

## Feature Article

### Eye Protection

The results of a SSERC survey are summarised. A number of related issues, raised by some of the more discursive comment from respondents and third parties, are discussed.

#### Introduction

In the Spring of this year we enclosed a short questionnaire within SSERC Bulletin 165. The last of the replies trickled in during the late Summer. The major part of the delay in reporting the results has been due however, not to slowness of response but to the unexpected complexity of the issues raised.

To an extent, analysis of the data merely served to confirm opinions previously based only on anecdotal evidence or advice from agencies such as CLEAPSS School Science Service as contained in reports based on a combination of accident statistics and informal gathering of opinion and information. In other respects the sample, though small, shed new light on a number of problems.

#### The Survey Results

##### Level of response

A total of 74 returns was received. This represents a response apparently of the order of 5% which, although small, is not overly disappointing where no pre-paid reply facility was provided. It is clear also that a number of responses were made on a departmental basis rather than as one response per bulletin recipient, of which there may be as many as four per establishment.

##### Quality of response - a cautionary note

As with any such survey the results have to be interpreted with due caution. They are partial, since it is often those with specific concerns who tend to take the trouble to respond. We can infer nothing from the silence of the majority. Against that has to be set the small but significant number of respondents who sent in returns which largely reported the lack of any specific problems.

Returns from technology education departments were few but that was largely our fault because of a lack of clarity in part of our questionnaire form, for which we apologise. Results from those returns we received from technology departments have been integrated into the main survey where it was sensible and useful to do so.

#### Analysis

An overall statistical summary of responses would be of limited value since the more interesting aspects arise from combinations of data and from some of the detailed written comment. Each section of the questionnaire will thus be dealt with in turn. Where appropriate, a numerical

summary of the data is presented followed by comment and interpretation based both on the data and respondents' written amplification where relevant. Any discrepancy in totals is almost always attributable to the usual errors from roundings.

#### Patterns of provision

Goggles of various sorts were the sole provision for pupils in 38% of cases. The figure for spectacles only was 27% and mixed provision - spectacles for some tasks and goggles for others - featured in 38% of the returns.

Full face protection in the shape of faceshields or visors, provided for occasional use of teachers and technicians where the degree of risk warranted it, was recorded in only 45% of the responses. That 45% included a few cases of such provision for occasional usage by CSYS students. A small number of responses added comment on the need also for safety screens (we were encouraged by the use of the plural) for hazardous demonstrations.

Opinion as to the significance, and an account of the reported causes, of these patterns of provision are given in the conclusion to this article.

There was apparent confusion over terminology in a minority of responses. We are certain that a few teachers and technicians reported a particular kind of spectacle with a browguard and lateral protector pieces (usually also called "eyeshields") as a "faceshield". In order to reduce such confusion in future, Figure 1 shows categories of protector as illustrated and named by the British Standards Institution.

#### Reported problems

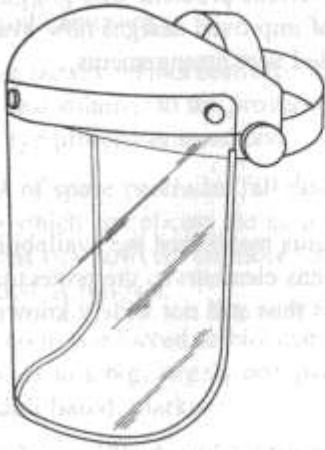
##### Poor fit

This was reported as a significant problem by about half of the respondents (48% and 50% for spectacles and goggles respectively).

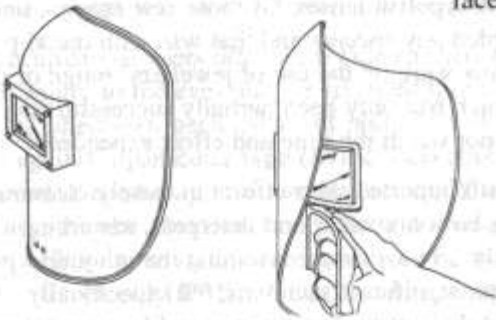
For spectacles the majority of reported problems fell into two main categories. Firstly, many responses recorded poor overall fit as a specific problem only with younger, S1 and S2, pupils. Further up the school and for adults there appear to be fewer problems except that there may be a gender difference. A minority of females find that the range of sizes in spectacles fails to cater for their somewhat neater physiognomies.

That is not to say that once your head gets big enough (and if you're male the odds are in your favour) that all problems with spectacles cease. Poor quality control over fit and surface finish seems the next most serious issue. There were a significant number of reports that rough edges on the legs, or nosepiece, or both, of some models caused discomfort and even soreness either behind the ears or to the bridge of the nose. A few reports also specifically mentioned the obvious difficulty that many models of such eye protectors cannot be worn over one's own prescription spectacles.

