Technical problems & solutions

Representative measurements & space/time variability within the SEG

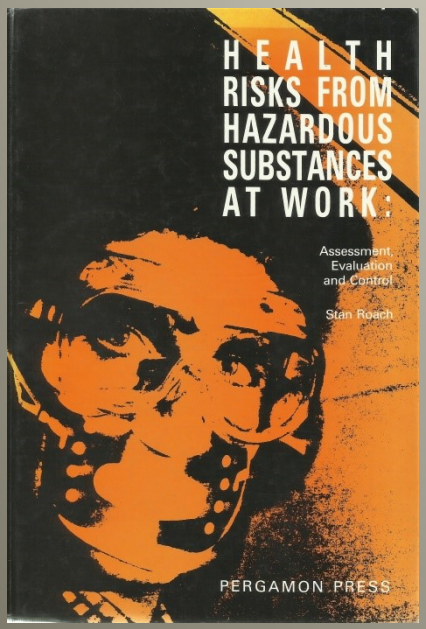
prEN 689 workshop

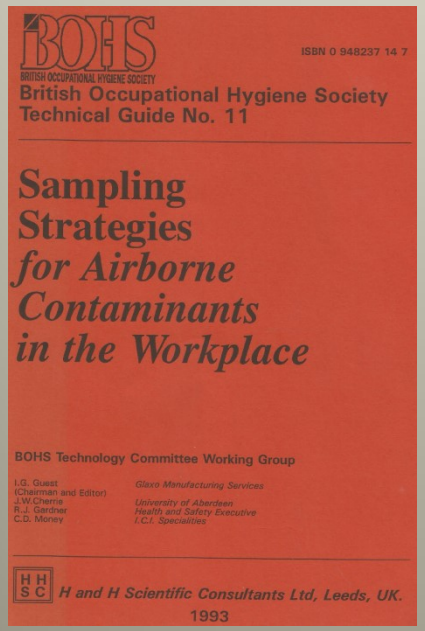
BOHS Conference Glasgow 2016

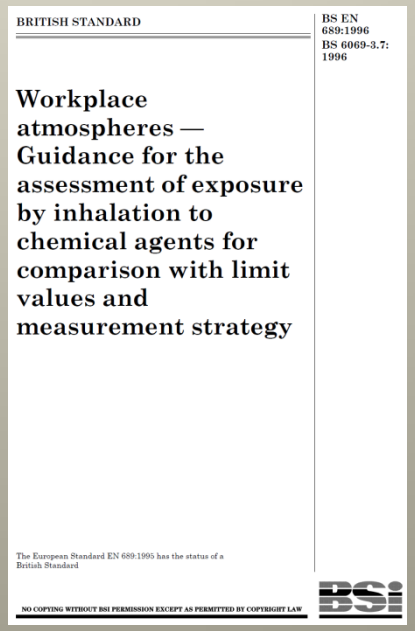
Theo Scheffers, NVvA representative

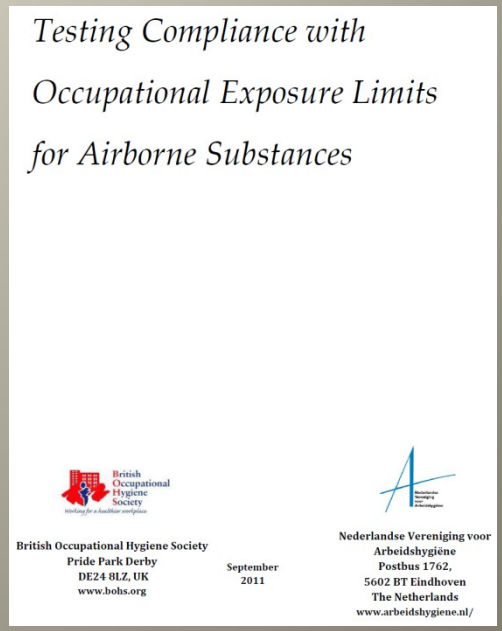
www.tsac.nl

Some UK/BOHS exposure assessment milestones, all struggling with representativeness, small sample sizes and exposure variability









