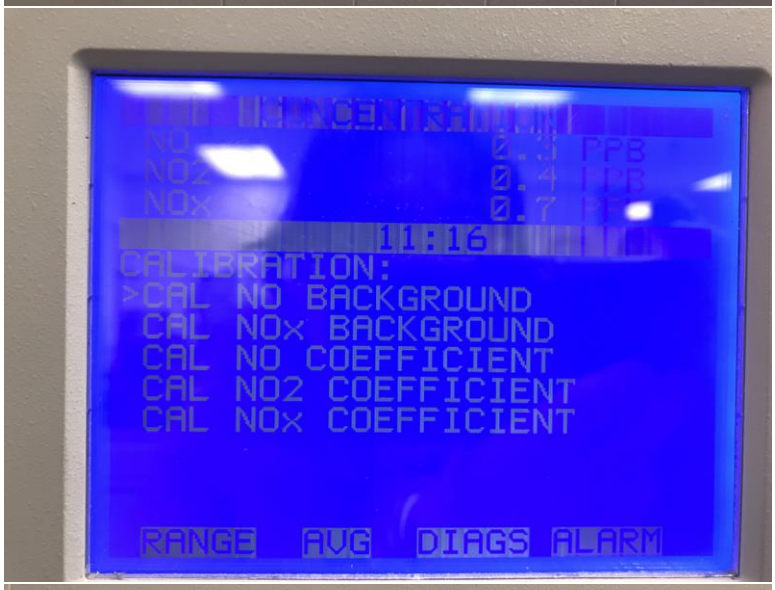


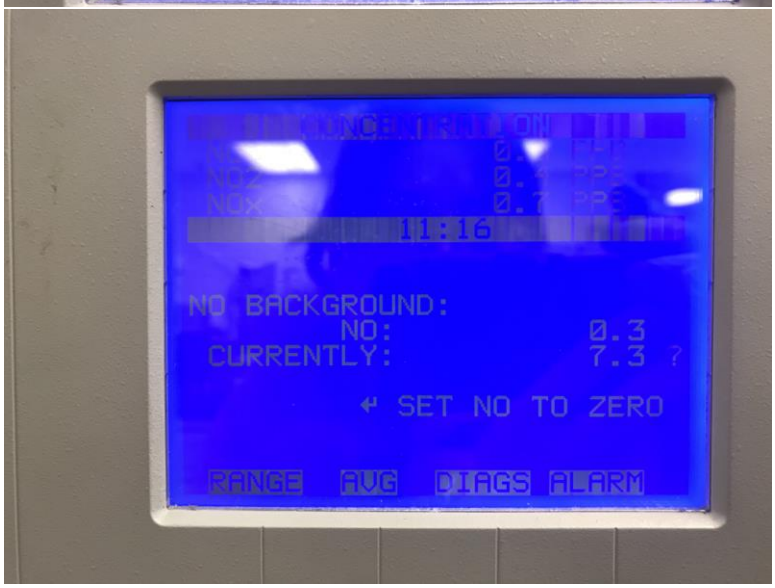
- Choose ‘Channels’ and NOx, there are 2 points or 3 points calibration sequence. We use 2 points calibration sequence, which has zero and 398 ppb as the reference concentration.
- Choose the ‘Calibration sequence’ for ‘Configuration type”, then choose the ‘NOx’. Change the state to ‘On’ and choose the start date and start time and then save the setting.
- Once the calibration sequence start, set the span zero at 5min. On the NOx gas analyzer, go to the main menu and choose ‘Calibration’. Then choose ‘CAL NO BACKGROUND’ and then set the NO to zero. Also choose ‘CAL NOx BACKGROUND’ and then set the NOx to zero.


NJMC
Input Signal
Original EU
Instantaneous
Last 1Min AVG.
Last 5Min AVG.
Setup
Configuration Tree
Channels
01 Ozone
02 Carbon Dioxir
03 NO
04 NOx
05 SO2
06 CO
Channel : 3
General
Calibration
Data Validation
Alarms
Send RS232 Calib. Commands
2 Points Sequence
OFF
1 Points Sequence
6: NOx 3 Pt
External Cal
Zero Bit
Span Bit
Span1 Bit
Sample No.
Duration (min)
2 Points
Offset
Reference
Value
STD.
Zero
Span
Factor
Multi Point
Sequence
Zero
Span1
Span2
Span3
Span4
Span5
Span6
Span7
Span8
Offset
Ref
Meas
STD
Save
Exit