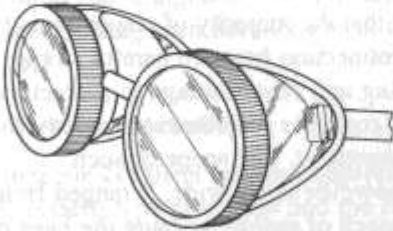
Face Screens  
or shields



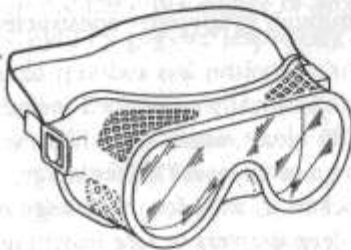
Welding  
face screens



Cup-type goggles



Box-type goggles



Eye Shields



Spectacles  
(including  
prescription  
spectacles)



Fig. 1

For goggles there were far fewer mentions of poor fit in the sense of mismatching of the protector's conformation with that of the head and face. There were however, similar reports to those for spectacles of poor finishing and rough edges occasionally causing discomfort and soreness. The greatest number of moans were about the quality and durability of elastic headbands used on this type of protector as well as the methods used to both adjust and anchor them.

Most complaints followed the pattern that as pupils could only adjust the fit of these goggles by adjusting the tension in the headband there was a tendency in most models for the elastic to weaken and eventually fail. Reports as to "Poor fit" tended as a consequence to be inextricably tangled up with those on "Breakage" (see next sub-section).

Several respondents viewed these failures in, or poor adjustment arrangements for, headbands as a serious safety issue. A number specifically mentioned that such features led to some pupils not properly adjusting the fit of goggles because it proved too irksome, to others wearing goggles either around their necks because they continually slip down off the face on their "droopy draws" elastics or to wearing them up on their foreheads because the elastic proves both too tight and difficult to adjust.

It is self evident that eye protection, however inherently effective, is completely useless when it isn't worn. This raises the issue of the need for a balance between inherent efficacy and a degree of comfort, acceptable to users, in order to achieve the maximum practicable degree of protection against potential injury to the eyes. This is another seminal issue and one to which we return in the closing part of this article.

Breakages

Reports on breakages as a problem were recorded at 25% for spectacle type protectors and 30% for goggles. For the former, specific cases usually included broken lenses and snapped off "legs" (side arms). A common cause of such breakages was genuinely accidental, for example, unintentionally dropping spectacles on the floor and standing on them.

With goggles many reports of breakages involved elastic headbands or their anchorage points. In a number of models headbands were reported as being of inferior quality and anchorage points as being insufficiently robust. Repeated adjustment by pupils led either to failure of the band itself or to the anchorage point snapping off at the side of the goggle.

A few cases of goggle lenses snapping across at their mid-point were reported but these seemed mostly to be in older models and the cause was sometimes genuinely accidental as with such lens failures in spectacles.

Very few problems were recorded against full face protectors such as faceshields and visors. These categories however are used less frequently than others. Only in technology departments do they get used

regularly by pupils and the majority of reports of damage came from those few responses we got from such sources. The only specific type of problem recorded more than once was the excessive loosening, or even loss, of the turnscrews which affix the actual faceshield to the brow band.

### **Vandalism**

A worrying feature of damage reports was the incidence of deliberate vandalism. This was suspected or reported in 36% of all of the responses where breakage was recorded as a significant problem. Such deliberate damage included breakage of lenses or side frames, melting spectacle side frames in Bunsen flames and defacement of lenses with permanent marker pens.

Whilst vandalism seems almost a fact of life in some schools, however socially unacceptable that may be, it is particularly disturbing when it applies to equipment provided for the protection of pupils. It may also be a trout in the milk. It is possibly circumstantial evidence that a significant number of pupils, both reasonable and otherwise, actively resent having to wear some kinds of eye protection in practical subjects.

### **Scratched lenses**

This would seem the most frequent of all reported problems with an incidence of 52% for spectacles and 60% for goggles.

At first sight the reports also seem to confirm conventional wisdom that polycarbonate lenses are more prone to such damage than are lenses of other materials. Some 40% of all reports of scratch damage (42 out of 104) involved polycarbonate lenses.

Caution is needed in interpreting the data however since in several cases the respondents reported scratch damage as a problem but did not know the nature of the lens materials.

A further complication may be that the majority of reports involve polycarbonate lenses simply because that is the material from which most eye protector lenses used in schools are made. This suspicion is reinforced by the fact that only about 10% of reports specifically named other materials (9 as "acetate" and 1 as "PVC").

### **Misting-up**

Results here were surprising in that more reported this as a problem with spectacles (30%) than did so for goggles (9%).

