

# Laser Safety

## MATTERS

NEWSLETTER OF THE LASER SAFETY FORUM ISSUE SIX JULY 2006

## Welcome to the sixth issue of *Laser Safety Matters*

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The NRPB is now fully ensconced within the Health Protection Agency and we are now known as the Radiation Protection Division of the HPA.

For those of you interested in intense pulsed light (IPL) systems, Marina Khazova and Bill Davies summarise the progress on the development of IPL standards.

John O'Hagan provides an update on laser safety standards and the Physical Agents Directive on optical radiation, and gives details about the ILSC 2007 conference being held in San Francisco.

In this issue you will also find a summary of last year's 10th anniversary Laser Safety Forum and details of this year's Forum which is scheduled for Tuesday 12 September.

Lastly, I would like to thank Mark Bradley and Leon Lobo for their contributions to this issue. If you would like to provide an article for the next issue of *Laser Safety Matters*, please contact me.

## Laser Safety Forum 2006

The 11th annual Laser Safety Forum will be held on Tuesday 12 September 2006 at the *imago* at Burleigh Court Conference Centre, Loughborough, UK.

Following the success of last year's 10th anniversary celebration dinner, a pre-forum dinner will be held at 7:00 pm on Monday 11 September 2006. The fee for this is £25 and we hope you will wish to join us.

If you are able to contribute a forum presentation then please email [laser@hpa-rp.org.uk](mailto:laser@hpa-rp.org.uk). The presentations will be followed by the usual open forum session.

A number of speakers are already confirmed. Dawn Harwood of the Healthcare Commission will talk about some of the issues from the use of lasers in private and voluntary healthcare, which includes high-street beauticians. Andy Pearson from the HPA will outline some of the key issues from the new EU Physical Agents Directive on optical radiation. Ken Barat from California will talk about how he uses 'lesson learned' as part of laser safety training, and John O'Hagan will provide the regular update on laser safety standards.

The Forum will also be used to launch the consultation document for the HPA guidance on ophthalmic surveillance for laser workers.

Professor John Marshall, who chairs the Subgroup of the Advisory Group on Non-ionising Radiation, which was responsible for reviewing the scientific evidence, will also give a presentation.

Finally, the Forum will give you the opportunity to see the result of the £8 million expansion of Burleigh Court. The new entrance and reception area is now at the carpark end of the complex. If you are staying overnight there will also be the opportunity to use the new leisure complex.

If you would like to attend this year's Laser Safety Forum please complete the enclosed booking form or visit [www.hpa.org.uk/laser](http://www.hpa.org.uk/laser).

If you require accommodation for the Monday night please send your form **as soon as possible** to ensure that a room is reserved for you. The closing date for receiving completed booking forms is Monday 14 August. We look forward to seeing you.

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### ATTENDANCE FEES:

Standard rate	£170 + VAT
Discount rate	£125 + VAT (former course participants)
Presenters	No fee



## Laser Safety Refresher Course 2006

Our annual Laser Safety Refresher Course takes place following the Laser Safety Forum on Wednesday 13 September 2006. This highly interactive course takes delegates through a quick revision of laser safety management techniques. New for this year will be the graphical tool now used to support the risk assessment process and first introduced on the Laser Safety Management Course held in June 2006.

To get the most out of this course it is essential that you have attended one of our normal or customised courses. It is also a requirement that you attend the Laser Safety Forum. The course fee includes registration for the Forum and accommodation at Burleigh Court for the Tuesday night.



© imago

**COURSE FEE:**

**£440 + VAT**

## Physical Agents (Artificial Optical Radiation) Directive

The first stage on the road to specific legislation on optical radiation safety in Europe was completed on 27 April 2006 with the publication of the above Directive in the *Official Journal of the European Union* (L114, pp 38–59, 27 April 2006). Member States have until 27 April 2010 to produce national legislation to implement the Directive. In the UK, this task rests with the Health and Safety Executive.

The Directive refers to the ICNIRP exposure limit values for laser and non-coherent radiation. Non-coherent radiation is defined as optical radiation other than laser radiation. The exposure limits are included as two annexes to the Directive.

Many of the provisions of the Directive are similar to the general provisions of existing UK legislation, such as the Management of Health and Safety at Work Regulations 1999. As such, it is possible that

the impact of the Directive will not be great. However, there are some provisions, including the requirements for health surveillance, which may have an impact on employers. We will have to wait to see how these requirements are turned into UK legislation.

It is important to emphasise that the Directive only covers artificial optical radiation so the sun, for example, is not included. It also only applies to workers. Many other directives have a general requirement to reduce exposures to a minimum; this approach could have serious consequences for area lighting, for example. Therefore, the approach of the Directive is to require the *risk* to be minimised. In order to carry out this risk assessment, the employer will need to take account of information provided by the equipment supplier and possibly carry out measurements or calculations. Of course, the better the information from the supplier, the easier the task.