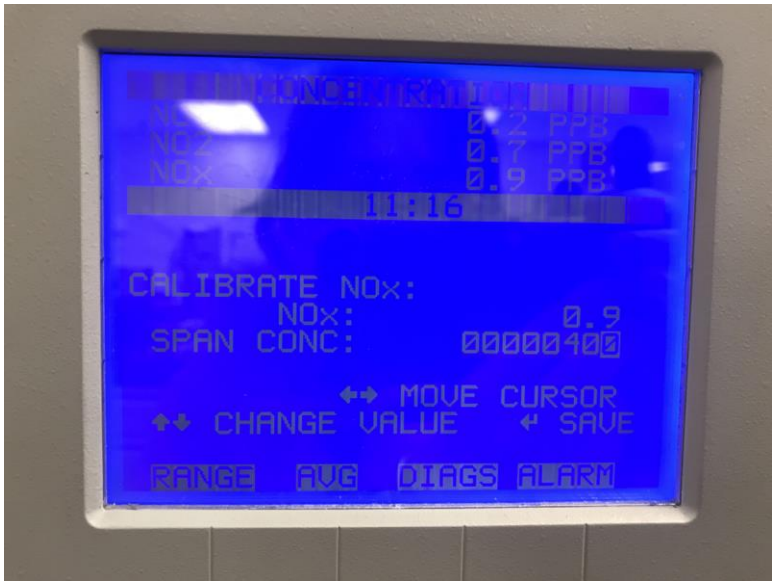

Tabular
NJMC
Channel
Input Signal
Original EU
Instantaneous
Last 1Min AVG.
Last 5Min AVG.
Setup
Configuration Tree
Calibration Seq.
NOx 01
Ozone 02
CO2 03
SO2 04
CO 05
NOx 3 Pt. 06
Ozone 3 Pt. 07
CO2 3 Pt. 08
SO2 3 Pt. 09
CO 3 Pt. 10
Sequence
Sequence Name
NOx
State
Time
Dig. Inp. Trigger
Start Time
Start Date
Duration
Hour Shift
Samp
Zero
Span
Purge
Enable Calibrator Cmd
set gas a span zero
set gas a span 1
set gas off
Save
Exit


11:15
MAIN MENU:
RANGE
AVERAGING TIME
CALIBRATION FACTORS
>CALIBRATION
INSTRUMENT CONTROLS
DIAGNOSTICS
ALARMS
RANGE AVG DIAGS ALARM


11:16
CALIBRATION:
>CAL NO BACKGROUND
CAL NOx BACKGROUND
CAL NO COEFFICIENT
CAL NO2 COEFFICIENT
CAL NOx COEFFICIENT
RANGE AVG DIAGS ALARM

