Editorial

Proposed British–Dutch Guidance on Measuring Compliance with Occupational Exposure Limits

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Occupational exposure limits (OELs) for hazardous substances are usually defined as exposures averaged over 8 h or 15 min which must not be exceeded. In the European Union (EU), examples are the limits in the Chemical Agents Directive (EU, 1998) and the Carcinogens Directive (EU, 2004). But if we define the limits as exposures which must never be exceeded, we disregard the complex patterns of real exposure. It is common experience that exposure distributions often include results which are several times the median value, not because of a failure of control but because there is a statistical chance that the many factors which determine exposure combine in a way which produces an outlying result. Do these outliers constitute non-compliance or are they freak happenings which can be disregarded, and if so what is the criterion for distinguishing ‘freak’ measurements from significant results which must be taken into account?

This has been a problem ever since OELs moved from being ‘guidelines to be used by professional industrial hygienists’ (ACGIH, 2009) to being sharp cutoffs of legally allowable exposure, and many attempts have been made to write guidance on how to demonstrate compliance with the limits. Probably, the most famous is of Leidel et al. (1977), published by the US National Institute of Occupational Safety and Health (NIOSH). In a commentary last year, Ramachandran (2008) described this guidance and its limitations and NIOSH’s plans to revise it. This work continues. In Europe, the most prominent guidance is the European Standard EN689 (CEN, 1995). A couple of years before that was published, the British Occupational Hygiene Society (BOHS) had produced a Technical Guide on the problem (BOHS, 1993). These documents all try to deal with the underlying difficulty that an OEL defined as a sharp threshold is out of step with the laws of physics that determine how exposure varies in the workplace.

A second problem is that individuals apparently doing the same job in the same way can differ substantially in exposure, which is not fully taken into account in EN689 and the earlier documents. The two problems of variability from shift to shift and from worker to worker mean that a statistically valid test of compliance with the OEL requires far more measurements than would normally be considered practicable.

Two years ago, a joint Working Party on the problem was appointed by the BOHS and Nederlandse Vereniging voor Arbeidshygiëne, the Dutch Occupational Hygiene Society (NVvA). This has produced draft guidance which is open for comment on the societies’ websites until the end of 2009 (http://www.bohs.org and http://www.arbeidshygiene.nl/index.php). The guidance is not finished, but the Working Party felt that it would be useful to expose it to public comment at this stage. Its approach to the fundamental problem is to emphasize the importance of the principles and methods of control, not just compliance with OELs. In this, it follows the European Chemical Agents Directive (EU, 1998), which in Articles 5 and 6 requires application of good control practice alongside but independently of compliance with exposure limits. This dual approach is also emphasized in the British COSHH regulations (HSE, 2005).

However, when it comes to measuring compliance, the statistical problem has to be faced. Like most other guidance, the British–Dutch draft uses a criterion that 95% of exposures should be below the OEL, arguing that this represents good professional practice even if it does not strictly guarantee compliance with the law. The main test involves division of...
the workforce into similarly exposed groups (SEGs) and measurement to determine the between-shift and between-worker variances. These are then combined to estimate two measures of compliance.

1. Group exceedance. The probability that the time-weighted average exposure from a random worker in the SEG exceeds the OEL.
2. Individual exceedance. The proportion of all the workers in the SEG who have 95th percentiles of exposure exceeding the OEL.

The parameters therefore recognize the differences between exposures of workers nominally doing the same job. In practice, the second parameter more often indicates non-compliance than the first, but having both provides a pointer to whether better control should be applied to the whole group or whether it should be concentrated on individuals.

There is a software package SPEED obtainable from a University of Utrecht website http://www.iras.uu.nl/iras_speed.php which is currently being updated to provide easy calculation of the parameters. The Working Party’s draft also gives an illustrated description of their calculation using Microsoft Excel.

The recommended method inevitably includes a lot of measurement. However, the guidance also gives a Stage 1 screening process, requiring only three measurements, designed to pick SEGs that have high probability of non-compliance, for which it would be sensible to apply better control before implementing the full compliance test. The guidance also discusses three shortcuts, which require a lot less sampling, but which have various shortcomings.

The guidance and its methods make extensive use of various sources. The American Industrial Hygiene Association software IHSTAT (http://www.aiha.org/content/insideaiha/volunteer-groups/eascomm.htm) is often referred to. The Stage 1 test is based on an evaluation of various strategies by Hewett (2005) and published on his company’s website. Among other sources, the calculation methods use Rappaport and Kupper’s (2008) book, an exposition of the problems which is systematic and clear and well illustrated from workplace data, although it does not shy away from the inevitable mathematics. In my view, it is indispensable for anyone seriously interested in these problems. Rappaport and Kupper evidently have little sympathy for the feeling that hygienists can only be expected to take a few measurements, and they refer to the potential of, for example, self-assessment. The Working Party’s main test is also strongly influenced by Kromhout et al.’s (2005) chapter.

Producing an international document on such a complex subject is clearly difficult, and the draft as it stands is really the work of the British half of the Working Party, strengthened by comments from their Dutch colleagues. The Working Party intends that any British bias should be corrected in the coming months as a result of the consultation. Everyone agrees that an international approach is highly desirable, particularly for countries in the EU or influenced by it. There is currently a group in Norway working on the same task, and we hope that the work can be integrated with theirs and possibly with others elsewhere in Europe. The work on the NIOSH method has already been mentioned, and Ramachandran (2008) explains the consultation with stakeholders involved in that.

It is perhaps unrealistic to expect that there will ever be a single method because over the last 30 years research has repeatedly shown shortcomings of past methods and possibilities of new approaches, and there is no sign of this stopping. At the moment, for example, there is a lot of attention to Bayesian methods in exposure assessment. The British–Dutch group did not feel that the Bayesian approach had reached a stage where it could be incorporated into their main method, but clearly things are developing fast, and perhaps we need to think in terms of guidance that is revised every 2 of 3 years so it remains a statement of current good practice rather than a document fixed for a long time.

For the moment, however, the British–Dutch Working Party hopes that the consultation will lead to useful comments and fairly fast revision to a version that can be published online with the imprimatur of the two societies.

REFERENCES
ACGIH. (2009) 2009 TLVs and BEIs. Cincinnati, OH: ACGIH.