EPA vs. EN standards

Tasks

- Goal: Determination of differences and similarities of EN and EPA to get a guideline what to change to be consistent within the EN CEMS framework
- Text comparison
  - Approx. 1 day per standard
- Site visit to measurements according EPA standards
  - PM, HCl, NH_3
  - Measurements are conducted according to standards

Overview EPA vs CEN Standards

Component	EPA standard	EN standard
NO_x	7E	14792
SO_2	6D	14791
TOC	25A	12619
PM	5 and 17	13284-1
CO	10A	15058
HCl	26 & 26A	1911
Moisture	4	14790
Velocity	2	16911-1
Sampling strategy	1	15259

Results

Detailed Comparison in the manual

Twinning Project IL/11: Implementation and Strengthening the Environmental Framework for
IPPC, Resource Efficiency and Eco-Management in Israel

2.2.4. Determination of number and position of measurement points

2.2.4.1. Number of measurement points for circular stacks

EN 15259	EPA 1
If the requirements (see 2.2.1) for the measurement location are fulfilled and the sampling strategy (see 2.2.1) requires a grid measurement the number of measurements points per axis depends on the diameter of the circular stack. The measurements have to be conducted on two axis oriented perpendicular to each other.	If the eight- and two-diameter criterion (see 2.2.1) is fulfilled the number of measurements points per axis depends on the diameter of the circular stack. The measurements have to be conducted on two axis oriented perpendicular to each other.

Diameter [m]	Number of points
<0,35	1
0,35 to 1,1	4
1,1 to 1,6	8
>1,6	> 12, 4 per m^2

The number of measurement points should not exceed 20.

Diameter [m]	Number of points
<0,3	Standard not applicable (see EPA 1A)
0,3 to 0,61	8
>0,61	>12

If the eight- and two-diameter criterion is not fulfilled the number of points has to be determined in dependence of the distances to the next flow disturbance up- and downstream from the measurement level and differs for gaseous and particulate emission components. For particulate components the following rules apply:

Distance (in duct	Number of points

Summary as slides

General remarks – Sampling time

- EN 14181 defines requirements for the sampling time:
  - Minimum 30 Minutes or 4 times the rise time of the AMS (the larger value)
  - Recommendation: Sampling time = shortest time-period associated with an ELV
- Measurements performed according to EPA standards should consider the above requirements of EN 14181.
- Proof of equivalence: EN 14793

Sampling Strategy EPA 1 vs EN 15259

- Many similarities between both standards:
  - Requirements for acceptable flow conditions are equal
  - Strategy for grid measurements is equal
    - EPA requires usually more traverse points
    - Method to determine the positions of the traverse points is identic
- EN 15259 allows sampling at only one traverse point, if only gaseous pollutants are measured and homogeneity is proven.
- EPA 1 lacks a procedure for the determination of the best sampling point for an AMS.

Sampling Strategy EPA 1 vs EN 15259

- Conclusion
  - SRM measurements conducted according EPA 1 can be used for QAL 2 & AST according to EN 14181
  - The sampling position of an AMS shall be determined according to No. 8.4 of EN 15259 to ensure a representative sampling.

Determination of flue-gas-velocity (EPA 2 vs EN 16911-1)

- Methods covered by standards:
  - EPA 2: Only pitot tubes
  - EN 16911-1: Any method that fulfils the performance criteria (i. e. pitot tube, anemometer, tracer gas)
- Calibration requirements
  - EPA 2: Allows calibration by the test lab itself (traceability is not required)
  - EN 16911-1: Independent calibration strongly recommended, calibration must be traceable to SI units
  - Performance criteria differ between EPA 2 and EN 16911

Determination of flue-gas-velocity (EPA 2 vs EN 16911-1)

- Conclusion
  - EPA 2 can be used in principal as SRM for EN 14181 QAL2 / AST measurements, if
    - The devices used are traceable calibrated (e. g. by an independent calibration lab according ISO 17025)
    - The calibrations fulfil the stricter performance criteria of EN 16911
    - The averaging time per traverse point is at least 1 minute.

Determination of water content (EPA 4 vs EN 14790)

- Only the reference method of EPA 4 is part of the comparison
- EPA 4 and EN 14790 rely on the same principles for determination of the water content of flue gases
  - In detail, EPA 4 has more strict requirements to ensure complete condensation / absorption of the water in the sampling system.
- Conclusion
  - Water content determinations according EPA 4 can be used as SRM measurements for QAL 2 / AST according EN 14181 as long as the reference method of EPA 4 is used.

Measuring Particulate Matter (EPA 5 / 17 vs EN 13284-1)

- 13284-1 describes as well in-stack (EPA 17) as out-stack (EPA 5) sampling for the determination of PM
- Most differences between EPA 5 and 17 are rather small
  - Different rinsing solution of the parts in front of the filter
  - Different acceptance range of the isokinetic (95-115% vs. 90-110%)
  - Different drying procedures for the filters
  - Recommendation to weigh filter and holder together (EN 13284-1)

Measuring Particulate Matter (EPA 5 / 17 vs EN 13284-1)

- Conclusions
  - PM measurements according EPA 5 or 17 can be used as SRM measurements in the context of EN 14181.
  - From a practical point of view it is recommended to do the following alteration of EPA 5 / 17:
    - Filter and filter holder shall be treated as unit and weighed together to prevent any losses due to filter handling
    - If possible (no water droplets) EPA 17 is preferred

TVOC (EPA 25A vs EN 12619)

- EN 12619 and EPA 25A describes TVOC determination based on FID
  - EN 12619 requires more periodic quality checks
    - Oxygen cross-sensitivity checks and measures
    - More elaborated linearity check
    - Requirements for response factors
    - …
  - EN 12619 has stricter requirements concerning maximum drift

TVOC (EPA 25A vs EN 12619)

- Conclusions
  - If possible TVOC measurements used as SRM in EN 14181 should be performed according to EN 12619 with QAL 1 certified devices.
  - EPA 25A based measurements may be used as SRM according EN 14181, if
    - A QAL 1 certified analyser is used and
    - The influence of oxygen on the measurement results is considered properly (reference gases must fit to oxygen concentration in stack).