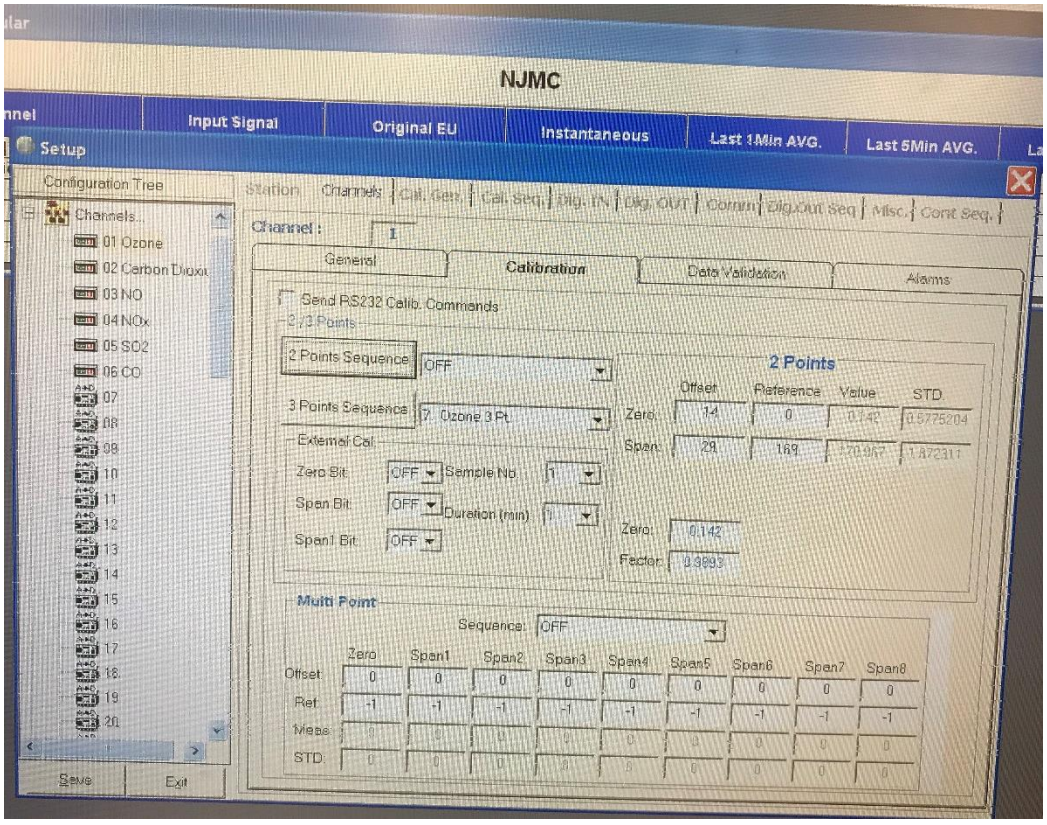

11:16
NO BACKGROUND:
NO: 0.3
CURRENTLY: 7.3
SET NO TO ZERO
RANGE AVG DIAGS ALARM

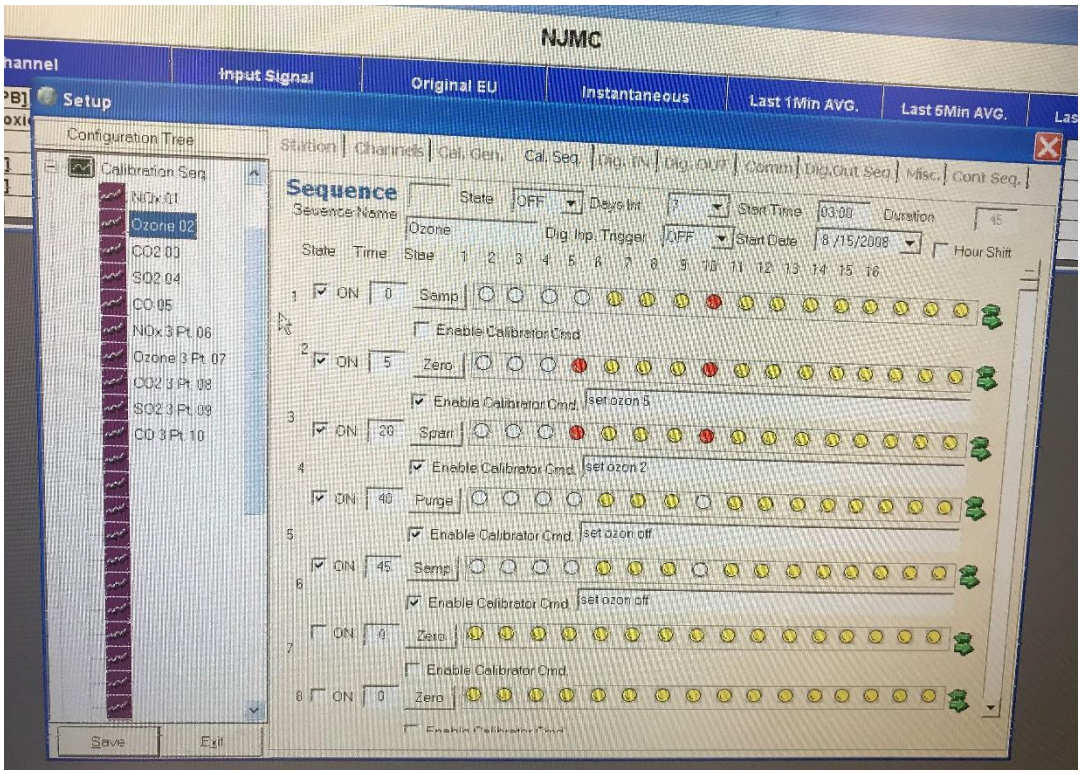
- After the calibration sequence start 30 min, set the span 1. On the NOx gas analyzer, go to the main menu and choose 'Calibration'. Then choose 'CAL NO COEFFICIENT' and then calibrate NOx concentration and set the span concentration at 400 ppb. Also choose 'CAL NOx COEFFICIENT' and then calibrate the NOx.

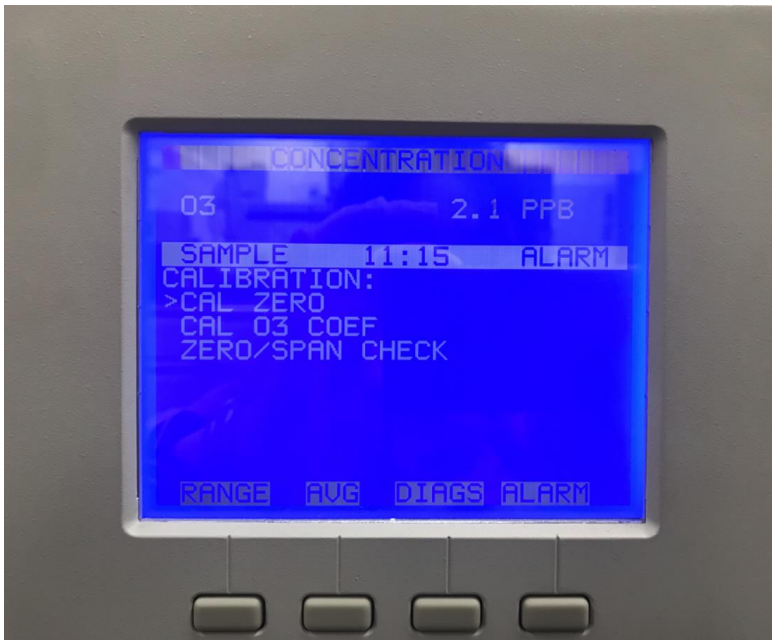


3. Ozone calibration

- First, open the Envidas software and go to the 'Configuration' and choose 'Setup'. Input correct Username and Password, then login to the setting of system.
- Choose 'Channels' and ozone, there are 2 points or 3 points calibration sequence. We use 2 points calibration sequence, which has zero and 169 ppb as the reference concentration.
- Choose the 'Calibration sequence' for 'Configuration type", then choose the 'Ozone'. Change the state to 'On' and choose the start date and start time and then save the setting.
- Once the calibration sequence start, set the span zero at 5min. On the Ozone gas analyzer, go to the main menu and choose 'Calibration'. Then choose 'CAL ZERO' and then set the ozone to zero.
- After the calibration sequence start 20 min, set the span 1. On the ozone gas analyzer, go to the main menu and choose 'Calibration'. Then choose 'CAL O3 COEF' and then calibrate ozone concentration and set the span concentration at 170 ppb.