Further information will be provided as the UK legislation develops. In the meantime, the Directive can be downloaded from [http://europa.eu.int/eur-lex/lex/LexUriServ/site/en/oj/2006/l\\_114/l\\_11420060427en00380059.pdf](http://europa.eu.int/eur-lex/lex/LexUriServ/site/en/oj/2006/l_114/l_11420060427en00380059.pdf).



# Laser Safety Forum 2005

2005 saw the 10th anniversary of the annual Laser Safety Forum held in Loughborough, UK. A celebration dinner was attended by 50 participants including all except one of the laser course presenters going back to 1992. Unfortunately, Robert Hill had to attend to domestic duties. Guests were treated to a quiz organised by Howard Rose, who was attending Burleigh Court for the first time, having handled the course bookings for a number of years. We were also treated to a laser show by James and Julie Stewart of Laser Visuals to graphically acknowledge all of the sponsors who kindly supported the event.

## Presentation Summary

The Forum was attended by 73 delegates. The day was split into five sessions:

- Regulations, Compliance and Inspections
- Manufacturers' and Suppliers' Forum
- Laser Safety in Military Applications
- Updates
- Open Forum



## Regulations, Compliance and Inspections

**Nirmal Raj**, of the Barts and the London NHS Trust, talked about his experiences relating to the implementation of a laser safety management programme in a hospital. He outlined the principles of risk assessment and the duties of the general manager with regard to laser safety. He stressed the need for funding to be made available for staff training and that the most important factor in laser safety is effective communication.

**Lisabeth Yates**, the Assistant Radiation Protection Officer at the University of Cambridge, recounted how the University coped with an inspection from the Health and Safety Executive (HSE). Fortunately, the University already had a laser safety management programme in place providing comprehensive support to LSOs who now have the authority to close down laser systems that they consider to be unsafe. The HSE visit comprised of an hour-long interview with the University's Health and Safety Division, laboratory inspection tours to the Physics and Engineering Departments, and a summary meeting.

**Mike George**, from the University of Exeter, provided a frank and entertaining presentation about recovering from an HSE inspection. Unfortunately, his experience

with the HSE proved to be a bit of a nightmare. The initial interview was tough and everything was torn to shreds. Being fairly new to the non-ionising side of things, Mike needed to find out as much as he could. He enrolled on the five-day Laser Safety Management Course run by the HPA Radiation Protection Division and Loughborough University and arranged for experts to talk about where the University was going wrong and what could be done about it. It was discovered that simple things – such as reducing laser powers, enclosing beam paths and using intelligent engineering controls – would create a much safer environment for the laser users. Following a re-inspection by the HSE, it was stated that a 'climate of safety' now existed throughout the laser research establishment at Exeter. It just shows that good training could make everyone's life much easier and safer.

From the other side of the fence, **Mark Bradley**, a principal specialist inspector with the HSE, provided an insight into what the HSE is looking for during an inspection. An inspection strategy considers the arrangements that are in place such as roles and responsibilities, information, instruction and training. It also checks that risk assessments are suitable and sufficient. Part of the visit will encompass a tour of the department(s) to see the implementation of practical risk control measures. The inspector will challenge laser users



about suitable and sufficient risk assessments and the practical side of procedures and control measures. Mark has kindly allowed us to publish his presentation handout here in the newsletter (see p8).

**Darren Clahane**, from the HPA, gave his account of Australian regulation which he encountered whilst working for the Australian Radiation Protection and Nuclear Safety Agency. Ionising radiation sources are long established and tend to be well controlled, whereas non-ionising radiation (NIR) sources are relatively new and the hazards are not always known. Lasers make up a significant proportion of registered NIR sources. Their use is strictly licensed, with an annual laser licence fee of \$400, and each inspector is likely to have many licence holders using lasers. The inspectors perceive that the safety issues relating to lasers are more understandable than those associated with some other NIR hazards and are concerned with limiting exposures and requesting hazard assessments and supporting documentation. Throughout inspections it has been found that there appears to be a lack of evidence as to the classification of a laser and a lack of measurement and calculation ability to ascertain the classification.

