

Excusez-moi!



grève



10/06/2016 11:30-12:00

session 2 Aspects techniques et scientifiques

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Statistics and Representative measurements

SOPHYT Lille Forum 2016
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www.dohsbase.com



DOHSBase COMPARE® : the most comprehensive database for Occupational Hygiene Exposure Limits and Sampling Methods.

238.000 substances
>8000 substances with 1* (health based) OELV
>3000 substances with 1* PAS method
Physchem (40k) & CLP H-statements (110k)

French version
Ranking vapor risk potential

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Statistics & Representative measurements

- Statistics is a scientific trick
 - Garbage in (delivered by you!!) => garbage out
- Collecting representative measurements is an art
 - Skills
 - Experience
 - Observation
 - Analyse
 - Communication

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Different scenarios Workshop

Representative measurements for OELV testing should reflect:

1. SEG exposure variability in space and time
2. the legal limit reference period specific exposure of an individual worker
3. Worst case
4. SEG long-term average exposure level
5. Task specific workers safe exposure



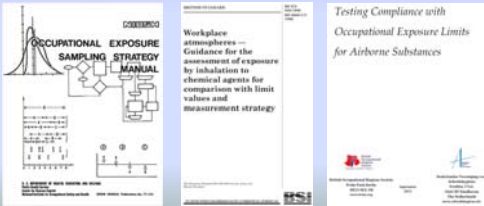
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Struggling with representativeness, small sample sizes and exposure variability

1977 1995 2011 2016



prEN 689
Next speaker
Roger Grosjean

EN 689 Screenings test

Decision 5.5.2	Compliance	reassessment	Non-compliance
Sample size N	All outcome < f*OELV	Otherwise	Outcome > OELV
3	f=0.1		≥ 1
4	f=0.15		
5	f=0.2		

Evidence based for GSD≤3 : INRS (2005) ND2231

Exercise 1



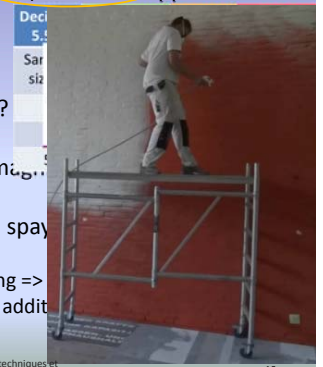
- Exposure profile/scenario: Operator filling bags
- 3 gravimetric 8 hr PAS measurements : 0.45, 0.4 and 0.45 mg/m³
- CV_t=25% (EN 482, coefficient of variation)
- OELV: 5 mg inhalable/m³
- Compliance or ?
- Representative measurements? or ?
- GSD=1.07 !
 - small sample error, autocorrelation
 - evaluate SEG/sampling plan => resamp



Exercise 2



- Three solvent measurements 0.01; 0.3 and 9.9 ppm
- Professional spay painting
- Solvent OELV: 100 ppm
- Compliance or ?
- Exposure range of 3 orders of magnitude
- Representative for professional spay painting
 - Read across (next slide)
 - If no, then improve SEG/sampling => add
 - If yes, then (not in standard) => add



Painters GSD, read-across Annals 1985

Type of object	Number of painters*	Type of paint	Remarks
1 Apartment building	6	Chlorocyclohex paint	
2 Ambassador's house	4 H	Synthetic wall paint, primer solvent varnish	
3 Telephone district centre	3 H	Alkyd resin, latex wall paint, synthetic wall paint	
4 Brewery	4	Synthetic wall paint, epoxy resin	
5 Furniture showroom	4 H	Alkyd resin	Spaying by 1 painter
6 Casino	4	Structure wall paint, alkyd resin	Spaying by 1 painter assisted by 1 colleague
7 Room of regents in Lower House residence	4	Terpenic paint	Only 2 persons were sampled
8 Garage	3 H	Latex wall paint, synthetic wall paint, 2-component varnish	
9 Pumping station	4	Chlorocyclohex paint	During only a few minutes were protective clothes with air refreshment worn
10 Laboratory	2 H	Synthetic wall paint	
11 Laboratory	3 H	Varnish, alkyd resin	
12 Distributing station	2	2-component polyurethane lacquer	Spray-painting was performed during several minutes



Painter group	Number of painters (n)	Tolerance factor k _c *	Log normality P†	Geom. mean GM‡ (mg m ⁻³)	Geom. stand GSD§
House painters	20	2.752	0.85	58.66	2.086
Total group	45	2.408	0.38	100.9	2.673
House painters	20	2.752	0.50	0.15	1.936
Total group	45	2.408	0.04**	0.28	2.648

Exposure variability

- Compare your GSD with the typical variability for the exposure profile tested:
 - measurement series performed before
 - GSDs reported in large databases like the French COLCHIS and the German MEGA
 - literature
 - Read across with comparable substances and workplaces

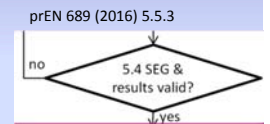
Initial Assessment – Testing Compliance with OELVs

- Statistical test : ≥ 6 results
 - The test shall measure, with at least 70% confidence, whether less than 5% of exposures in the SEG exceed the OELV
 - $C_{95\%,70\%} < \text{OELV Compliance}$
 - $C_{95\%,70\%} > \text{OELV Non-Compliance}$