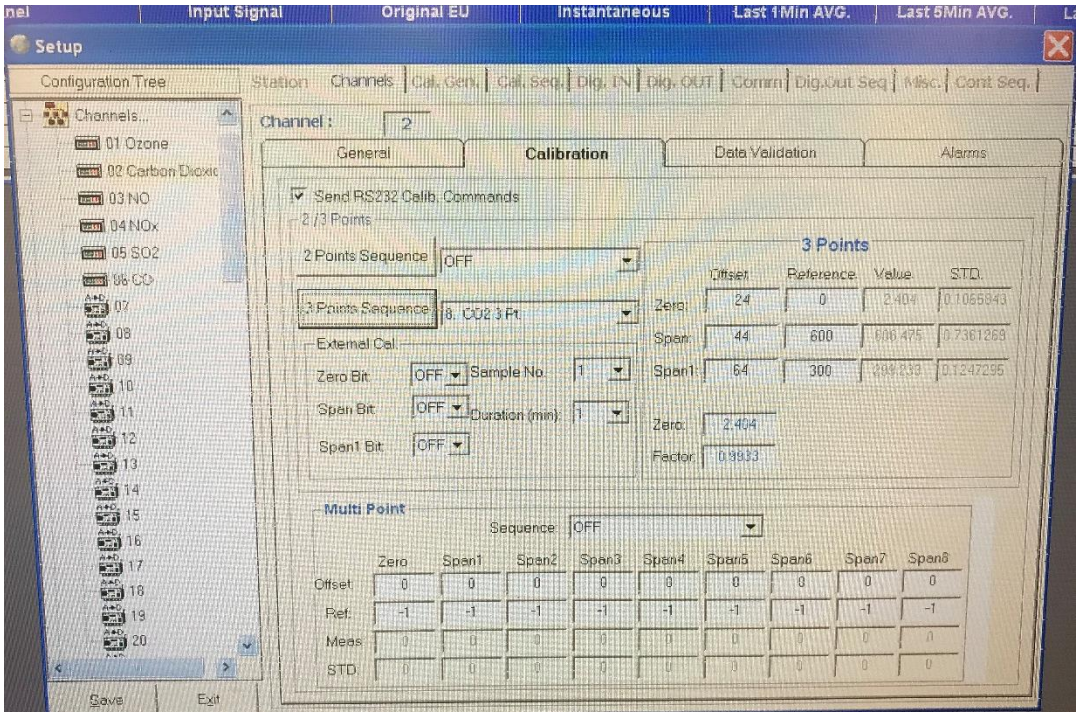

NJMC
Input Signal
Original EU
Instantaneous
Last 1Min AVG.
Last 5Min AVG.
Setup
Configuration Tree
Channels
01 Ozone
02 Carbon Dioxi
03 NO
04 NOx
05 SO2
06 CO
Channel :
General
Calibration
Data Validation
Alarms
Send RS232 Calib. Commands
2 Points Sequence
OFF
3 Points Sequence
External Cal
Zero Bit
Span Bit
Span1 Bit
Sample No
Duration (min)
2 Points
Offset
Reference
Value
STD
Zero:
Span:
Factor:
Multi Point
Sequence:
Zero
Span1
Span2
Span3
Span4
Span5
Span6
Span7
Span8
Offset
Ref
Meas
STD
Save
Exit