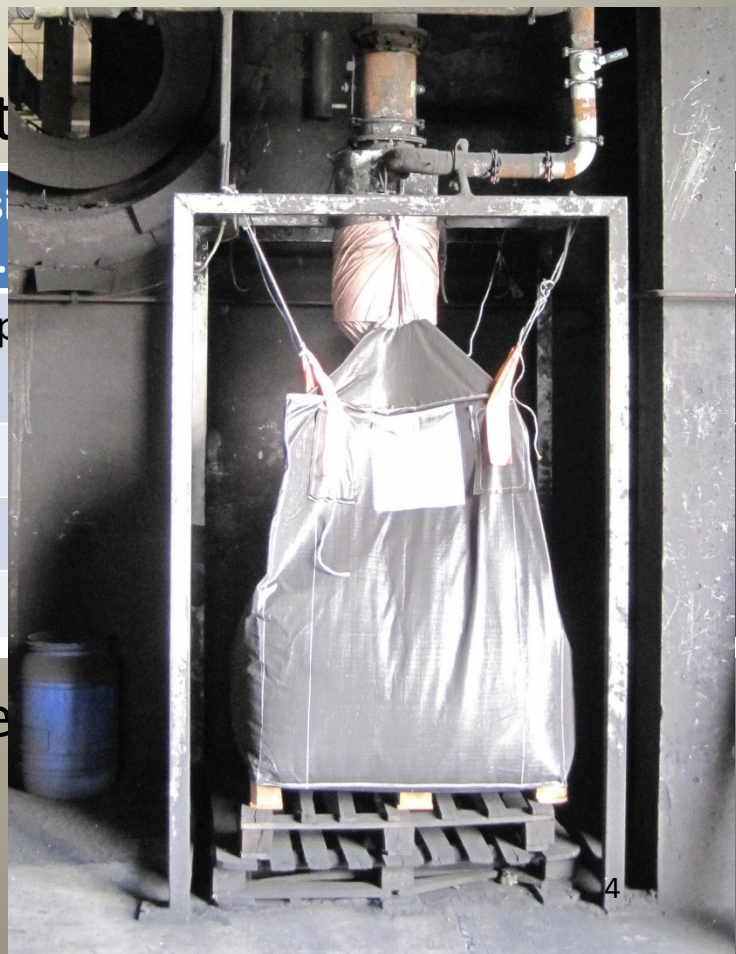
Screenings test 5.5.2

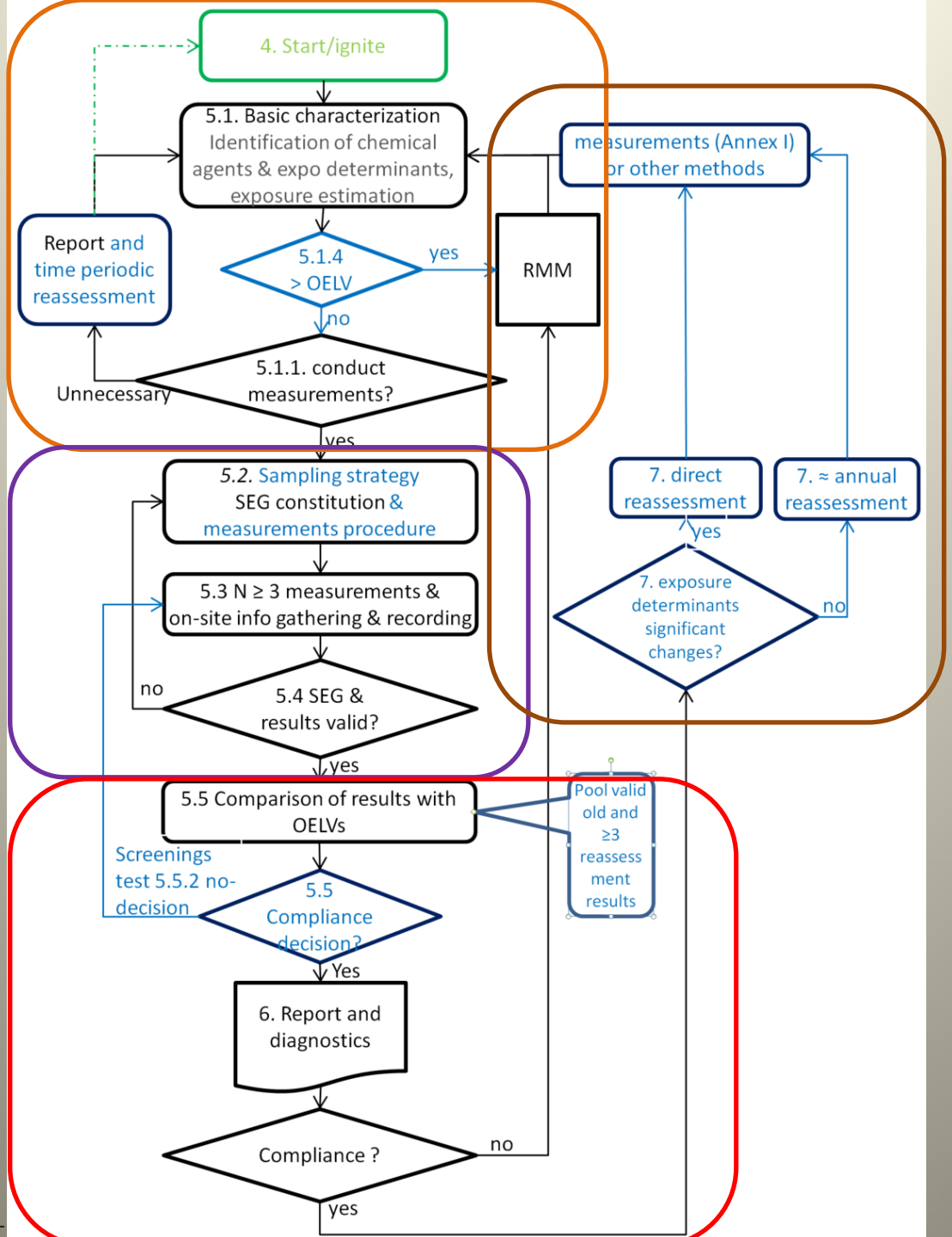
Decision 5.5.2	Compliance	reassessment	Non-compliance
Sample size N	All outcome < f*OELV	Otherwise	Outcome > OELV
3	f=0.1		≥ 1
4	f=0.15		
5	f=0.2		