**Bill Ertle**, of Rockwell Laser Industries Inc, Cincinnati, USA, provided an overview of Rockwell's laser incident database (LID) which it aims to maintain and expand for the world's laser community. It has been found that laser incidents generally fall into the following categories:

- alignment incidents
- improper restoration of equipment following maintenance
- eyewear either not worn or inappropriate for the wavelength (this covers about 70% of reported incidents)
- unanticipated eye/skin exposure
- failure to follow written standard operating procedures (SOPs)
- non-beam hazards

The information is collated from various sources including accident reports, scientific literature, laser manufacturers and university contacts. The types of information required to provide a comprehensive outline of the incident are:

- location and type of facility
- type of laser and output parameters
- exposure conditions
- injured person's details
- type of injury and its outcome
- presence of protective equipment
- source of incident information

Analysis of the data shows that approximately 70% of incidents are related to medical applications and 23% are related to industrial applications. Where the type of laser is known, about 68% of incidents involve either an Nd:YAG, CO<sub>2</sub>, Argon or Excimer laser. As a result of an incident, approximately 49% of people have suffered permanent damage and 51% have suffered temporary damage. From the records obtained so far, the majority of incidents involve eye injuries. It has been estimated that the database reflects between 10 and 20% of the laser incidents that occur worldwide.

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## Manufacturers' and Suppliers' Forum

**Leon Lobo**, of Laser Optical Engineering Ltd, talked about the new INTELLILOCK interlock systems, which incorporate hardwired interlock circuits. Up to eight system/cabinet interlocks and up to eight room/door interlocks can be daisy chained. They incorporate active intelligent monitoring and the system displays the location of open and disabled interlocks. The key benefits to this interlock system are that it is informative, tamperproof and fail-to-safe, as well as being of low voltage (5 V dc) and having retrofit capability. Leon has provided further information later in this newsletter (see p10).

**Neil Haigh**, of Lucid Optical Services, promoted Lucid proprietary software called Laser Bee for the interactive classification of lasers. He demonstrated the key features of the software and its compliance with current legislation.

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## Laser Safety in Military Applications

The first presentation in this session was given by **Tom Riley**, from the Ministry of Defence (MoD), who talked about laser safety in a UK MoD establishment. He described the main role of the Military Laser Safety Committee (MLSC), which was formed in 1974 to develop policy and guidelines in response to the problems created by the introduction of high-powered laser systems on tanks and aircraft. Among other things, the MLSC is also responsible for

- reviewing Laser Safety Papers (LSP)
- issuing Laser Safety Clearance Certificates (LSCC)
- maintaining the UK laser safety database

The main laser policy and guidance document is the Joint Services Publication (JSP) 390 – Military Laser Safety. This describes the documentation and techniques required for the procurement, development and use of a MoD laser system. The MLSC also supports NATO in the



development of policy for the outdoor use of lasers and is responsible for the publication of the NATO document on laser range safety – STANAG 3606.

**Colin Bradley** and **Jason Duignan**, from Dstl, continued on the military theme giving an insight into laser weapons and the controls that are put in place to test and assess them safely. Following the closure of the old outdoor laser facility at Throckmoreton Airfield, a purpose-built laser facility was constructed at Porton Down. It has three laser beam propagation lengths of 1200, 2500 and 4500 m, which are all directed downwards across typical northern European downland.

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## Updates

**Chris Lane**, from BAE Systems, gave a light-hearted look at the International Laser Safety Conference 2005, which was held in California and attended by 160 delegates. The conference was chaired by John O'Hagan and included ten sessions:

- Bioeffects
- Safety Standards and Legislation
- Hazard Evaluation and Analysis
- Measurements
- Safety Programme
- Lasers in Outdoor Environments
- Probabilistic Risk Analysis
- Medical Laser Safety
- Protective Laser Filters and Guards
- High Power Lasers and Non-beam Hazards

**Werner Horak**, of Siemens AG in Germany, gave a comprehensive presentation on risk assessment for light emitting diodes (LEDs), highlighting the main differences between typical lamp sources, which includes most LEDs, and typical laser sources. LEDs are included in both IEC 60825-1:2001 'Safety of laser products part 1: Equipment classification and user's guide' and CIE S 009/E:2002 'Photobiological safety of lamps and lamp systems'. Since 1993, the photobiological safety aspects of LEDs have been covered by IEC 60825. The worst-case assumptions combined with the laser safety philosophy led to an overestimation of the hazards of LEDs in some applications. It has been suggested that LEDs should be removed from the scope of IEC 60825-1 because the optical radiation safety of LEDs can be more appropriately addressed in recently developed lamp safety standards. In fact, drafts for product-specific IEC safety standards such as IEC 62031 'LED modules for general lighting – safety

requirements' already require compliance with the CIE lamp safety standard.

**Simon Hall**, of the National Physical Laboratory (NPL), presented the results of an NPL project to develop a measurement method for the determination of the apparent source size for LEDs. This method can be used for LED risk assessment. He compared the results with data from other studies and recommended a broad intercomparison study to form the basis of standardisation of an LED assessment protocol.

**John Tyrer**, of Loughborough University, looked at the issues regarding the safety of laser pointers. The output power seen in commercially available laser pointers range from 0.5 to 10 mW with the majority now being around 5 mW. It is surprising then that there have been no permanent eye injuries recorded in the UK during the ten years that laser pointers have been freely available. He presented results from the evaluation of retinal images of a range of laser pointers and concluded that for the damage mechanism, all tested laser pointers should be assessed as extended sources.

