EN 689: WORKPLACE EXPOSURE
MEASUREMENT OF EXPOSURE BY INHALATION TO CHEMICAL AGENTS

Strategy for testing compliance with occupational exposure limit values

TNO innovation for life

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INTRODUCTION

- Measurement strategy for comparing workers' exposure by inhalation with occupational exposure limit values (OELVs)
- Fulfil the requirements of EN 482
- Variability in exposure
- Does not take into account the use and effectiveness of RPE
- Occupational hygiene practice:
  If the basic characterization shows that exposure is probably higher than the OELV, then it is recommended to reduce exposure by risk management measures (RMM) before measurements are planned for compliance testing

1 SCOPE

- This European Standard specifies a strategy to perform representative measurements of exposure by inhalation to chemical agents in order to demonstrate the compliance with occupational exposure limit values (OELVs).

- This European Standard is not applicable to OELVs with reference periods less than 15 min.

2 NORMATIVE REFERENCES

- EN 482, Workplace atmospheres — General requirements for the performance of procedures for the measurement of chemical agents

- EN 1540, Workplace exposure - Terminology

3 DEFINITIONS AND ABBREVIATIONS

Appraiser

- person who is sufficiently trained and experienced in occupational hygiene principles, working and measurement techniques, to conduct the part of the assessment he or she is performing according to the state of the art

Exposure profile

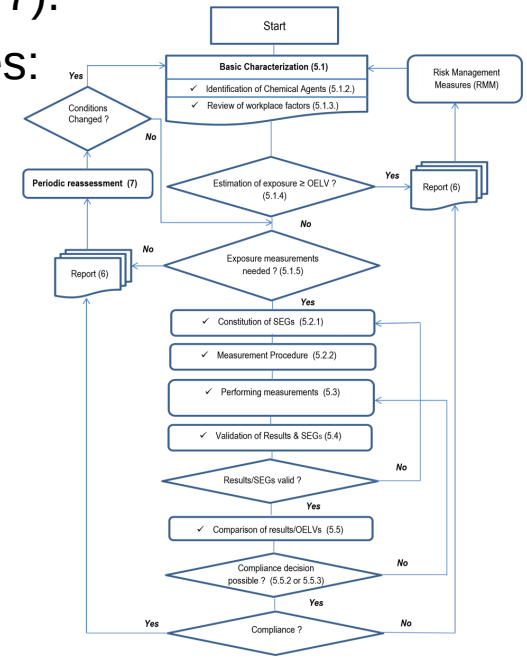
- description of the exposure variations to a chemical agent in relation to the definable series of activities from the periods under consideration