Exercise 1

- Exposure profile/scenario: Operator filling bags
- 3 gravimetric 8 hr PAS measurements : 0.45, 0.4 and 0.45 mg/m^3
- CV_t=25% (EN 482, coefficient of variat
- OELV: 5 mg inhalable/m^3
- 5.5.2. Compliance  or  ?
- Representative measurements?
- GSD=1.07 ! 
  - If no, then improve SEG/sampling => re
  - If yes, then compliance indeed

Decis 5.5.
Samp size
3
4
5





Green is somehow missing in the prEN_689:
Risk assessment /stakeholder question

Blue parts in the Figure 1 are in the text but not in the current figure

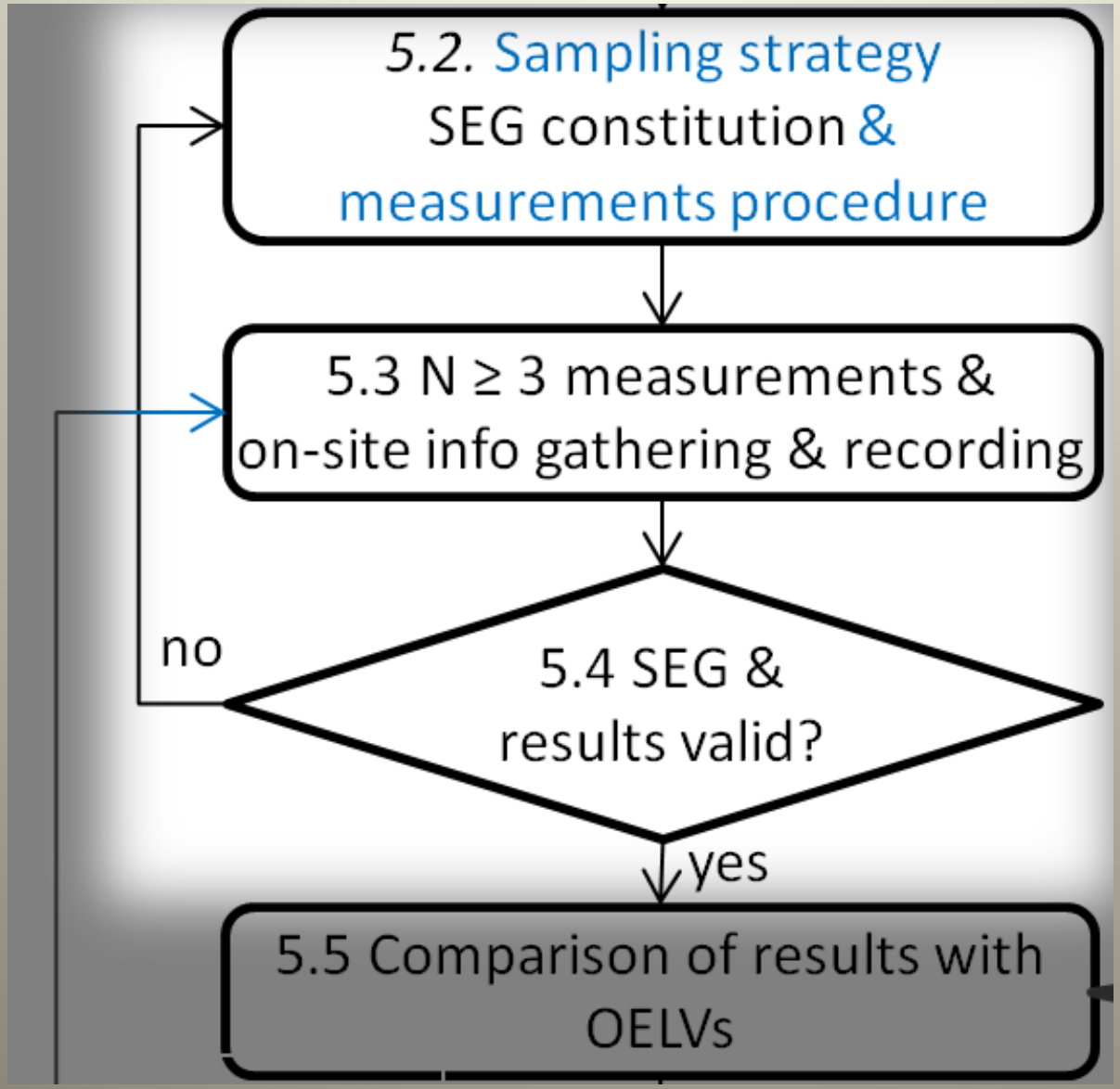
Basic characterization

Representative sampling

Compliance testing

Reassessment

representative of worker exposure



Representative sampling

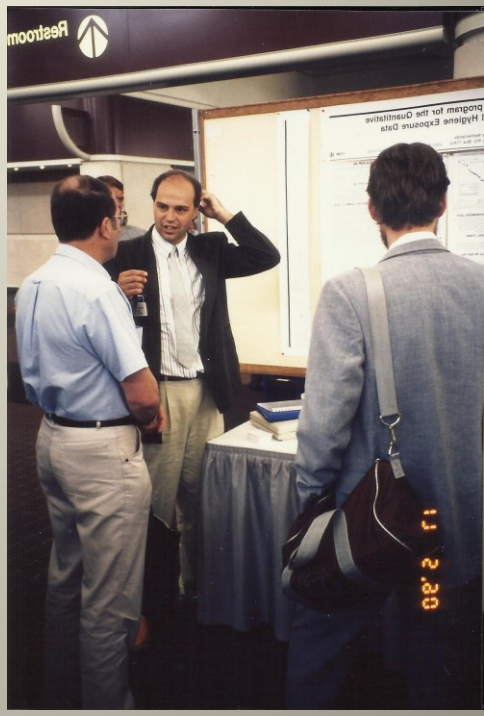
Excercise 2

Workshop

- Three solvent measurements 0.01; 0.3 and 9.9 ppm
- Professional spay painting
- Solvent OELV: 100 ppm
- 5.5.2. Compliance  or  ?
- 3 orders of magnitude (GSD=31)
- [IH-Stat $C_{95\%}$ =90 ppm, prEN 689 5.5.3.
- GSD=31, representative for professiona
  - Read across (next slide)
  - If no, then improve SEG/sampling => res
  - If yes, then (not in standard) => addition

Painters GSD, read-across Annals 1985

Type of object	Number of painters*	Types of paint	Remarks
1 Apartment building	6	Chlororubber paint	
2 Ambassador's house	4 H	Synthetic wall paint, prime colour varnish	
3 Telephone district centre	3 H	Alkyd resin, latex wall paint, synthetic wall paint	
4 Brewery	4	Synthetic wall paint, 2-component epoxy resin	
5 Furniture showroom	6 H	Alkyd resin	Spraying by 1 painter
6 Canteen	4	Structure wall paint, alkyd resin	Spraying by 1 painter assisted by 1 colleague