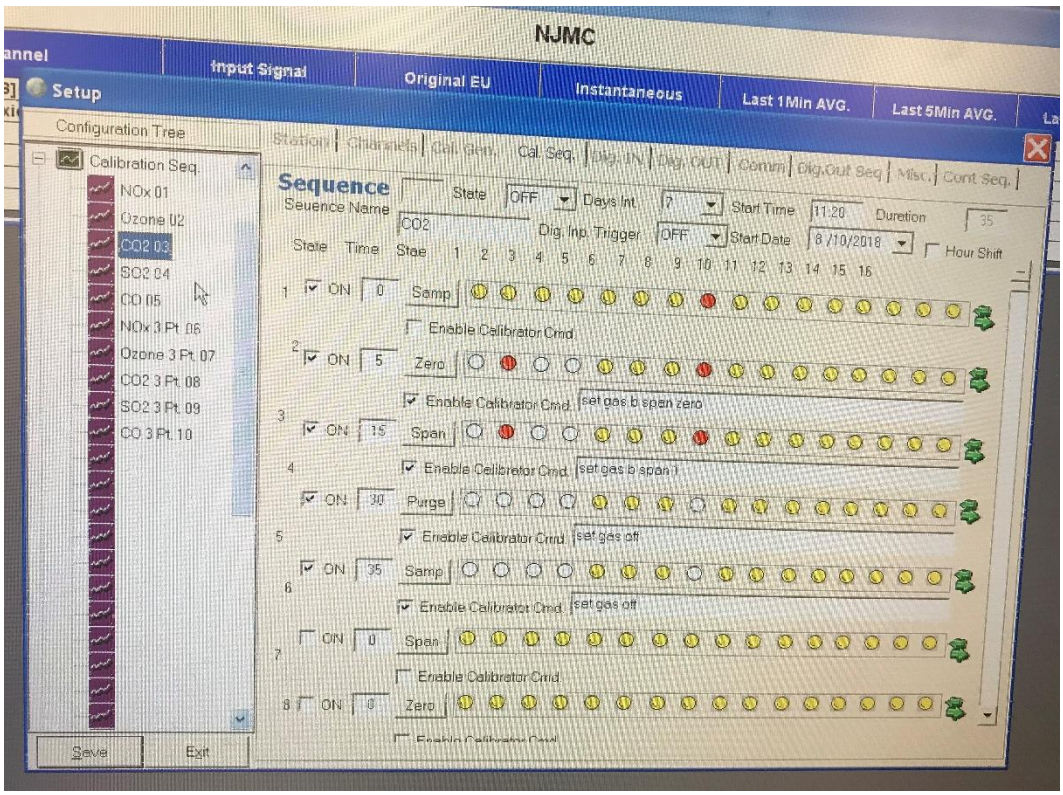

NJMC
Input Signal
Original EU
Instantaneous
Last 1Min AVG.
Last 5Min AVG.
Setup
Configuration Tree
Calibration Seq
NOx 01
Ozone 02
CO2 03
SO2 04
CO 05
NOx 3 Pt. 06
Ozone 3 Pt. 07
CO2 3 Pt. 08
SO2 3 Pt. 09
CO 3 Pt. 10
Sequence
Sequence Name
Ozone
State
Days Int
Start Time
Duration
Dig. Inp. Trigger
Start Date
Hour Shift
Step
Time
ON
Semp
Zero
Span
Purge
Enable Calibrator Cmd
set ozon 5
set ozon 2
set ozon off
Save
Exit



4. CO_2 calibration

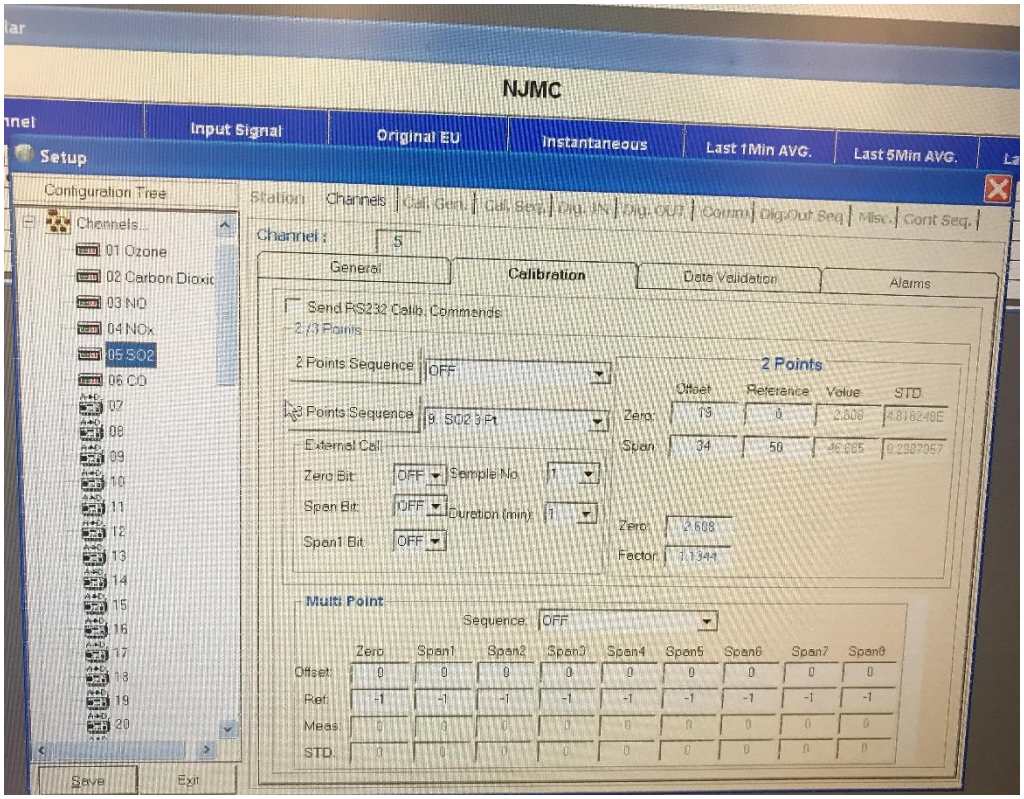
- First, open the Envidas software and go to the 'Configuration' and choose 'Setup'. Input correct Username and Password, then login to the setting of system.
- Choose 'Channels' and CO2, there are 2 points or 3 points calibration sequence. We use 2 points calibration sequence, which has zero and 600 ppm as the reference concentration.
- Choose the 'Calibration sequence' for 'Configuration type", then choose the 'CO2'. Change the state to 'On' and choose the start date and start time and then save the setting.
- Once the calibration sequence start, set the span zero at 5min. On the CO2 gas analyzer, go to the main menu and choose 'Calibration'. Then choose 'CAL BACKGROUND' and then set the CO2 to zero.
- After the calibration sequence start 15 min, set the span 1. On the CO2 gas analyzer, go to the main menu and choose 'Calibration'. Then choose 'CAL COEF' and then calibrate CO2 concentration and set the span concentration at 600 PPM.