**John O'Hagan**, from the HPA, provided an annual update on the progress being made in laser safety standards and legislation. Significant points to note are as follows:

- **IEC 60825-1:1994, including amendments 1 (1997) and 2 (2001) – main standard**  
There have been discussions relating to LED exemptions and classification measurements. The user's guide is now a separate document – PD IEC TR 60825-14:2004.
- **IEC 60825-2:2000 Fibre Communications Lasers**  
Edition 3 is being prepared so that the hazard levels are in line with Part 1 Classification.
- **IEC TR 60825-13 Measurements for classification of laser products**  
The UK is concerned that there is a lack of guidance for 'straightforward' assessments and there is the potential for confusion between classification and MPE.
- **JSP 390 Military Laser Standard**  
This is currently being updated to incorporate the new classification scheme.

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## Open Forum

**Jason Duignan**, of Dstl, demonstrated a green laser pointer that was bought on Ebay. He was concerned that such high-power devices were available to the public.

Laser Protection Adviser accreditation was discussed and the different schemes were summarised.

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## International Laser Safety Conference 2007

The Laser Institute of America's next International Laser Safety Conference takes place at the San Francisco Airport Marriott Hotel from 19 to 20 March 2007. John O'Hagan was the Conference Chair for the 2005 Conference; the baton is handed over to John Tyrer for the forthcoming Conference.

Ben Rockwell, from the US Air Force Research Laboratory Optical Radiation Branch, takes over from David Sliney as the General Conference Chair.

The format for the Conference is expected to be similar to that in previous years, with a mixture of leading edge research and presentations on practical experience. However, a two-day Laser Safety Practical Applications Seminar is also being offered at an additional cost. This will be chaired by Eddie Ciprazo and Robert Sarason of Berkeley and the University of California at Davis, respectively.

The Conference usually provides an opportunity to meet many of the key people involved in laser safety. The membership of the Laser Safety Forum is also usually well represented.



John O'Hagan receiving the commemorative gavel from General Conference Chair, David Sliney, at ILSC05 (Photo courtesy of the Laser Institute of America)

Further details are available on the Laser Institute of America website: [www.laserinstitute.org](http://www.laserinstitute.org).

## New Book on Laser Safety Management

Laser Safety Officer, Ken Barat, presents practical tools for implementing a successful laser safety management programme. A sample safety programme is included to help you evaluate and develop your current safety plan. The book covers aspects such as biological effects of laser radiation and the types of accidents that can occur as well as providing methods of controlling hazards and ensuring a safe working environment.

The book incorporates the following chapters:

- 1 Overview
- 2 Biological effects: Why we care about laser exposure
- 3 The Laser Safety Officer: The key to laser safety
- 4 Standard operating procedures: A binding safety contract
- 5 Practical tools for laser safety and traps to avoid
- 6 The Laser Safety Management Program
- 7 Laser safety training
- 8 Personal protection equipment
- 9 Laser accidents
- 10 An explanation of control measures
- 11 US and European Regulations and Standards
- 12 Laser safety calculations
- 13 Nonbeam hazards
- 14 Practical control measures
- 15 Laser basics

Ken is hoping to bring some copies of his book to the Laser Safety Forum on 12 September 2006.



Laser Safety Management  
Ken Barat  
CRC Press, Taylor & Francis Group, 2006  
ISBN 0-8247-2307-4  
\$119.95



## Update on Standards

A meeting of the International Electrotechnical Commission TC76 committee, which is responsible for laser safety standards, met in Frankfurt in November 2005. This was an extremely productive meeting and significant progress was made with a number of standards.

Perhaps the most important news is that edition 2 of the parent laser safety standard, IEC 60825-1, was worked on and, subsequent to the meeting, the UK provided the editorial support to turn the many comments received on the earlier drafts of the revised standard into reality. The main differences in content relate to the removal of light emitting diodes (LEDs), except when used for fibre or free-space communications, and removal of the user's guide. However, substantial changes have been made to the layout. This should make the document a little easier to navigate. There are also flowcharts to help with laser product classification. National committees, such as EPL/76 within the BSI, have until 1 September 2006, to vote and comment on the document. If there are no significant comments, the document could then move directly to publication. If there are comments, then attempts will be made to resolve these and another version will be circulated to the national committees.

There was a great deal of concern that non-communication LEDs should not be left 'in limbo'. To address this, it has been proposed that the CIE (International Commission on Illumination) standard CIE S 009:2002 'Photobiological safety of lamps and lamp systems' should be adopted as a joint-logo IEC/CIE standard. This is currently being voted upon by the national committees and, if agreed, will be adopted as IEC 62471. Even before this has been agreed, work on the next edition of CIE S 009 has been started.