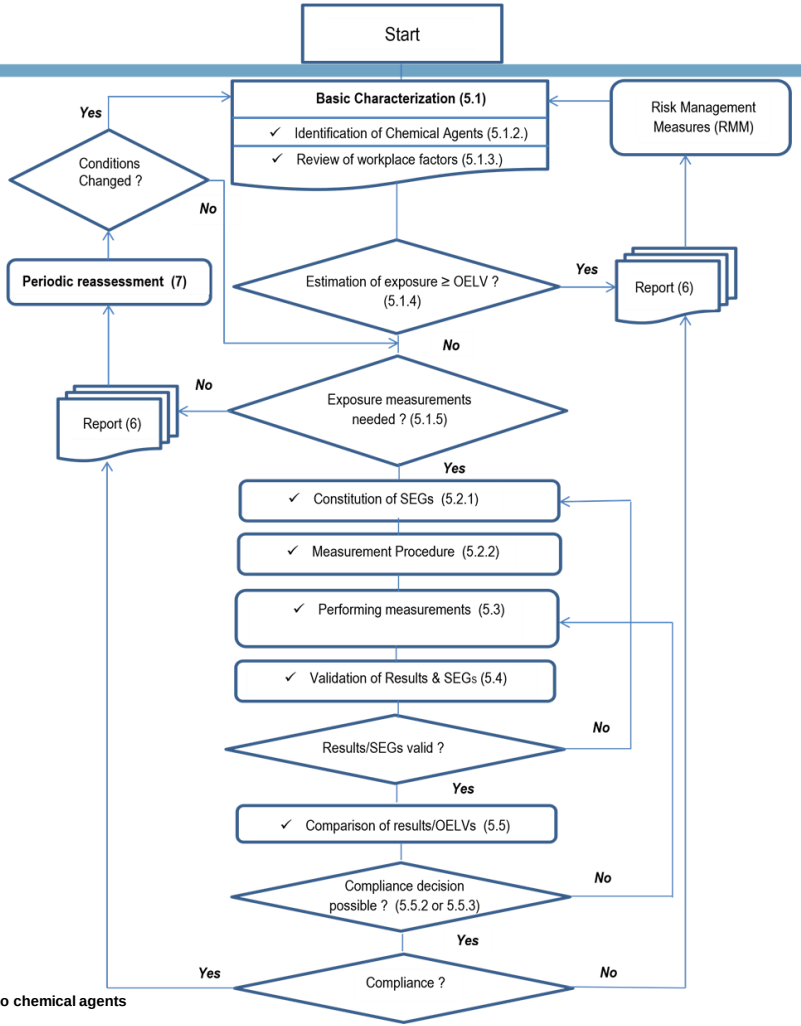
Similar exposure group (SEG)

- group of workers having the same general exposure profile for the chemical agent(s) being studied because of the similarity and frequency of the tasks performed, the materials and processes with which they work, and the similarity of the way they perform the tasks

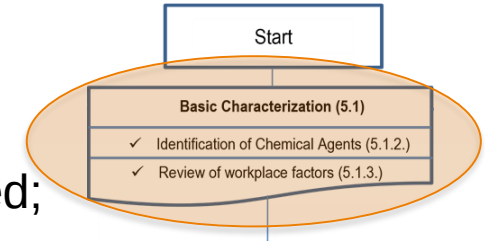
4 GENERAL

- The strategy consists of an **initial workplace assessment** (described in clauses 5 and 6) and then **periodic reassessment** (clause 7).
- The initial workplace assessment comprises different phases:
  - basic characterization of the workplaces;
  - constitution of similar exposure groups;
  - selection of a suitable measurement procedure;
  - performing exposure measurements;
  - validation of exposure measurements results and SEGs;
  - comparison of results with OELVs;
  - reporting of results.




Start
Basic Characterization (5.1)
✓ Identification of Chemical Agents (5.1.2.)
✓ Review of workplace factors (5.1.3.)
Risk Management Measures (RMM)
Yes
Conditions Changed ?
No
Periodic reassessment (7)
Estimation of exposure ≥ OELV ? (5.1.4)
Yes
Report (6)
No
No
Report (6)
Exposure measurements needed ? (5.1.5)
Yes
✓ Constitution of SEGs (5.2.1)
✓ Measurement Procedure (5.2.2)
✓ Performing measurements (5.3)
✓ Validation of Results & SEGs (5.4)
No
Results/SEGs valid ?
Yes
✓ Comparison of results/OELVs (5.5)
No
Compliance decision possible ? (5.5.2 or 5.5.3)
Yes
Yes
Compliance ?
No

5 OCCUPATIONAL EXPOSURE ASSESSMENT



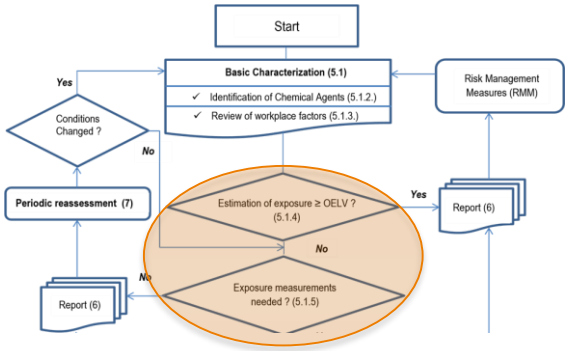
5.1 Basic characterization

- Identification of chemical agents and other information required;
- Review of workplace factors;
- Estimation of exposure (i.e. earlier measurements, results from comparable processes, calculations based on relevant quantitative information, exposure modelling (Annex A))

All the information collected during the basic characterization shall be used to:

- Decide whether measurements are necessary or not;
- Constitute the different SEGs.