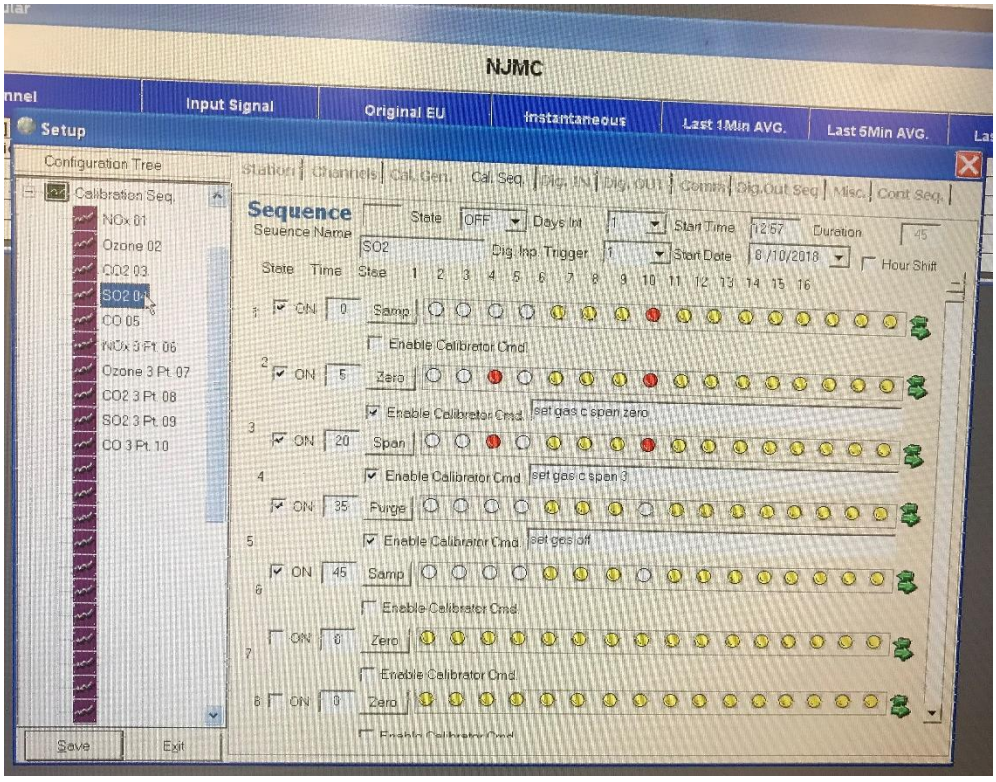

Input Signal
Original EU
Instantaneous
Last 1Min AVG.
Last 5Min AVG.
Setup
Configuration Tree
Station
Channels
Cal. Gen.
Cal. Seq.
Dig. IN
Dig. OUT
Comm
Dig.Out Seq
Misc.
Cont Seq.
Channels
01 Ozone
02 Carbon Dioxic
03 NO
04 NOx
05 SO2
06 CO
Channel :
2
General
Calibration
Data Validation
Alarms
Send RS232 Calib. Commands
2 / 3 Points
2 Points Sequence
OFF
3 Points Sequence
6. CO2 3 Pt
External Cal
Zero Bit
OFF
Sample No.
1
Span Bit
OFF
Duration (min)
1
Span1 Bit
OFF
3 Points
Offset
Reference
Value
STD
Zero
24
0
2.404
0.1065843
Span
44
600
606.475
0.7361269
Span1
64
300
299.233
0.1247295
Zero
2.404
Factor
0.9933
Multi Point
Sequence
OFF
Zero
Span1
Span2
Span3
Span4
Span5
Span6
Span7
Span8
Offset
Ref
Meas
STD
Save
Exit


NJMC
Input Signal
Original EU
Instantaneous
Last 1Min AVG.
Last 5Min AVG.
Setup
Configuration Tree
Calibration Seq
NOx 01
Ozone 02
CO2 03
SO2 04
CO 05
NOx 3 Pt 06
Ozone 3 Pt 07
CO2 3 Pt 08
SO2 3 Pt 09
CO 3 Pt 10
Sequence
Seuence Name
CO2
State
OFF
Days Int
7
Start Time
11:20
Duration
35
Dig. Inp. Trigger
OFF
Start Date
8 /10/2018
Hour Shift
State Time
Stae
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
1 ON 0 Samp
Enable Calibrator Cmd
2 ON 5 Zero
Enable Calibrator Cmd
set gas b span zero
3 ON 15 Span
Enable Calibrator Cmd
set gas b span 1
4 ON 30 Purge
Enable Calibrator Cmd
set gas off
5 ON 35 Samp
Enable Calibrator Cmd
set gas off
6 ON 0 Span
Enable Calibrator Cmd
7 ON 0 Zero
8
Save
Exit