CIE S 009:2002 uses a classification system similar to that used in the laser safety standard, termed Risk Groups. However, it makes better use of an Exempt Group, to recognise lamps that do not present a risk of injury under reasonably foreseeable circumstances. Risk Group 1 is for lamps where normal behavioural limitations on exposure provide adequate protection. Risk Group 2 utilises the aversion responses and Risk Group 3 lamps present a risk of injury for momentary or brief exposure.

CIE S 009:2002 doesn't cover manufacturing requirements, including product interlocking and labelling, etc. Therefore, it is felt that an additional document is required. The initial proposal was to produce a guidance document for product/application specific standards' committees. However, this project is continuing to evolve.

Intense pulsed light is used in a number of medical and aesthetic applications in a similar manner to lasers. Although it could be argued that CIE S 009:2002 could be used for these sources, that standard does not deal adequately with pulsed sources. Therefore, the UK has proposed two new documents to the IEC. The first is a direct equivalent to IEC 60601-2-22 (for medical laser products), which defines the manufacturing requirements for intense light sources used for medical and aesthetic applications. The second is a guidance document for the use of intense light sources, similar to IEC 60825-8 for medical lasers. Fairly mature drafts of these documents have been produced, but discussions continue on the practical implications of some of the proposed parameters.

Another new work proposal relates to the increasing optical powers used within optical fibre communication systems, due to the increase in data rate and data volume. The power levels associated with these systems are typically greater than 500 mW (ie Class 4). Issues that need to be addressed include: additional user information; additional requirements for automatic power reduction; and potential for damage to optical components, including the fibre core and connections.

The long-awaited measurement part of IEC 60825 (part 13) has been circulated for comment. The UK view has been that a simple document is required initially, covering the standard situations likely to be encountered by most people. Additional measurement requirements can be added later. Although this document is progressing, the UK had a significant number of comments on the latest draft.

There are a number of standards that have been published within Europe only. The first was produced by the European equivalent of the IEC, CENELEC, and was essentially a UK-produced document. PD CLC/TR 50448:2005 is a guide to levels of competence required in laser safety. It provides guidance on employers' responsibilities, levels of competence for the Laser Safety Officer, laser user, other persons and the Laser Protection Adviser, and also advice on training requirements.

Two other European documents were produced by CEN, which is the European equivalent of the International Organization for Standardization (ISO). The two standards are the first of a set of four in the BS EN 14255-1 series 'Measurement and assessment of personal exposures to incoherent optical radiation'. Part 1 (2005) covers ultraviolet radiation emitted by artificial sources in the workplace; and part 2 (2005) covers visible and infrared radiation emitted by artificial sources in the workplace. Parts 3 and 4 will cover the sun and definitions, respectively.





# When An Inspector Calls

## Risk assessment: time to see the light

**Mark Bradley, Health and Safety Executive, Birmingham**

The objective of any health and safety inspection is clear: to determine whether health and safety risks are being appropriately managed. In order to do so, an inspector has many tools in his armoury, including a raft of legislation to refer to. In the case of work with lasers where there is currently no specific laser safety legislation, the general requirements of the Management of Health and Safety at Work Regulations 1999 are entirely relevant. Lasers, after all, are just another device with hazards that need to be controlled. Consequently, a sensible starting point to any inspection is to establish how laser safety is managed before examining the laser facilities.

An inspector will look for documented organisational arrangements including the roles and responsibilities of individuals at all levels in ensuring that an organisation's health and safety policy is put into effect and risks are appropriately controlled. The remit of any working groups or committees should be detailed and reference made to any supporting documents such as local rules; training matrices; maintenance schedules; procurement procedures; and ... you know what's coming! ... risk assessments.

The risk assessment is a sensible place to start the practical side of a laser safety inspection. After all, it should form the basis of all health and safety procedures. The risk assessment process is a practical one and needn't be over-egged. Remember that the process is intended to help identify and control risks so far as reasonably practicable, and then any further actions required to address those risks which cannot be completely removed.

**A quiz:** What is the first stage of risk assessment?  
Identify the hazards?

No! Before doing that, you should ensure that you have competent risk assessors with sufficient knowledge and experience of the hazard you are assessing and an understanding of the risk assessment process. All too often this is not the case: laser users who don't understand risk assessment; risk assessors who don't know the first thing about laser hazards; or both. Where such competences are shared around, you may need to use a team of people. If your risk assessment says something like... Hazard: Laser radiation. Risk: High. Probability: Low. Overall risk: Low. Actions: None ... as many do, you probably haven't got this bit right.

Necessarily, some technical input to the risk assessment is required and organisations should have access to this. The laser supplier or manufacturer also has a part to play here and should provide details specific to the laser

(power, wavelength, nominal ocular hazard distance, etc) which can be fed into the risk assessment.