5 OCCUPATIONAL EXPOSURE ASSESSMENT



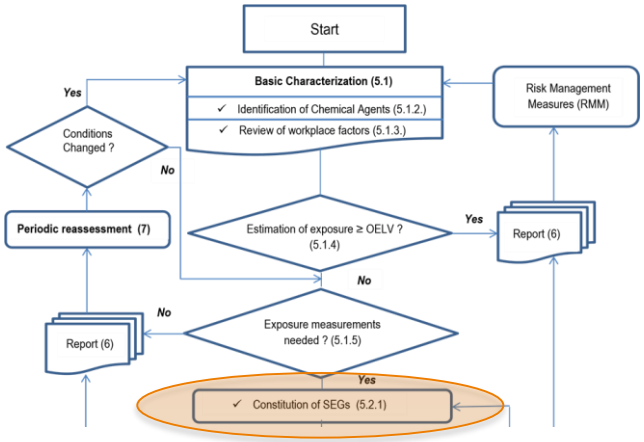
5.1 Basic characterization (Decisions)

- *Exposure > OELV (non-compliance):* appraiser shall report this and advise on a programme to reduce exposures, using RMM, before making measurements to test compliance;
- *Exposure <<< OELV (compliance):* appraiser shall decide if measurements are necessary or not. If measurements are unnecessary, the appraiser shall report this and advise on a reassessment
- Available information on exposure is *insufficient* to decide on compliance with the OELV: appraiser shall continue to develop a sampling plan

5 OCCUPATIONAL EXPOSURE ASSESSMENT

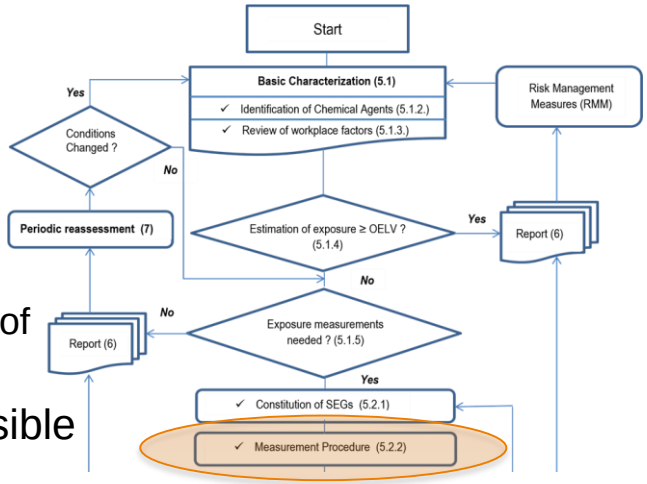
5.2 Sampling strategy

- Constitution of Similar Exposure Groups (SEGs)
  - Usually not possible to measure the exposure of each worker during each working day
  - Permits measurement of exposure of a small number of workers belonging to a SEG for comparison with OELVs
  - Using information on the profile of exposure and duration of the tasks performed
  - Requires occupational hygiene expertise