5. SO_2 calibration

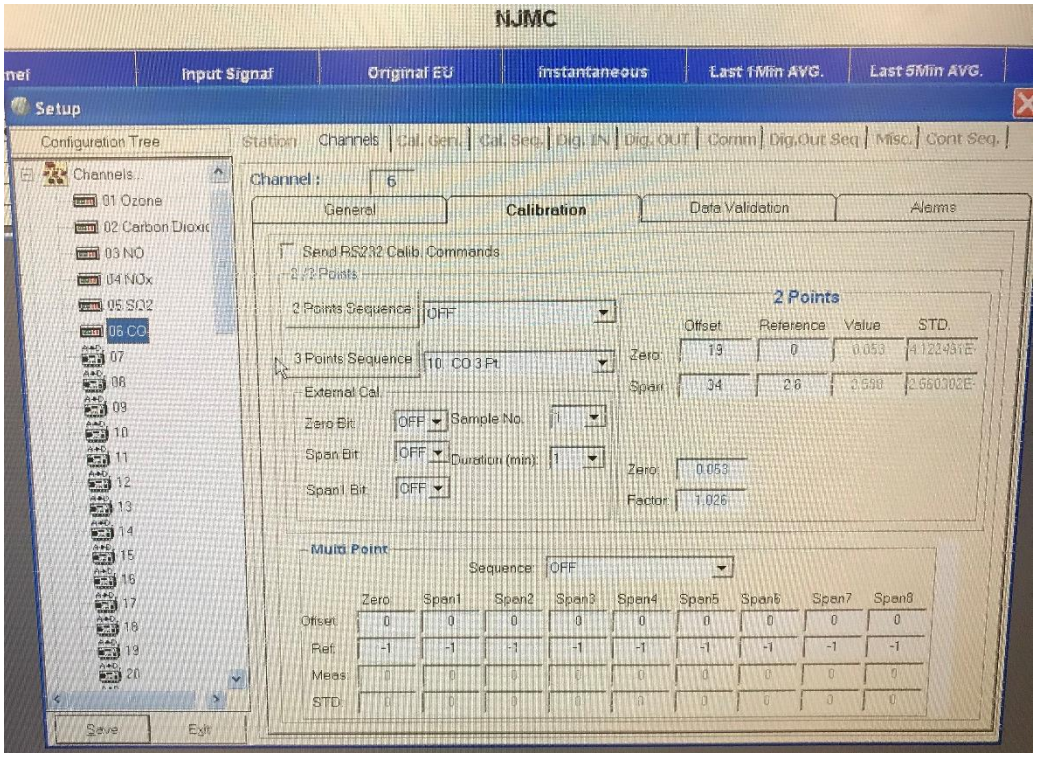
- First, open the Envidas software and go to the 'Configuration' and choose 'Setup'. Input correct Username and Password, then login to the setting of system.
- Choose 'Channels' and SO_2, there are 2 points or 3 points calibration sequence. We use 2 points calibration sequence, which has zero and 50 ppb as the reference concentration.
- Choose the 'Calibration sequence' for 'Configuration type", then choose the 'SO_2'. Change the state to 'On' and choose the start date and start time and then save the setting.
- Once the calibration sequence start, set the span zero at 5min. On the SO_2 gas analyzer, go to the main menu and choose 'Calibration'. Then choose 'CAL SO2 BACKGROUND' and then set the SO_2 to zero.
- After the calibration sequence start 20 min, set the span 1. On the SO_2 gas analyzer, go to the main menu and choose 'Calibration'. Then choose 'CAL SO2 COEFFICIENT' and then calibrate SO_2 concentration and set the span concentration at 50 ppb.

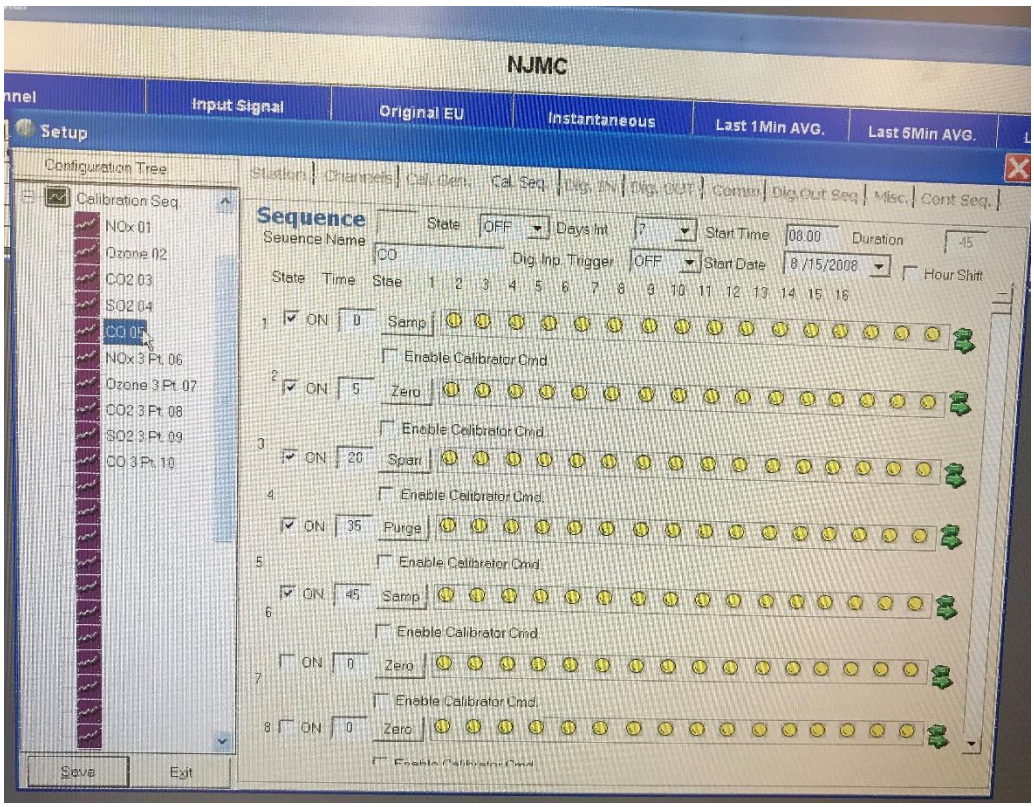

NJMC
Input Signal
Original EU
Instantaneous
Last 1Min AVG.
Last 5Min AVG.
Setup
Configuration Tree
Channels
01 Ozone
02 Carbon Dioxic
03 NO
04 NOx
05 SO2
06 CO
Station
Channels
Cal. Gen.
Cal. Seq.
Dig. IN
Dig. OUT
Comm
Dig.Out Seq
Misc.
Cont Seq.
Channel :
5
General
Calibration
Data Validation
Alarms
Send RS232 Calib. Commands
2 /3 Points
2 Points Sequence
OFF
3 Points Sequence
9. SO2 3 Pt
External Cal
Zero Bit
Span Bit
Span1 Bit
Sample No.
Duration (min)
2 Points
Offset
Reference
Value
STD
Zero:
Span:
Zero
Factor
Multi Point
Sequence
OFF
Zero
Span1
Span2
Span3
Span4
Span5
Span6
Span7
Span8
Offset
Ref
Meas
STD
Save
Exit