At first sight this is doubly confusing since misting up has previously been cited as one of the major disadvantages of goggle type protectors.

We can only offer a combined explanation for such unexpected responses. It would seem that some teachers and technicians had confused "misting up" as caused by condensation of water on the lens surfaces with damage

from fine scratches. The relatively low incidence of reports of misting as a serious problem with goggles may be due to the number of improved designs now available with much better guarded vent arrangements.

## **Remediation**

### **Replacement lenses**

Only 9% of respondents mentioned the availability or fitting of replacement lens elements to the protectors held by them. This facility is thus still not widely known about or used.

### **Repolishing lenses**

Again, this was apparently neither well known nor widely attempted. Only 4% of all returns reported attempts to repolish lenses. Of those few reports, only one recorded any success and that was with metal polish. Two reports were on the use of jewellers' rouge or ceric oxide, which had only been partially successful and certainly not worth the time and effort expended.

More folk reported their efforts in merely cleaning eye protectors with hot water and detergent, remarking particularly on how time consuming that may also prove. A small but significant number (10%) specifically mentioned their concern over issues of hygiene where eye protection was shared.

### **Storage arrangements**

Reports revealed that the majority of respondents had made the obvious connection between careful storage and minimising scratching and other damage to protectors. About two thirds of responses recorded some kind of special storage arrangement. The scope of such arrangements was however fairly wide. It ranged from the minimalist approach of merely keeping the bags or boxes in which the protectors had been originally supplied (13%) right through to specially constructed pigeon holes (12%).

Other arrangements specifically mentioned included hooks and hangers (20% or so), some made like the *mug trees* used for the storage of cups and coffee mugs, collections of cloth pockets as used for the storage of shoes (8%), lined-out deep drawers or *tote* (carrying) boxes (13%).

Some apparently excellent arrangements were also simple. One such was the use of bent nails covered with rubber tubing (an idea from an island's school, Shetland - where else would nails be used so imaginatively?). Those who used boxes or pigeon holes reported that whilst they were effective, they used up a lot of space. One excellent suggestion was that suppliers should consider providing their eye protectors in boxes which could be fitted together on site to form a storage unit.

## General and specific conclusions

### No simple answers

These survey results reinforce our view that there is no single best solution to the provision and ensurement of use of eye protection in schools.

Lack of space precludes full discussion of all the factors which complicate the issue. The principal problems can however be more simply listed and described as follows:

- schools are forced to buy eye protection as minority customers in a big, largely occupationally oriented and thus adult based, market;
- in that market the goods are perceived, in large part, as at least semi-disposable, being replaced whenever wear and tear so requires;
- occupational users often each face specific types of risk of injury to the eyes and are required to wear routinely their own personal set of protectors often to guard against a particular type of risk. Educational users on the other hand may face a wider range of risks but only in particular places and only for restricted time spans so that the issuing of personal sets of protectors is perceived, certainly for pupils, as neither necessary, practicable nor, for that matter, affordable.

The issues are therefore complex and it is unlikely that policy decisions on patterns of provision in education can be simple and straightforward. For schools the major factors affecting such decisions would seem to be as follows:

### Comfort versus caution

There are conflicts between apparent user preferences for spectacle type protectors and the desire of advisers, other EA staff with health and safety responsibilities, and teachers for the fuller degree of protection afforded to pupils' eyes by goggles (especially in guarding against chemical splashes and projectiles with peculiar angles of trajectory). The difficulty here is that 90% protection worn 100% of the time is likely to be 90% effective and thus better than 100% protection worn for any less than 90% of the time.

A number of our correspondents reporting "goggles only" provision specifically remarked that this was a regionally imposed policy and that they would have preferred either a mixed provision or even spectacles only. Where specific reasons were given these were usually connected with comfort or fit and pupil attitudes to wearing the protection provided. Only one reply indicated an EA policy for spectacle provision where the respondent would have preferred goggles only.

Newer types of spectacle type protector are worthy of further consideration in this connection. These are of the type, often called "eyeshields" (see Figure 1) and which have browguards and lateral protection pieces.

As always there is "no free lunch" here in that they are not the cheapest of spectacle type protectors and with some models the side pieces may cause some loss of peripheral vision. However they may provide more effective protection than simple spectacles against chemicals or objects projected at odd angles. They begin to approach the standards of protection offered by some types of goggle. All but the youngest and smallest of pupils may find them easier and more comfortable to wear. They may also be worn over normal prescription spectacles. Some models of such protectors came in for particular praise in the survey responses.