5 OCCUPATIONAL EXPOSURE ASSESSMENT

5.2 Sampling strategy

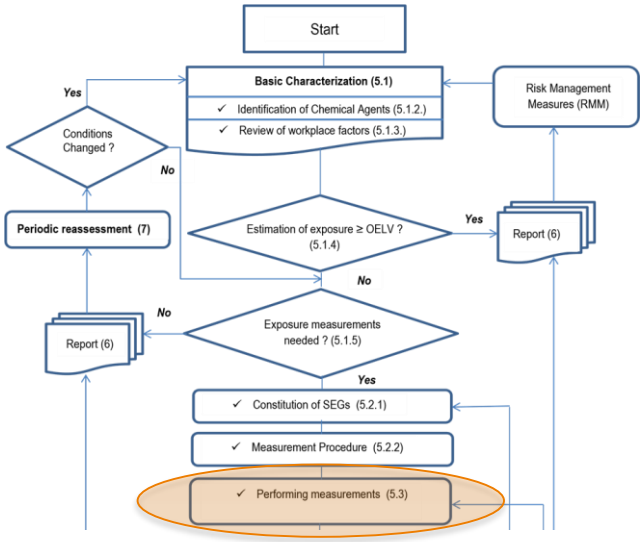


- Specifying the measurement procedure
  - Obtain valid and representative measurements
  - Comply with the requirements of EN 482 (Sensitivity, limit of quantification, expanded uncertainty, specificity, capacity of samplers, transportation and stability of the sample)
  - Personal sampling devices shall be used whenever possible
  - Sampling duration
    - Should representatively describe the exposure for the reference period (Annex D)
    - Minimum of 2h
    - Extended workshifts (>8h)
  - During sufficient days and during various specific operations
  - Minimum number of measurements shall be in accordance with 5.5

5 OCCUPATIONAL EXPOSURE ASSESSMENT

5.3 Performing exposure measurements

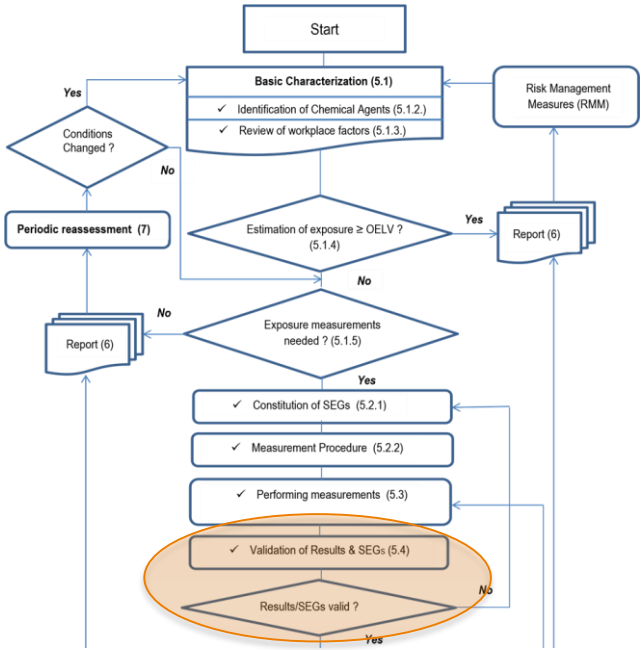
- Document relevant information for the future interpretation of the results:
  - Identification of the SEG and of the workers;
  - Description of the workplace;
  - Chemical agents relevant for the activity;
  - Work tasks performed;
  - Daily working hours and the duration of exposure to chemical agents considered;
  - Risk management measures
  - Relevant environmental conditions at the workplace
  - Smoking by nearby workers
  - Presence of other or unusual activities, incidents, etc.
  - Sampling information



5 OCCUPATIONAL EXPOSURE ASSESSMENT

5.4 Validation of results and SEGs

- Validation of measurement results
  - Unusually high or low values: possibility of sampling/ analytical errors shall be considered
  - Accidents with equipment, malfunctions, deliberate misuse
  - If no such irregularity can be reliably identified, the measurement shall not be excluded
  - Any removal of results and the reasons shall be explicitly described in the report
- Validation of SEGs
  - Distribution of results shall be examined (log probability plot, statistical test (Annex E))
  - Exposure measurements are usually log normally distributed
  - Any changes to the SEG as a result of these tests shall be recorded in the report