Oxygen EPA 3A vs EN 14789

- Similarities between both standards:
  - Same equipment of the continuous measurement system: Probe, heated filter, conditioning system (cooler, dryer), analyzer
  - EPA 3A refers to EPA 7E (NOx)
    EN 14789 is similar to 14792 (NOx) or 15058 (CO)
  - Check of the system in field using calibration gases
    EPA 3A: three different concentrations
    EN 14789: zero and span gas used

Oxygen EPA 3A vs EN 14789

- Differences between both standards
  - EN 14789:
    type of analyzer is restricted to paramagnetic systems. Requirements of the quality assurance and performance characterstics of the measuring system are specified in detail (verification of many aspects by type approval according to EN 15267)
- Conclusion
  - Both methods are comparable, but a QAL 1 certified analyser with a paramagnetic cell should be used.

HCl EPA 26/26A vs. EN 1911

- Difference between both standards:
  EPA describes the separate measurement of gaseous HX and X_2 (X = Halogen Cl, Br)
  EN 1911 only for HCl

  EPA 26/26A five impingers in line:
  1., 2. and 3. with 0.1 n H_2SO_4;
  4. and 5. with 0.1 n NaOH

  EN 1911: two impingers with pure water

HCl EPA 26/26A vs. EN 1911

- Similarties between both standards:
  - Sampling set up (discontinuous measurement, absorption in solution)
  - Sampling line and filter heated to prevent water condensation
  - Leak-test (EPA at the beginning and at the end; EN only at the beginning)
  - Analytical method:
    EPA with IC
    EN with 3 methods:
    potentiometric titration or photometric titration or ion chromatographically determination

HCl EPA 26/26A vs. EN 1911

- Conclusion
  - The sampling step of the EPA method is much more complicated than in EN 1911
  - EN 1911 only for HCl-measurement
  - Sampling set up is comparable
  - It is required to confirm that you get same results for HCl with both standards (comparison measurements with both standards, according EN 14793)
- Acceptable solution:
  EPA 26/26A with an absorption-solution of pure water

Sulfurdioxid EPA 6 vs EN 14791

- Difference between both standards:
  EPA 6 describes the separate measurement of gaseous sulfurdioxide and sulfurtrioxide;
  EN 14791 the measurement of the sum of sulfuroxides (SO_2 and SO_3)

  EPA 6 three impingers in line:
  1. with 80% isopropanol for SO_3;
  2. and 3. with 3% H_2O_2 for SO_2

  EN 14791 two impingers with 0.3 % H_2O_2 for So_x
  (3 % H_2O_2 only for SO_x-concentrations > 1000 mg/m³)

Sulfurdioxid EPA 6 vs EN 14791

- Similarties between both standards:
  - Sampling set up (discontinuous measurement, absorption in solution)
  - Sampling line and filter heated to prevent water condensation
  - Leak-test (EPA at the beginning and at the end; EN only at the beginning)
  - Analytical method:
    EPA with IC
    EN with IC or thorin-titration

Sulfurdioxid EPA 6 vs EN 14791

- Conclusion
  - The sampling step of EPA 6 method is much more complicated than the on according to EN 14791. (separation of SO_3 and SO_2)
  - EN 14791 for SO_x-measurement
  - Sampling set up is comparable
  - It is required to confirm that you get same results of SOx with both standards (comparison measurements with both standards according EN 14793)
- Acceptable solution:
  EPA 6 with an absorption-solution of 0.3 % H_2O_2

Nitrogenoxides EPA 7E vs EN 14792

- Similarities between both standards:
  - Continuous measurement of gaseous nitrogen oxides
  - set-up for the sampling is comparable
    - Sampling probe
    - Heated filter
    - For dry basis measurement:
      conditioning system (condenser, dryer) or dilution with a dry gas
    - For heated analyzer:
      maintaining the high temperature up to the analyzer
  - On site check with calibration gas (EPA 7E with 3 concentrations; EN 14792 zero and span gas)

Nitrogenoxides EPA 7E vs EN 14792

- Difference between both standards:
  EN 14792
  - Measuring principle is restricted to chemiluminescence
  - Minimum performance criteria and date are required for the measuring system
  - NO_2-NO-conversion efficiency: for EPA > 90%; for EN 14792 > 95%
  - Performance criteria are partly checked by the type approval according to 15267 (QAL 1)
  - Calculation of the measurement uncertainty is described in detail
  - Requirement for using as SRM:
    overall measurement uncertainty < 10 % of the limit value

Nitrogenoxides EPA 7E vs EN 14792

- Conclusion
  - Sampling setup comparable
  - The checks on site with calibration gases are comparable
  - It is required to use an analyser with QAL 1 certificate or to perform the test to get the performance data needed

Carbonmonoxide EPA 10 vs EN 15058
Oxygen EPA 3A vs EN 14789

- Structure for the EN-standards for CO and O_2 are comparable to the standard for NOx (EN 14792) therefore:
  similarities and differences see NOx comparison
- Conclusion
  sampling set up comparable
  check in field is comparable
  analyzer with a QAL 1 certificate must be used