### Provision pattern

The survey results reinforce our view that provision of one type of protector only may well be misguided. The HSE has been consistent in expressing the view that the pattern should be:

- spectacles often,
- goggles sometimes,
- full face protection occasionally

Our sample was far too small for us to presently consider publishing details of those specific models which were praised, or indeed of those condemned, by our respondents. We will however follow up some of the leads so provided and will take the information into account when giving advice on purchasing. We are also looking at the possibility of a limited evaluation and testing programme, partly based on the survey results.

### Replacement cycles

It was obvious from the scratching and other damage reported that many schools were not being provided with replacement eye protectors as often as they should. One school reported heavy scratch damage to polycarbonate lenses on one class set of eye protection but added that this should be no cause for surprise since the sample in question was at least 20 years old.

Given that the requirement for the wearing of eye protection "whenever there is a foreseeable risk of injury to the eyes" is statutory and contained within "The Protection of Eyes Regulations" it would seem that at least some educational employers and managers need to give more attention to their replacement policies.

### Storage arrangements

Replacement cycle times clearly may be lengthened through more effective storage arrangements. Reasonable degrees of effort in this area promise to be cost effective.

# Technical Articles

## Standard Grade Biology

### - further practical tips

In Bulletin 165 we announced our intention to publish short notes to assist teachers and technicians over any minor practical difficulties which crop up as the course materials are implemented. The following, short, pieces deal with such snags in two practicals for Topic 7: "Biotechnology : Sub-topic C - Reprogramming Microbes" [1].

### Milk agar and enzyme action

#### Media problems

In the "Exemplar" materials a method is described for investigating the action of biological and non-biological washing powders on milk agar plates. The technicians' guide recommends that the plates are made up with milk powder in nutrient agar. Our experience shows however that this addition of nutrient agar tends, not suprisingly, to encourage the casual growth of micro-organisms. On one of our recent training courses such milk agar plates suffered significant airborne contamination from *Micrococcus sp.* We recommend, therefore, that plain, technical agar (Unipath [previously known as "Oxoid"] Agar No. 3) is used instead of any nutrient agar.

Agar No.3 is widely available from the usual biological suppliers both as a powder (ca.£15/100 g) or in tablet form (£14.50/100 tablets - e.g. from Philip Harris). It is a basic agar which will, by itself, not encourage the growth of micro-organisms and, in this context, is safer to use.

The second point to note is that if rehydrated skimmed milk is autoclaved it is likely to caramelize. St.Ivel "5 pints" seems especially prone to this problem. For this particular practical it would be acceptable, so long as our other advice is followed and only unenriched basic agar is used as the setting agent, to dissolve the dried milk powder in sterile water and then add it to the autoclaved agar. You should ensure that the agar has cooled sufficiently before adding the milk suspension.

#### Veracity problems

Some of you who have already presented for Biology at Standard Grade may have noticed that this experiment is more complex than at first it might appear. Something which we highlight on our training courses is that non-biological washing powder, alkali and even autoclaved biological washing powder will produce some clearing of milk agar plates.

It seems that the apparent proteolytic action of biological washing powders and detergents is only partly attributable to enzymic action. At least some of the effect observed is connected with the alkaline nature of these proprietary compounds. It is also interesting to compare the rate of 'clearing' between ordinary washing powder

### Matters for designers and makers

A number of general and detailed points emerged which are worthy of the attention of some makers and sources of supply.

Briefly, these were as follows:

1. More effort could usefully be put into post-moulding quality control, in particular weeding out poorly finished samples with rough edges to frames etc.

2. Improved designs are required for headband anchorage points on some models of goggle and in others the headband itself is of too low a quality and insufficiently robust. In the case of anchorage points both greater ease of adjustment and more protection against breakage need attention.

3. Consideration should be given to the more utilitarian design of packaging so as to allow its recycling as part of a longer term storage arrangement.

### Matters for policy makers

EA and other advisers, including health and safety specialists, as well as classroom teachers need to be more aware of the balance to be struck between the degree and type of protection inherent in different kinds of eye protector and the probability that the protection will be accepted and actually worn.

This balance is further complicated by the fact that for some students the need to wear such protection may be an attractive feature of a practical subject. For others that requirement may actually become a major turn-off. It may even lead to the protective devices being perceived as an uncomfortable and sometimes unnecessary nuisance.

As our survey showed, this dislike is manifested in its extreme form as deliberate damage. Whilst such sheer vandalism is not something we should ever condone, we may need to be more sensitive to the pupil preferences of which it is, perhaps, ultimately a symptom. Do we need another survey - one wherein we ask pupils and students for their views on eye protection?

### Acknowledgement

The extracts from BS 7028 : 1988, shown in reduced form as Figure 1 in this article, are reproduced with the permission of BSI. Complete copies of the Standard can be obtained by post from the address given on the front inside cover of this bulletin.