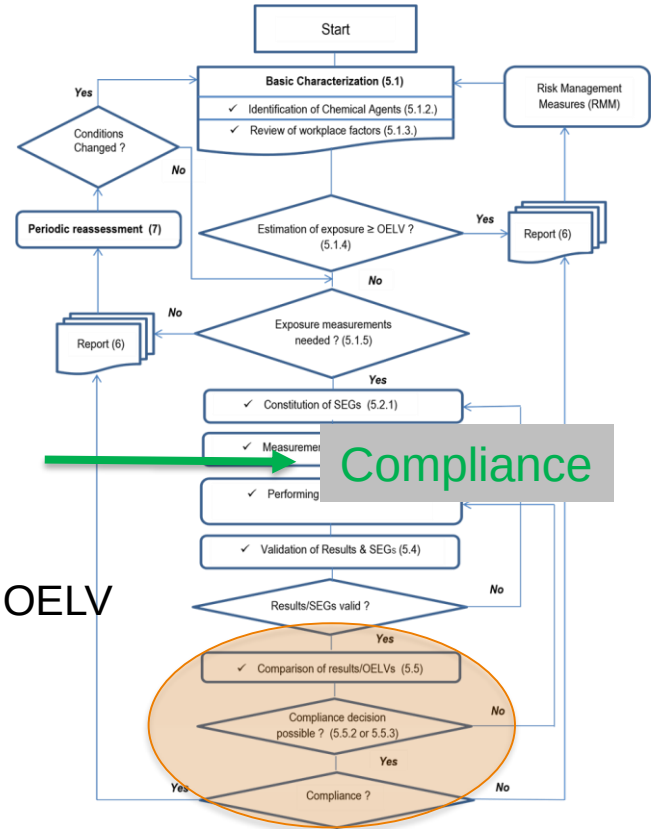


5 OCCUPATIONAL EXPOSURE ASSESSMENT

5.5 Comparison of results with OELVs

- Comparison with OELV for a single chemical agent
  Exposure to several hazardous chemical agents => Annex C
- Preliminary test (requires 3 to 5 measurements)
  - If all results are below:
    1. 0,1 OELV for a set of three exposure measurements or,
    2. 0,15 OELV for a set of four exposure measurements or,
    3. 0,2 OELV for a set of five exposure measurements.
  - One of the results > OELV: Non-compliance.
  - All results < OELV and one result > 0,1 (or 0,15, or 0,2) OELV