7 Room of regents in Lower House residence	4	Turpentine paint	Only 2 painters were sampled
8 Garage	5 H	Latex wall paint, synthetic wall paint, 2-component varnish	
9 Pumping station	4	Chlororubber 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_7*	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 (1)

- Compare your GSD with the typical variability for the exposure profile tested:
  1. measurement series performed before
  2. GSDs reported in large databases like the German MEGA and the French Colchis
  3. literature
  4. Read across with comparable substances and workplaces
  5. Modelling ??
  6. Physical-Chemical properties ??
  - ….

Validity screening test (5.5.2)

Evidence based for GSD≤3 ! [INRS (2005) ND2231 table VII]

More strongly, if the exposure measurements are indeed representative for the Similar Exposure Group (SEG 5.2.1),and based on a valid measurement procedure (5.2.2), sampling and analysis (5.3).

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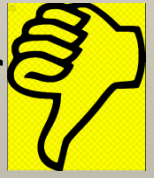
Exercise 3

- ≥ 6 measurement in a clean room
- GSD=2
- CV_t=5%
- $C_{95\%,70\%}$<OELV

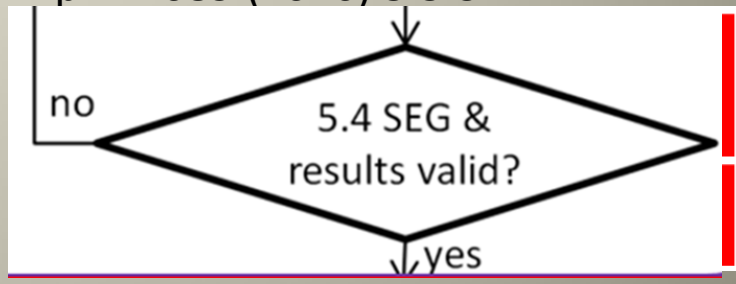
prEN 689 (2016) 5.5.3

- 5.5.3. Compliance!
- Is the GSD representative for clean room?
  - If yes, then compliance
  - If no, then test between worker differences (N≥2*3) or check/improve controls => resampling N≥3

Exercise 4

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

prEN 689 (2016) 5.5.3



- Is a GSD=1.4 representative for this exposure scenario?
- If no, then validate SEG & measurements before compliance testing

