

STANDARD OPERATING PROCEDURE:

Use of lasers in schools

Part 1: Laser pointers

Note: To be undertaken only once a site-specific risk assessment has been conducted.

1. Introduction

The word LASER is an acronym for **L**ight **A**mplification by **S**timulated **E**mission of **R**adiation, which describes the process by which lasers generate light (electromagnetic radiation).

There are many applications of the use of lasers in schools, including as a white board pointer, a pointer for astronomy observations, the teaching of optics, ray paths, refraction and diffraction, the modulation of laser beams to carry signals, and the applications in fibre optic communications.

As laser technology is very widely used in industry, medicine and in everyday life, it is desirable that students learn to safely and responsibly use and manage lasers in a supervised school science environment.

The most common laser pointers emit red light (635 nm wavelength). Units emitting green light (523 nm) are also available and sometimes used as pointers in astronomy.

Due to the high portability, ready availability and low cost of pointer lasers, there is greater potential for their misuse than for conventional gas lasers. Consequently, there are stricter controls regarding their permitted power output.

2. Context

- This document summarises the guidelines for the storage and use of laser pointers in Australian primary schools, secondary schools and colleges.
- **This is Part 1 of a three part document addressing three separate applications:**
 - **Part 1: Laser pointers** (solid state diode lasers)
 - **Part 2: Bench lasers** (as used in Physics investigations, usually He-Ne gas lasers)
 - **Part 3: The construction of laser equipment**

3. Safety notes

- Laser pointers should be stored in a secure locked cupboard (e.g. in a storeroom) to prevent unsupervised student access.
- Do not leave a laser unattended.
- Avoid shining a laser beam at or near persons.
- Despite the low power rating i.e. Class 1 or 2 lasers, eye damage is possible if magnifying viewing instruments such as lenses, microscopes, binoculars or telescopes are used. Do not use these to view a laser beam.

- Laser light differs from light emitted from conventional sources. It is monochromatic, coherent and is collimated (refer to definitions below). This last feature is very important in considering the safety of lasers.

Definitions of properties of laser light:

Monochromatic	The emitted light is concentrated at a single wavelength
Coherent	The light waves remain in phase as they propagate
Collimated	The light rays are parallel, with very little divergence, so that the intensity is maintained over long distances

- Conventional light sources emit light in all directions, and so the intensity of the light rapidly diminishes with distance from the source (the inverse square law). As laser light is collimated into a beam with very little divergence, the intensity is maintained over long distances. There is then a much greater capacity for laser beams to cause eye damage.
- The Class rating, the appropriate laser symbol and hazard warning statement are to be clearly marked on the instrument. A table of the laser classes is given in the 'Supplementary information' section at the end of this document. If the class of any laser is not clearly identified then it should not be used.
- Laser pointers used in schools should not normally exceed Class 2 and a power rating of 1 milliWatt (mW). At this power any possible eye injury is normally avoided through the human aversion responses (blinking and turning away). Exemptions for higher powered laser pointers are available for specific uses, but these would not normally apply to schools. **Science ASSIST strongly recommends that laser pointers for general school use do not exceed Class 2 (1 mW power output).** As a guiding principle, always use the lowest power laser for any particular purpose.
- Laser pointer purchases should be made from a reputable local supplier who can confirm that the laser has been tested according to Australian Standards rather than from overseas or through the internet. Concerns have been raised regarding lasers purchased from overseas, or through the internet, where there can be a misclassification of the laser. It may be labelled as Class 1 or 2, but may in fact be a higher class when tested according to Australian Standards.
- In addition, although it is illegal to import laser pointers of a power greater than 1mW into Australia without special written approval, there are many countries where the import/export of higher-powered lasers are not regulated. Caution is advised because their low price and common availability overseas means that some higher powered lasers do find their way into Australia, and in some cases into schools.

4. Regulations, licences and permits

- The use of lasers in schools is informed by the *Safety Guide: Use of Radiation in Schools (2012), Part 2: Lasers* <http://www.arpansa.gov.au/pubs/rps/RPS18.pdf>.

It is recommended that persons handling lasers be familiar with this document and a **printed hard copy of this resource is recommended for reference.**

For details of your state/territory regulator see:

<http://www.arpansa.gov.au/Regulation/regulators/index.cfm>

- It is unlawful (Australian Customs) to import laser pointers of over 1 mW power without written approval. They are classified as prohibited weapons in the ACT, New South Wales, South Australia, and Victoria, and as controlled weapons in the Northern Territory and Western Australia. They are restricted items in Queensland, and in Tasmania they require a lawful excuse. For further information refer to your state/territory regulator.
- In some circumstances exemptions can be sought for the use of higher powered (Class 3R/ 3A) laser pointers e.g. for use in astronomy. This introduces higher levels of hazard that would require risk assessment and controls beyond the scope of this document.