After identifying the hazards and those who could be exposed to them, the next step is to identify what protection measures are already in place to reduce laser risks. Then decide what else you can do, applying the standard hierarchy of control measures. Where the risk cannot be completely engineered out and a significant residual risk of exposure is considered to exist (ie access to the open beam is still reasonably foreseeable) you should consider procedural means to control that residual risk. These procedures may include, for example, access restriction; drawing of blinds; damping theatre drapes; or, lastly, the wearing of personal protective equipment (PPE). Obviously, if any of those practical measures aren't then implemented, a lesser standard of protection exists than has been identified as achievable by the risk assessment. Often, the origins of the risk assessment and local rules appear to be as confused as the chicken and egg. This should demonstrate that the risk assessment definitely comes first, since the significant findings of the assessment should form the basis of the systems of work included in laser local rules.

### **I'll finish with a practical, although not exhaustive, self-inspection aid:**

Imagine you are using a Class 4 laser that we know presents an eye, skin and fire hazard from direct and reflected beams. Look around you. Are reflective surfaces or flammable materials present? Can they be removed or covered? Is the laser hazard contained within the room dimensions? If not, and someone could gain access to the hazardous area, what controls are there at doors or windows? Why aren't the doors locked or interlocked? ... and before you scream at the page, I'm not suggesting they should be. Now is an appropriate juncture to quash a common misconception that when an inspector asks 'Why isn't...?' they actually mean 'You should ...'. They don't. They are simply challenging the adequacy of your assessment and the justification for your decisions. In this example, can you justify why the doors are not locked? Answers involving 'crash teams' and 'fire safety' may well be right, but in my experience they are seldom supported by a risk assessment.

Are local rules available which address the significant findings of the risk assessment and have all users, ancillary staff, cleaners, etc, been provided with appropriate training in their requirements? A consultant ophthalmologist once answered my question about refresher training with 'I don't need any. It's like driving a car'. 'That it may be', I replied, 'but you occasionally have to refer back to the Highway Code'. It may have been a flippant exchange, but nonetheless a valid analogy.



Whilst most of us never forget how to drive a car, health and safety training goes further than the safe operation of the device. And whilst the rules of the road may not have changed, evidence suggests they are quickly forgotten. Laser local rules may change and peripatetic staff may be faced with different procedures at different locations. The training needs of individuals, whether consultants, operators or maintenance staff, right down to those simply required to obey laser warning signs (such as cleaners), should be considered as part of the risk assessment process.

If people rely on PPE, is appropriate equipment available and well maintained? The list of questions could go on. Many may be considered daft but so what? As CJ would

probably say, I didn't get where I am today without asking stupid questions. Anyway, if the question is stupid, the answer will surely be straightforward and if a satisfactory answer isn't forthcoming, the chances are you need to give a little more thought to your risk assessment.

Finally, having carried out a suitable and sufficient risk assessment and implemented practical safety procedures as a result, it's simply a case of making sure they are being followed!

HSE specialist inspectors are based at offices in Birmingham, Luton, Cardiff, Edinburgh, Preston and Bootle, and are available to answer any enquiries on these or other matters relating to work with lasers.

## Development of IPL Standards

**Marina Khazova, HPA, and Bill Davies, NHS**

More than 20,000 intense pulsed light sources (IPL) systems are already in use in beauty shops and spas worldwide for applications such as hair removal, acne treatment and skin rejuvenation. The pulsed, incoherent, broadband, high-energy sources emit approximately 2–100 J/cm<sup>2</sup> on to 1–10 cm<sup>2</sup> tissue area with exposure times up to several hundred milliseconds for each pulse or pulse complex. Marketing of inexpensive devices for home use has already begun within the public arena. The energy sources may be flashlamps, LEDs or other broadband emitters. Additionally, devices combining the optical radiation with radiowave, microwave or acoustic energies are available.

The optical radiation presents a risk of retinal and corneal burns if the radiation is inadvertently directed at the eye at a close enough distance; skin and ocular damage have been reported. Operator known side-effects include photic stimulation and dry-eye, as well as annoyance and unwanted chronic effects from scattered radiation.

Manufacturers wishing to market the equipment within the EC have to comply with the Low Voltage Equipment Directive 73/23/EEC, but this Directive does not address either manufacturing specifications, issues of optical safety or safe practice. This situation is similar for manufacturers and users in most countries.

There has been considerable concern regarding the specification and measurement of the optical output of IPL devices and acceptable variations of output parameters. Current industry specifications of IPL devices from different manufacturers are inconsistent and the given information is often difficult to compare. It is still apparent that a robust measurement technique is not fully developed and there is no agreed measurement protocol.

Concern has been also expressed over the clinical (medical and cosmetic) use of these devices and in harmonisation of guidance for the use of intense light sources with the guidance provided on the use of medical lasers (IEC 60825-8).