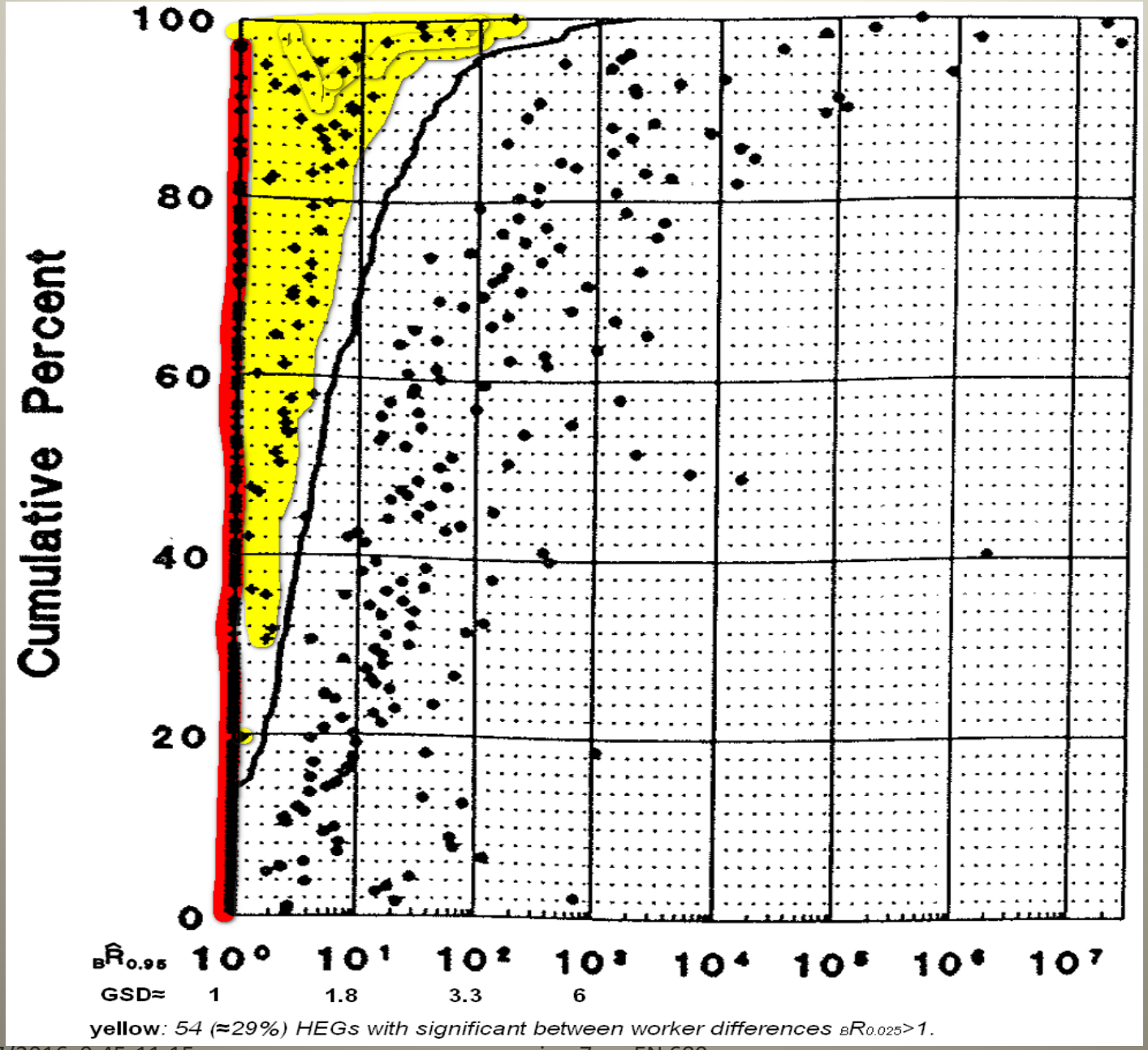
Exposure variability (3)

- Low GSD's:
  - Well controlled workplaces (clean room)
  - Workers performing a fix task, 8 hours a day, 40 hrs a week
  - Dominant background concentrations
- Low workplace GSD's may lead to:
  - significant between worker differences =>Poorly defined SEGs
- Current prEN689 (Annex E) and AIHA IH_Stat/INRS Altrex state for GSD>3: "process out of control or poorly defined SEGs".

Exposure variability (2)

- 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 OH brains and expertise (and prEN 689 chapter 5.1 through 5.4)!
- For workplace GSD≤3, between-worker differences may become relevant: individual exposure testing