Exercise 3



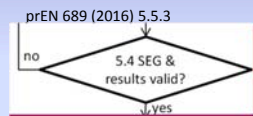
- ≥ 6 measurement in a clean room
- GSD=2
- $CV_t=5\%$
- $C_{95\%,70\%} < \text{OELV}$
- 5.5.3. Compliance!
- Is the GSD representative for clean room?
 - Evaluate controls => resampling $N \geq 3$
 - Evaluate between worker differences ($N \geq 2 \times 3$)



Exercise 4



- ≥ 6 measurement outdoor painter, solvent exposure
- GSD=1.4
- $CV_t=5\%$
- $C_{95\%,70\%} < \text{OELV}$
- Compliance or ?



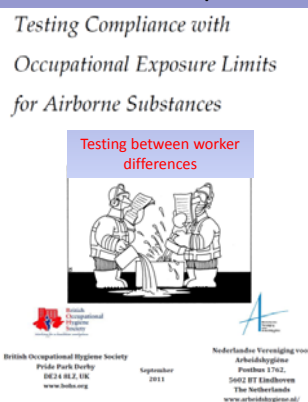
Is a GSD=1.4 representative for this exposure scenario?

- evaluate SEG & sampling plan

Exposure variability

- Underestimation of GSD's is caused by:
 - one day sampling.
 - small sample size
 - sloppy handling of non-detectables
 - autocorrelation (one outcome determines the next)
 - 2-decades analytical detection methods (like gravimetric dust and inorganic acid sampling)
 - EM in stead of PAS
- Use your expertise (and prEN 689 chapter 5.1 through 5.4)!
- For workplace $GSD \leq 3$, between-worker differences may become relevant: individual exposure testing

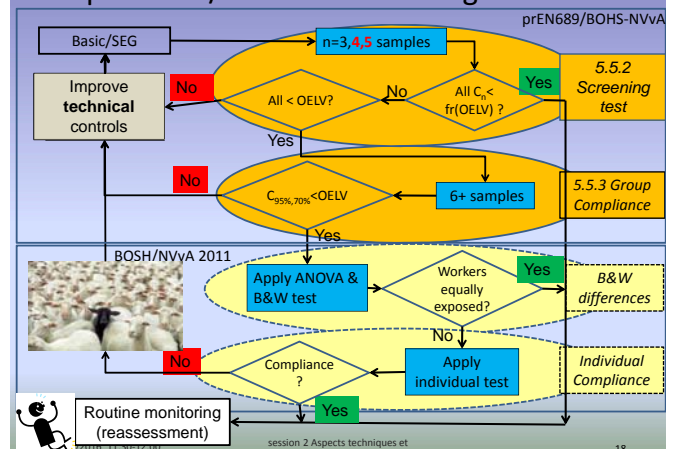
No two workers are exposed exactly the same



2011

But are their differences within a well defined exposure group relevant ?

prEN 689/NVvA-BOHS testing scheme



Between Worker Variability in SEG

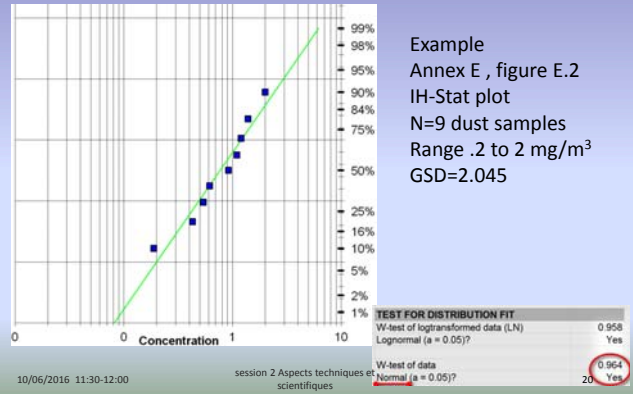
- Becomes apparent if long-term day-by-day $GSD < 3$
- Linked to well-controlled (“clean room”) or fix tasks exposure scenarios
- May stigmatize workers as “dirty”, incorrectly if individual sample size is small (< 6)

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Lognormal probability Exercise 5



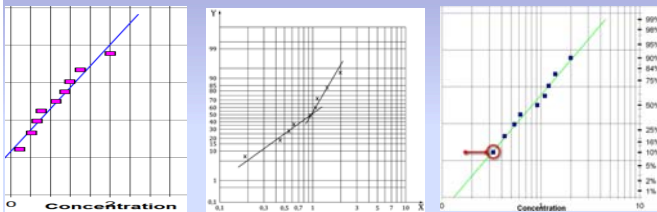
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A little bit of lying with statistics



CVt Normal?

2 lognormal distributions?

one inaccurate low value?

Not the statistics, but the exposure determinants (5.1 through 5.3) will tell!

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Become a representative measurement expert!
Let BW_stat do the statistics

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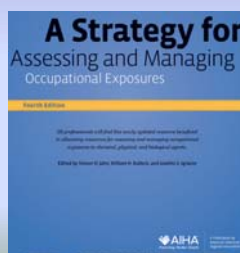
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2018 start with developing a global aligned strategy (ISO/IOHA) ?



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