An IPL review meeting, jointly held by the HPA Radiation Protection Division and IEC TC76/WG4 in Chilton in April 2005, brought together a wide range of expertise from IPL manufacturers, users, measurement instrumentation and optical radiation protection professionals. Open and constructive discussion addressed the optical safety and user issues and recommended to propose two new projects to IEC TC76/WG4:

- Safety standard for the manufacture of IPL equipment
- Guidance for the safe use of IPL equipment

The working group of UK EPL/76 National Committee, with Bill Davies from Swansea NHS Trust as the project leader, submitted proposals for these two documents to the IEC in January 2006. The next few months provided time for international consultations and a voting period to confirm acceptance of new IEC work items by other countries. The working group aims to prepare the first draft of the document by early autumn this year and the first Committee Draft by January 2007.

To provide a comprehensive package of standard documents and to address adequate provision for the optical safety of IPL devices, proposals for IPL protective eyewear have been developed in parallel within the BSI PH2/3 Committee. The working group hopes to initiate broad discussion over IPL issues. Comments and contributions will be greatly appreciated.

For further information, please contact Bill Davies ([bill.davies@swansea-tr.wales.nhs.uk](mailto:bill.davies@swansea-tr.wales.nhs.uk)) or Marina Khazova ([marina.khazova@hpa-rp.org.uk](mailto:marina.khazova@hpa-rp.org.uk)).



# INTELLILOCK

## Robust and informative interlock control

**Leon Lobo, Laser Optical Engineering Ltd**

Interlocks are an important engineering control for any laser or non-laser system where a hazard needs to be actively controlled. Any laser system that contains a Class 3B laser and above *must* have interlocks to contain the hazard. The switchgear used must be rated to withstand long periods of inactivity and yet break the circuit when required. Microswitches tend to stick and are thus not viable as safety interlocks. For fail-safe operation, the interlock circuits *must* be hardwired and not software controlled.

Basic interlock functionality requires the installation of interlock switchgear on any point where the hazard can be accessed (doors, hatches, enclosures, etc) (see Figure 1). These interlocks are connected in series and disable the laser when the circuit is broken. This type of system can be easily tampered with by bypassing an interlock. For systems with several interlocks, there is no way of knowing which interlocked panel/door has been opened. This is especially true when the interlock has not been engaged fully on closure of the panel/door. The laser operator is not informed that the interlock circuit has been broken. In the case of laser processing systems, the computer numerical control system will continue regardless of whether the laser is processing the material or not. This can cause significant throughput reductions purely because of lack of information.

The next level of interlock control functionality involves the use of a dedicated controller to which the interlock switchgear is connected. This controller informs the user when the interlock circuit has been broken. Additionally, multiple interlock circuits can be implemented allowing for either local (cabinet/ enclosure) hazard containment or room control when enclosure access is required for system alignment. Once again this type of control system can be tampered with. Basic information regarding system status is relayed to the operator but the position of the break in the circuit cannot be determined. The additional functionality of independent circuits is useful for normal operation as well as system servicing/alignment whilst containing the hazard.

The INTELLILOCK interlock control system (Figure 2) consists of a base unit and remote nodes. Every physical interlock in the system is assigned a node. The base unit is connected to the nodes using Cat5e Ethernet cabling.

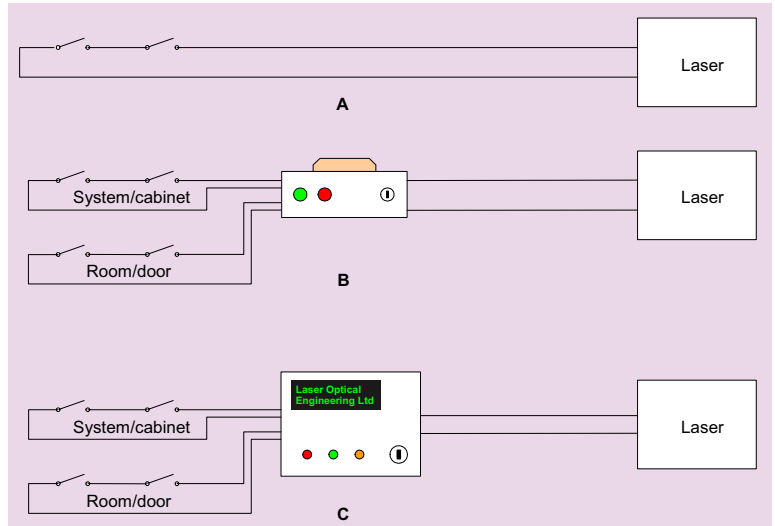


Figure 1 Interlock system types. A: Basic series linked circuit. B: Dual circuit with basic information. C: INTELLILOCK system providing informative and tamperproof interlock control

