Letters to the Editor

Safety cabinets and product protection

Scientists frequently need to handle biological material in a cabinet that can provide sterile conditions for the work as well as protection to the operator. This requirement highlights one aspect of the current debate concerning the performance and use of microbiological safety cabinets where there is an increasingly held belief that class I cabinets can be relied upon to provide considerable product protection in addition to the operator protection for which they were designed and that consequently there is no need for the sophistication of a class II type. The basis for this additional use of class I cabinets has been occasioned partly by the lack of confidence in the performance and installation of some class II types where compliance was claimed with BS 5726.¹ In a class I cabinet, because contaminants in the inflowing airstreams pass over the work surface at up to 1.0 m/s it is sometimes assumed that the work itself will not become contaminated as there is insufficient time for particles to sediment out of the flow. For example, a 10 µm diameter particle with a settling velocity of 0.5 cm/s will only sediment about 0.5 cm in the time that it has moved forward a distance of 1 m when entrained in a 1.0 m/s airflow.

We have carried out some experiments to demonstrate the basic differences in product contamination in the two classes of cabinet. A class II cabinet (meeting the requirements of BS 5726) and a class I type (with an inflow air velocity variable between 0.5-1.0 m/s) were installed in the same laboratory.

Five settle plates filled with blood agar and distributed across the width of the working surface were exposed in the class I cabinet for two hours on three separate occasions at inflow air velocities of 0.5, 0.6, 0.7, 0.8, 0.9 and 1.0 m/s. Each time the plates were exposed in the class I cabinet five plates were also exposed in the class II cabinet.

The results showed contamination of all the test plates exposed in the class I cabinet as summarised in the Table. Three plates exposed in the class II cabinet, on separate occasions, exhibited one colony on each; the rest of the plates in this cabinet were sterile.

In the class I cabinet the greatest contamination was seen at the higher inflow

air velocity. Increased turbulence, which has been shown to reduce operator protection factors at high inflows, might be responsible for this. When product protection tests are carried out with a challenge aerosol generated in front of the aperture, class I cabinets produce product protection factors indistinguishable from zero whereas a good class II cabinet conforming to BS 5726 can give factors consistently above 10⁶.

The tests described here were much less stringent in respect of the challenge concentration and represented the situation in "good" laboratory conditions. Had the cabinet exhausts been ducted to the outside, there would inevitably have been less turbulence in the laboratory as the air would not have been continually filtered and it is likely that greater contamination would have occurred on the plates exposed in the class I cabinet.

The exposure period of two hours was longer than would occur with most work in practice and was chosen to illustrate both the difference in performance between the cabinets with a reasonable degree of sensitivity in the test whilst, at the same time, showing the sustained high performance of the class II cabinet.

Clearly, the contamination of work in a class I cabinet will depend, to a large extent, on the number of organisms in the air of the room housing the cabinet and on the time of exposure of the work. If sedimentation were the dominating mechanism for producing this effect, it may well be argued that the higher the airflow the less likely would be the contamination as the particles would "overfly" the work before they could "fall-out." However, smoke tests can demonstrate that the airflow at the front opening of a class I cabinet is turbulent and it is well known in two-phase fluid mechanics that such

turbulence in airstreams can "convect" particles to a wall or floor and this is probably the mechanism by which the observed contamination occurred. Even in new "aerodynamic" cabinets with faired inlets the flow is not truly streamlined.

In view of all these factors, it is reasonable to expect product contamination to be very varied and unpredictable in a class I cabinet and it may be possible to have good results if the room air is particularly clean. However, this is unlikely to occur in a busy laboratory and contamination will be inevitable.

The class II cabinet, built to the requirements of BS 5726, and working correctly is designed to produce a high degree of product protection that is independent of the particulate contamination in the laboratory air and this has been demonstrated previously² and in the present results. Although the idea of using a class I cabinet to give some degree of product protection is attractive, it is evident that this is intrinsically unsound and should be abandoned.

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References

¹ Clark RP, Elliott CJ, Lister PA. How safe are safety cabinets? *Nature* 1980; **294**: 394.
² Clark RP, Goff MR. The potassium iodide test system for open-fronted microbiological safety cabinets. *J Appl Bacteriol* 1981; (in press).

Results of contamination tests on class I and class II cabinets

Air velocity into the class I cabinet (m/s)	Total No of colonies on five plates in each cabinet					
	Class I (three tests)			Class II (three tests)		
	1	2	3	1	2	3
0.5	32	53	—	0	0	—
0.6	22	22	17	1	2	0
0.7	13	25	18	0	0	0
0.8	5	55	40	0	0	0
0.9	37	152	24	0	0	0
1.0	19	102	39	0	0	0