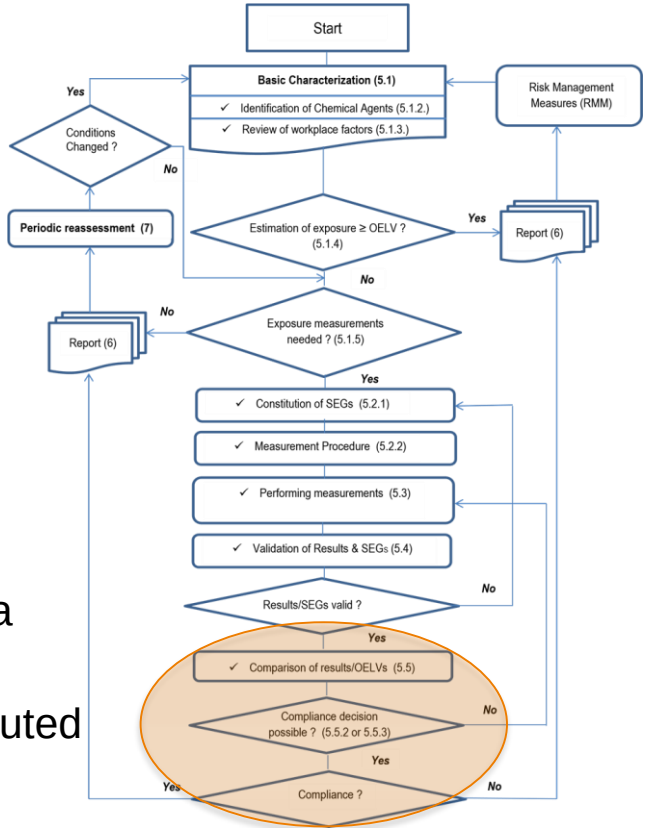
No-decision: Statistical test



5 OCCUPATIONAL EXPOSURE ASSESSMENT

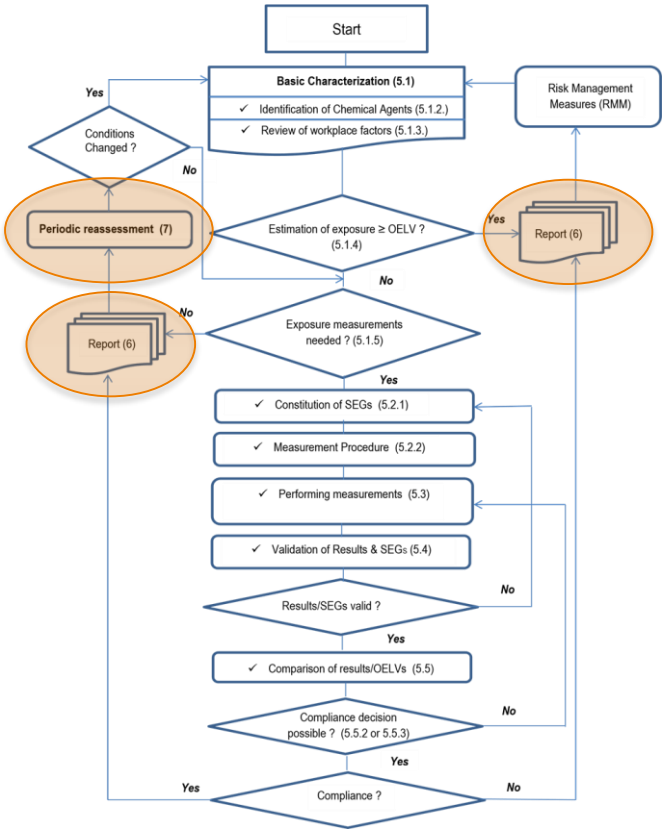
5.5 Comparison of results with OELVs

- Statistical test
  - Appraiser shall select a statistical test to check whether the exposures of the SEG comply with the OELV
  - The test shall measure, with at least 70 % confidence, whether less than 5 % of exposures in the SEG exceed the OELV (Annex F)
  - Exposure measurements shall meet the requirements of the test chosen
  - Values < LOQ shall be treated in a way which produces a reliable result (Annex H)
  - Assumes that the measurements are log-normally distributed



6 REPORT

- Name of the appraiser and institutions undertaking the assessment and the measurements;
- Purpose of the assessment;
- Name of the chemical agents considered;
- Name and address of premises;
- Description of the workplace factors and working conditions;
- Observations made during sampling;
- Results and conclusions of the basic characterization;
- Measuring procedure and equipment used and agreement with requirements of EN 482;
- Time schedule (date, beginning and end of sampling);
- Exposure concentrations;
- Details of quality assurance
- Clear identification of results;
- Result of the comparison with the limit value.



7 PERIODIC REASSESSMENT

- Workplace exposure assessment shall be updated periodically to keep it current and ensure that worker's exposure remains in compliance with the OELV
- Reassessment of exposure can be done with exposure measurements or other methods (see Annex A)
- In case of significant changes in workplace factors the basic characterization shall be updated immediately
- Despite the absence of significant modification of workplace factors, the appraiser shall justify why also in future compliance can be expected
  - In general, an annual interval is recommended for reassessment
  - When reassessment is conducted with exposure measurements, periodic intervals for measurements are proposed in Annex I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