Figure 1 - Shrouded leads.

Countdown to physics safety

Here we look at what we believe are the top three issues in school physics health and safety.

3 High Tension power supplies

We don't do scare-mongering at SSERC so when we say that one of these, used incorrectly, could kill you, we're choosing our words carefully. In school physics, HT supplies are used for Teltron tubes and, occasionally, neon bulb experiments. Biologists may use electrophoresis power supplies that are HT and older microwave kits had Klystron power supplies that fell into this category. The HT supplies you come across will tend to be of the order of a few hundred volts. However, anything over 70 V smooth d.c. or 33 V a.c. or unsmoothed d.c. requires the same control measures. If used in wet areas, the limits drop to 35 V and 16 V respectively. Anything above these limits can create a "hazardous live". The exception is the school extra high tension (EHT) supply. Though the output may go up to 5000 V, these devices are current-limited. They cannot produce a large enough current to harm you. See Bulletin 208 for further details [1].

Control measures for HT supplies

- HT supplies and circuits are not to be used by pupils. The exception is that an S6 student, in a class where there were no pupils under 16, could use one under supervision, following instruction.
- The power supply should be labelled "not for pupil use" or similar. A warning notice should be placed beside any HT circuit.
- Shrouded leads (Figure 1) **must** be used. The conducting parts are covered unless it is plugged in to a suitable socket.

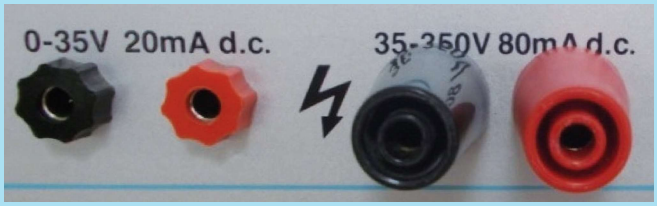

Figure 2 - Shrouded sockets.

- Shrouded sockets should be used on power supplies and apparatus. These can be retrofitted, as has been done to the HT supply in Figure 2. The shrouded sockets fit over the existing ones. An Allen key then fixes them in position. In the picture, the 0-35 V sockets are not shrouded (and don't have to be) but the 35-350 V sockets are. You can tell by the deep groove.
- Any hazardous live parts should be enclosed within the apparatus.
- Only specialist meters and leads should be used to take measurements. Contact SSERC if more information is required.

It is still possible to plug a standard 4 mm lead into a socket designed for a shrouded lead. In the case of an HT supply, this must not be done. Some newer EHT supplies also have sockets for shrouded leads. If you have shrouded leads, there is no reason not to use them, but from a safety point of view, it is not essential.

Some HT supplies are beyond redemption. The Klystron power supply in Figure 3 could be fitted with shrouded sockets but there are other features of the design that make it no longer suitable for school use.

2 Laser pointers

All our laser advice is based around the following principles:

- The lasers must produce only visible light so that the human aversion response is triggered.
- The laser power must be great enough for it to be useful but not so great that damage can occur in the time between the beam entering the eye and the aversion response - closing the eye or turning away - to happen. The aversion response takes on average about 0.25 seconds.

Figure 3 *- Potentially dangerous power supply.*

This means that only Class 2 (and not Class 2M or 2A or even 1M) lasers are suitable. They produce only visible light and are restricted to 1 mW or less. It is reasonable to ask, then, why we do not sanction the use of Class 2 laser pointers for experiments. There are two reasons. Firstly, laser pointers are too easily picked up and waved around by pupils. Secondly, the labelling of laser pointers is shockingly unreliable. Have a look on eBay. You will find "powerful Class 2" lasers. By definition, a Class 2 laser is not powerful. A contact at what was then the Health Protection Agency described battery-powered laser pointers as a "nightmare", having found some that were nine times more powerful than their alleged classification. If this is not bad enough, consider the following. An organisation recently bought a batch of laser pointers to give away to delegates at an event. The pointers came from what looked like a reputable UK website that gave credible safety advice. One attendee felt that the pointers looked more powerful than expected and had theirs tested. It was 35 mW. Think how much less time you have before damage is done should this beam enter your eye, compared with one from a true Class 2 laser. The pointers were recalled. The company sent a sample of replacements but they too proved to be more powerful than they should have been. We have written, most recently in Bulletin 250 [2] about Class 2 laser diode modules from reputable suppliers. If you use these rather than laser pointers for experiments, you are adhering to SSERC, and by extension your employer's guidance. Regarding laser pointers as presentation aids, we recommend sticking with red laser pointers of the sort built in to remote control handsets.