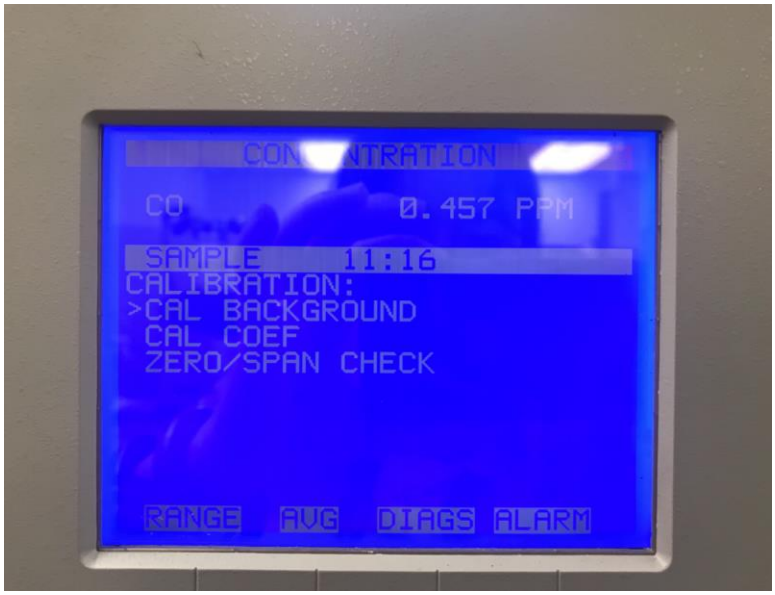

NJMC
Input Signal
Original EU
Instantaneous
Last 1Min AVG.
Last 5Min AVG.
Setup
Configuration Tree
Calibration Seq.
NOx 01
Ozone 02
CO2 03
SO2 04
CO 05
NOx 3 Pt 06
Ozone 3 Pt 07
CO2 3 Pt 08
SO2 3 Pt 09
CO 3 Pt 10
Sequence
Seuence Name
SO2
State
OFF
Days Int
Start Time
12:57
Duration
45
Dig. Inp. Trigger
Start Date
8/10/2018
Hour Shift
State Time Step
Samp
Zero
Span
Purge
Enable Calibrator Cmd
set gas c span zero
set gas c span 3
set gas off
Save
Exit

6. CO calibration

- First, open the Envidas software and go to the 'Configuration' and choose 'Setup'. Input correct Username and Password, then login to the setting of system.
- Choose 'Channels' and CO, there are 2 points or 3 points calibration sequence. We use 2 points calibration sequence, which has zero and 2.6 ppb as the reference concentration.
- Choose the 'Calibration sequence' for 'Configuration type", then choose the 'CO'. Change the state to 'On' and choose the start date and start time and then save the setting.
- Once the calibration sequence start, set the span zero at 5min. On the CO gas analyzer, go to the main menu and choose 'Calibration'. Then choose 'CAL BACKGROUND' and then set the CO to zero.
- After the calibration sequence start 20 min, set the span 1. On the CO gas analyzer, go to the main menu and choose 'Calibration'. Then choose 'CAL COEF' and then calibrate CO concentration and set the span concentration at 2.6 ppb.


NJMC
Input Signal
Original EU
Instantaneous
Last 1Min AVG.
Last 5Min AVG.
Setup
Configuration Tree
Channels
01 Ozone
02 Carbon Dioxi
03 NO
04 NOx
05 SO2
06 CO
Channel : 6
General
Calibration
Data Validation
Alarms
Send RS232 Calib. Commands
2 Points Sequence OFF
3 Points Sequence 10 CO 3 Pt
External Cal
Zero Bit OFF
Span Bit OFF
Span1 Bit OFF
Sample No.
Duration (min): 1
2 Points
Offset Reference Value STD.
Zero 19 0 0.053
Span 34 2.6 2.598
Zero: 0.053
Factor: 1.026
Multi Point
Sequence: OFF
Zero Span1 Span2 Span3 Span4 Span5 Span6 Span7 Span8
Offset
Ref
Meas
STD
Save
Exit


NJMC
Input Signal
Original EU
Instantaneous
Last 1Min AVG.
Last 5Min AVG.
Setup
Configuration Tree
Calibration Seq.
NOx 01
Ozone 02
CO2 03
SO2 04
CO 05
NOx 3 Pt. 06
Ozone 3 Pt. 07
CO2 3 Pt. 08
SO2 3 Pt. 09
CO 3 Pt. 10
Sequence
Seuence Name CO
State OFF
Days Int 7
Start Time 08:00
Duration 45
Dig. Inp. Trigger OFF
Start Date 8 /15/2008
Hour Shift
State Time Stae 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
1 ON 0 Samp
Enable Calibrator Cmd.
2 ON 5 Zero
3 ON 20 Span
4 ON 35 Purge
5 ON 45 Samp
6 ON 0 Zero
7 ON 0 Zero
8 ON 0 Zero
Save
Exit


CO 0.457 PPM
SAMPLE 11:16
CALIBRATION:
>CAL BACKGROUND
CAL COEF
ZERO/SPAN CHECK
RANGE AVG DIAGS ALARM