Between worker differences in <29% of HEGs



Rappaport et. al. AIHAj, 1994, p873-7

HEG and SEG

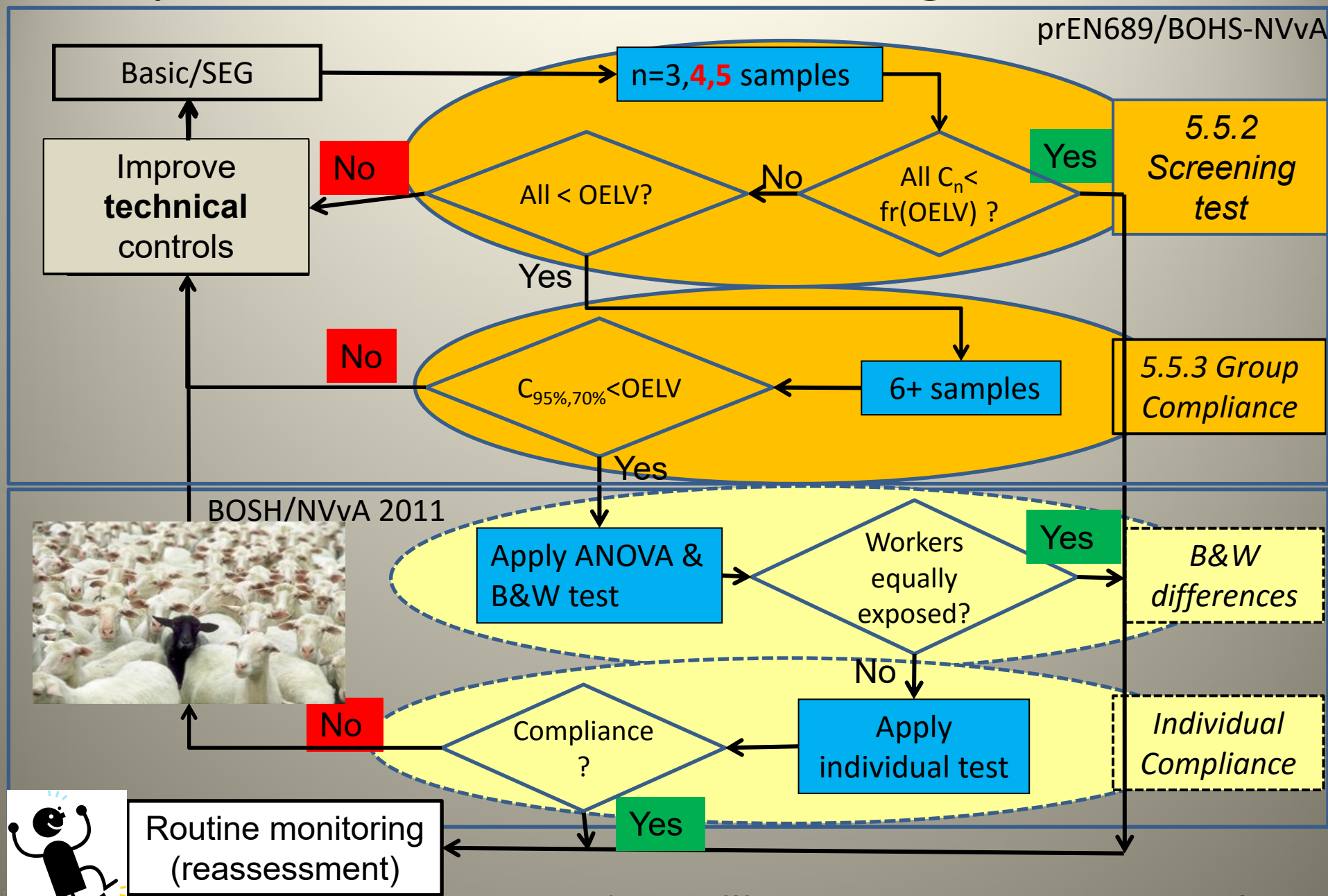
HEG (late seventies)

- occupational health and epidemiology concept
- Workers with equal average exposure
- Jobs and tasks combines

SEG (nineties)

- industrial hygiene concept
- similarity and frequency of the tasks performed
- Room for between worker variability