1 Radioluminescent dials

Around eight years ago, a programme was in place in schools to get rid of radioactive sources that either should never have been in schools or which were no longer considered suitable. The initiative made it easy for schools to dispose of material at no cost. It was highly successful but, occasionally, something turns up in a school that should not be there. Usually this is because it was overlooked when stock was audited during the disposal programme. Perhaps it was not kept in the main radioactive source store. Sadly, there have been a very small number of cases where schools have obviously retained stock that they claimed to have got rid of. In both cases, it is almost invariably a new member of staff who is left to pick up the pieces. These artefacts are often discovered after someone comes on a SSERC radiation protection course and subsequently decides to carry out their own audit. In the past year, two radioluminescent dials have been discovered (Figure 5). A few decades ago, it was common practice to paint the figures on watch or aircraft instrument dials with a mixture of radium and a luminous material. The mixture glowed, making numerals and indicator needles visible in the dark. Normally, we'd applaud anything that illustrates a physical principle in an interesting historical context, but here we have to say "no". Current thinking is that an aircraft dial or watch containing radioactive material fulfils the definition of a sealed source provided its face is intact. If its activity is below 370 kBq it can be legally kept without expensive permits. If its activity is below 200 kBq, forthcoming legislative changes should make it easy to dispose of to dustbin. If the face is cracked, lower limits kick in. It is not a sealed source. Unfortunately, there is no easy way to tell the activity of a dial just by looking at it or researching on the internet. Here is the bottom line:

- Don't bring radioluminescent articles into school.
- If someone offers you a radioluminescent article, politely decline.
- If you find a radioluminescent dial, please contact SSERC after double-bagging it and placing it in your radioactivity store, if you have one.

Figure 4 *- Not suitable for work.*

Figure 5 *- "Glow in the dark" aeroplane instrument.*

We have a method of estimating dial activity and will come to you, wherever you are, to carry out this procedure. So far, every dial we have tested has been in good condition and below both the legal limit for possessing it and the disposal limit based on forthcoming legislation. We will be recommending disposal because dropping the objects could transform them from sealed to unsealed sources. The estimated activities of the ones we tested would suggest that unsealed dials would need to be disposed of by commercial contractors which could prove to be expensive. Note that not everything that glows in the dark is radioactive. We tested a number of alarm clocks at a museum. They did indeed glow in the dark but the glow faded with time suggesting they were merely luminous, absorbing light energy when it was bright and re-emitting it later. We could detect no ionising radiation coming from them with our instruments. Don't panic if you find a glow-in-the-dark object, but don't ignore it either.

This is not, of course, an exclusive list of safety topics in physics. Please have a look at the Physics section of the Health and Safety area of our website. You will need a log in to access it. Contact SSERC if you cannot get on.

References

[1] http://www.sserc.org.uk/images/Bulletins/208/4-6_Working_with_HT_supplies.pdf.
[2] http://www.sserc.org.uk/images/Bulletins/250/SSERC_250p2-3.pdf.

Health & Safety

Face masks - update

We recently received an enquiry from a school asking whether there have been any changes to the specifications for face masks and this led us to review the recommendations for the face masks for the SAPS ELISA kit used for the detection of Botrytis infection in raspberries [1]. A previous Bulletin article [2] focussed on the best disposable masks for asthmatic students wishing to carry out this experiment or other activities involving spores.

We recommend that disposable masks/respirators should conform to **BS EN 149:2001**. The Health and Safety Executive [3] also advise that all respirators for use at work should be CE marked. Additional markings indicate the protection level achieved providing the respirator is a good fit and used correctly; these markings are, in order of increasing protection, **FFP1**, **FFP2** and **FFP3** . The amount of dust breathed is reduced by a factor of 4, 10 or 20 respectively. In some catalogues, these protection factors may be quoted as well (or instead), as **AP** (or **APF**) **4**, **10** or **20**.

An **FFP3** (**APF 20**) respirator is advisable if you are exposed to high levels of grain dust or mould spores. It is important to remember though that these face masks will only provide proper protection if they are a good fit. It is not reasonable to expect one mask to fit different people; each person who might need one should have their own.

An updated table of appropriate facemasks/respirators and their suppliers is available from SSERC.

References

[1] Science and Plants for Schools - http://www.saps.org.uk/secondary/teaching-resources/120-the-saps-elisa-kit-for-botrytis.
[2] Face Masks (2007), SSERC Bulletin, **221**, 2.
[3] Health & Safety Executive - http://www.hse.gov.uk/agriculture/dustmasks.htm.