5. Equipment

- Laser pointer Class 1 or Class 2

6. Operating procedure

1. Storage

Laser pointers should be stored in a secure locked cupboard (e.g. in a storeroom) to prevent unsupervised student access.

2. Steps before use

2.1 Check that the laser pointer is rated at no higher than Class 2, and with a power output not exceeding 1 milliWatt (mW).

2.2 Check that the laser pointer is appropriately labelled as below:

Class 1 laser



Class 2 laser



3. Use

The use of Class 1 or 2 laser pointers does not normally require any specialist knowledge on the part of the operator.

7. Trouble shooting/emergencies

- Not applicable

8. Waste disposal

- Not applicable

9. Related material

- Australian Radiation Protection and Nuclear Safety Agency 'Safety Guide: Use of radiation in schools Part 2: Lasers. Radiation protection series no. 18', ARPANSA website, June 2012 <http://www.arpansa.gov.au/pubs/rps/RPS18.pdf>. This includes guidance on developing a Risk Assessment for the use of lasers in schools (see Section 10).
- Manufacturer's instructions

- Risk Assessment
- Useful links:
 - Macquarie University 'Faculty of Science Occupational Health and Safety – Lasers' Macquarie University website. (Accessed January 2015).
<http://web.science.mq.edu.au/intranet/ohs/lasers/>. This page contains much useful information including information on laser classifications and laser induction.

Overview of IEC laser classes.

<http://web.science.mq.edu.au/intranet/ohs/lasers/documents/classoverview.pdf>

Typical accessible emission limits (AEL) for visible CW lasers.

<http://web.science.mq.edu.au/intranet/ohs/lasers/documents/classifications.pdf>

Laser Induction: with links to watch the [MPG free Faculty Laser Induction Module](#) (PPT, 3.3 MB) plus the [Eye Effects Video](#) (46 MB, 5 minutes) and the [Laser Safety Video](#) (231 MB, 30 minutes)

References:













Australian Radiation Protection and Nuclear Safety Agency (ARPANSA) 2012. *Safety Guide for the Use of Radiation in Schools (2012)* <http://www.arpansa.gov.au/pubs/rps/RPS18.pdf> [CC BY NC 3.0 AU](http://creativecommons.org/licenses/by-nc/3.0/au/) <http://creativecommons.org/licenses/by-nc/3.0/au/>

Australian/New Zealand Standard AS/NZS IEC 60825.1:2014. Safety of laser products Part 1: Equipment classification and requirements.

SUPPLEMENTARY INFORMATION:

Classification of lasers

Lasers are classified according to their potential degree of hazard, with the higher numbers indicating higher hazard levels. Older units may be classified under a similar early system, with the comparisons set out in the table below. It is important to remember that laser classification is made on the basis of the *entire* laser product. This means it is possible that a laser product could contain a high power laser internally with the engineering design allowing a lower classification for the unit.

Current classification	Former classification	Notes	Labelling and signage	
Class 1	Class 1	Considered safe under foreseeable conditions because of low emission levels or through engineering design. Not harmful to eyes or skin.		
Class 1M		Higher emissions than Class 1, but because of the spread of rays, not capable of causing eye damage. This means the beam can be magnified with the help of optics.		
Class 2	Class 2	Low powered visible lasers (to 1mW power). Not harmful to skin. Eye damage avoided through natural aversion responses (blinking, turning away)		
Class 2M		Higher emissions than Class 2, but because of the spread of rays, normally safe for viewing with unaided eye. This means the beam can be magnified with the help of optics.		
Class 3R	Class 3A	For visible wavelengths, up to 5 times the emissions of Class 2 (i.e. up to 5 mW power). Risk of injury from accidental exposure is low.		
Class 3B	Class 3B	Visible or invisible wavelengths where direct viewing is hazardous to eyes. (i.e. between 5mW and 500mW for visible wavelengths)		
Class 4	Class 4	High powered lasers capable of causing damage to skin and eyes. (i.e. > 500mW)		

Lasers in schools

It is expected that in almost all cases, lasers used in schools should be restricted to Class 1 and Class 2 (common outputs of 0.5 to 1 mW). At this level, eye damage from accidental exposure is very unlikely due to the human 'aversion responses' such as blinking and turning away. Lasers classified as Class 3R/ 3A, with power outputs in the 1–5 mW range, may be used subject to gaining school permission and following good safety practices as detailed in Part 2 of this SOP. Lasers of Class 3B and above, and any that emit wavelengths not in the visible spectrum, should not be used in schools. If the class of any laser is not clearly identified then it should not be used.