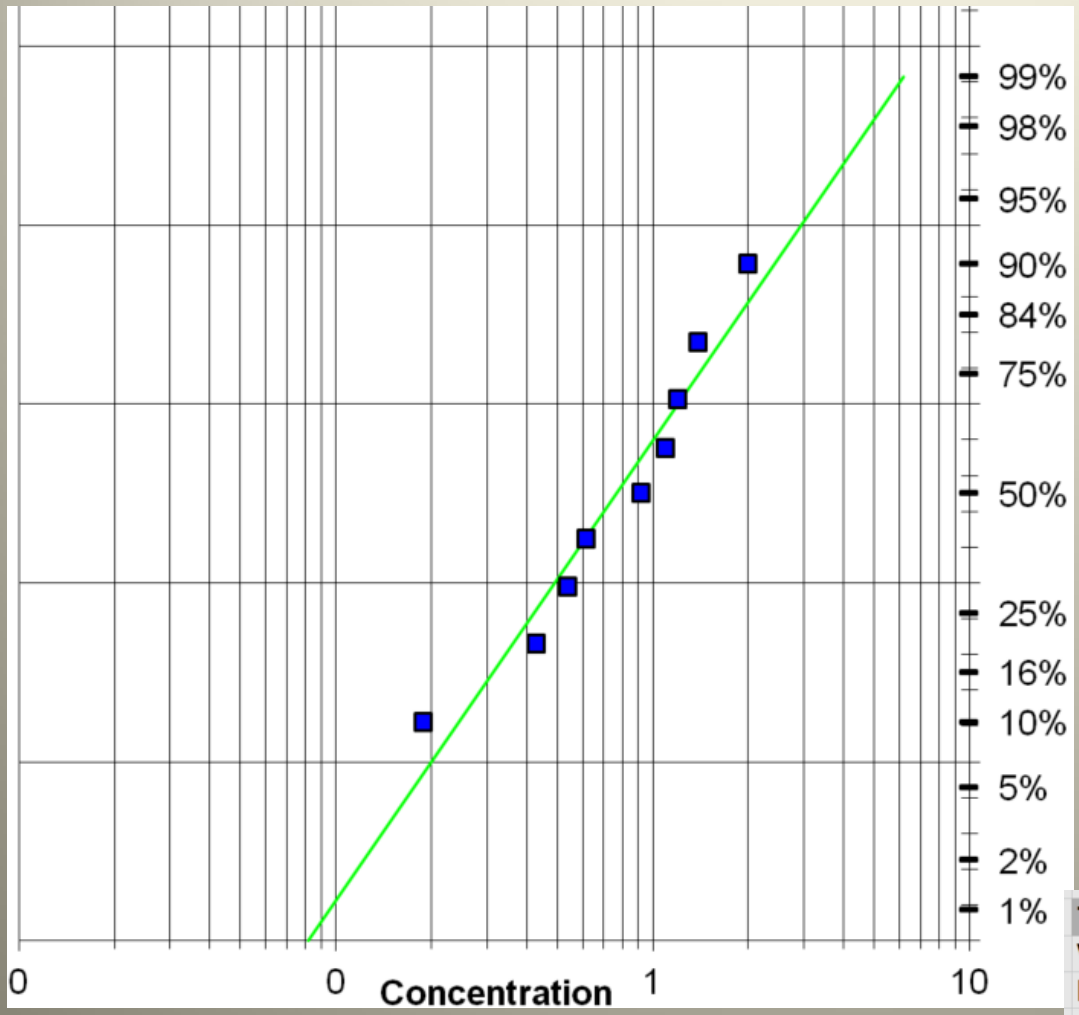
prEN 689/NVvA-BOHS testing scheme



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)

Exercise 5

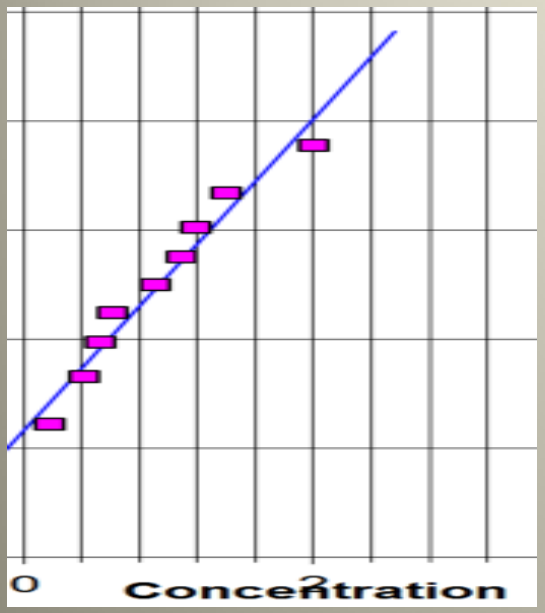


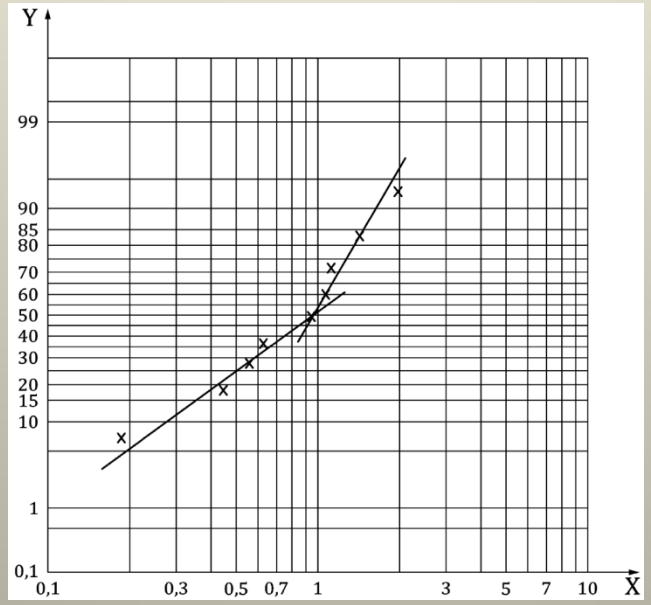
Example
Annex E , figure E.2
IH-Stat plot
N=9 dust samples
Range .2 to 2 mg/m^3
GSD=2.045

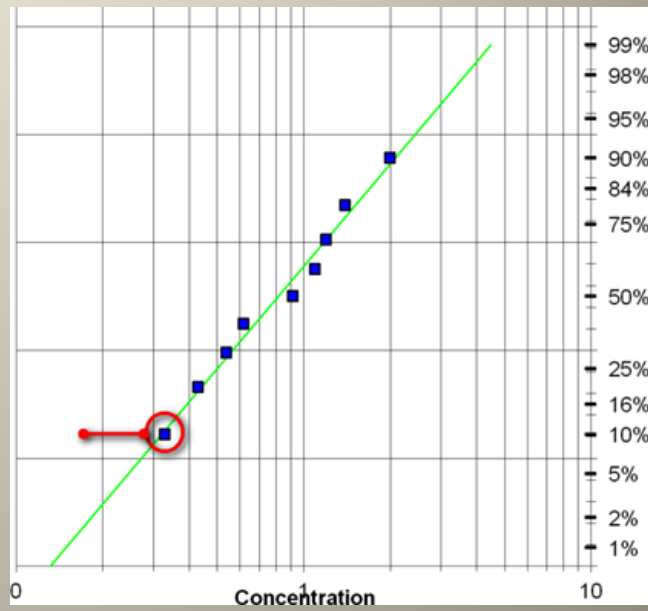
TEST FOR DISTRIBUTION FIT	
W-test of logtransformed data (LN)	0.958
Lognormal (a = 0.05)?	Yes
W-test of data	0.964
Normal (a = 0.05)?	Yes

Workshop

Preferred distribution?







CVt Normal?

2 lognormal distributions?

one inaccurate low value?

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

Important issue

Compliance decision

- The screenings test 5.5.2 , EN 689 (1995) annex D.3 and AIHA (2016) use three outcome for the compliance test (red, orange, green)

EN 689 (1995) Annex D.3

Compliance	additional measurements	Non-compliance
P(C>OELV)≤.1%	Otherwise	P(C>OELV)>5%

prEN 689 (2016) Screening 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		

The 6+ compliance test prEN 689 (2016) 5.5.3. has only two outcome: Non compliance(red) or periodic resampling decision (orange)

Compliance & reassessment	Non-compliance
$C_{95,70\%}$≤OELV	$C_{95,70\%}$>OELV

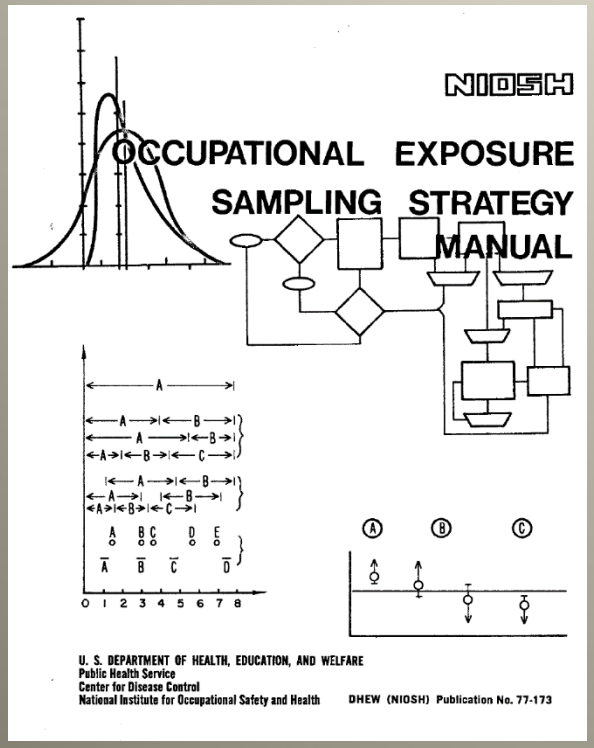
Next steps 2016

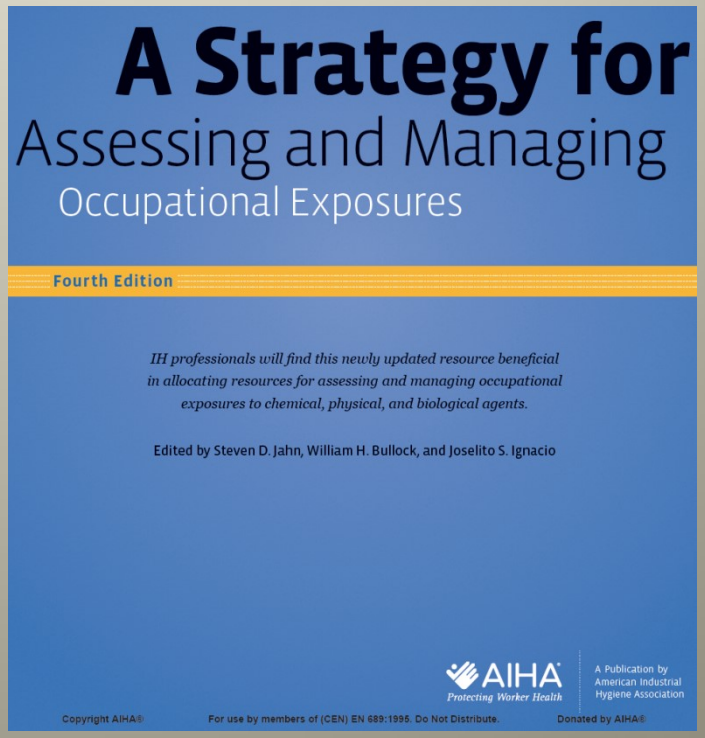
- the CEN enquiry is now scheduled from 2016-06-02 to 2016-09-02 (3 months).
- During this period, each national bodies will organize a national consultation.
- The next WG 1 meeting will be held on 19th and 20th September 2016 in Roma (Italy) and will be dedicated to consider national comments submitted during the CEN-Enquiry.

Next steps

- 2017 a minimum standard for the EU.
- Countries or industrial hygiene associations are free to expand the standard for national use, but it should not conflict with the 689
- CEN TC 137 /WG 1 and the national bodies are dominated by labs with commercial interest in sampling and little interest in exposure assessment strategy

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





Who is responsible/accountable for compliance testing quality?

There is no national or EU law demanding compliance testing to be sound science/evidence based, however:

- Causation and control of work-related illness# does!
- As occupational hygiene ethics
- So, we are responsible/accountable for good quality compliance testing
- prEN 689 can be a helpful an protective vehicle, especially if science/evidence does not help in the decisions

Thanks!

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Theo.Scheffers@tsac.nl

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