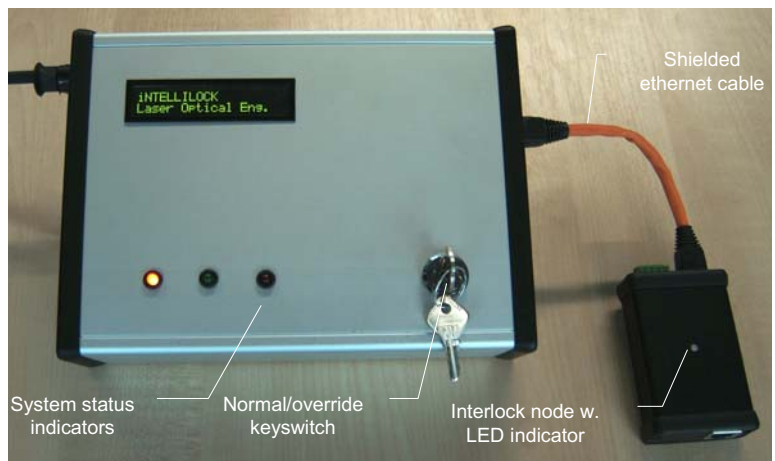


Figure 2 INTELLILOCK interlock control system

The nodes can be daisy chained and their physical order of connection is not important. Up to 255 nodes each on two hardwired circuits allow plenty of connection points for a cabinet/ enclosure and room access (Figure 3). An additional 6x255 node capacity is available for sensory information. Each base controller is preconfigured and is specific to the laser system. The individual node/interlock pairs are assigned meaningful descriptive names. This information is stored on a memory chip in the INTELLILOCK controller. System reconfiguration is carried out by connecting the controller to a PC.

The INTELLILOCK system operates at 12 V dc. It can be either mains powered or battery powered for portability. It conforms to the Machinery Directive, Low Voltage Directive and EMC Directive. As an interlock system, it is classed as a Category 4 system according to EN 954-1. It is CE marked and conforms to EN 61010 and EN 60947-1. The keyswitch allows the system to be

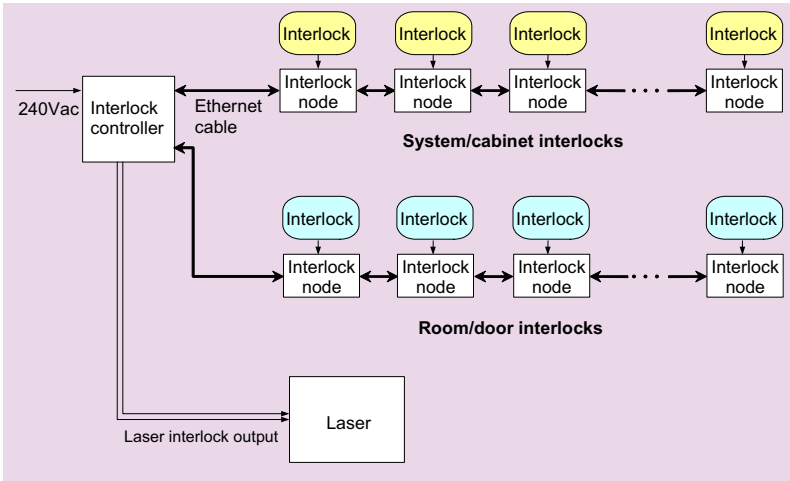


Figure 3 System connection schematic showing node/interlock pairs, ease of connection and system scalability

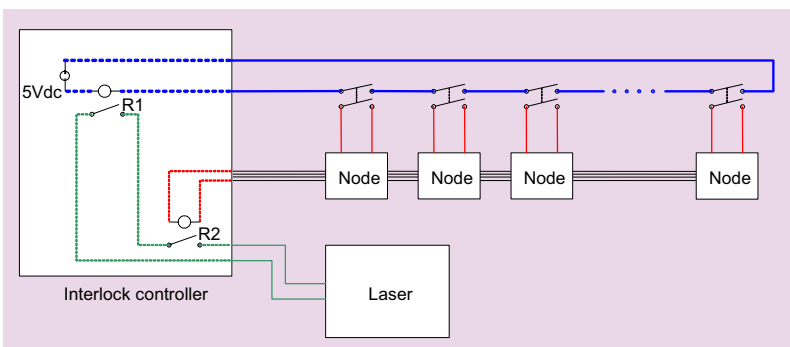


Figure 4 System operational schematic showing hardwired circuit and software interrogated node structure

Each physical interlock used must be single pole double throw normally-closed. This allows two circuits to be formed – a hardwired series linked circuit (blue in Figure 4) and a software interrogated circuit (red in Figure 4). The iNTELLILOCK controller series links the two circuits using relays to enable or disable the laser (green in Figure 4).

An operational flowchart is shown in Figure 5. On system startup, a check is carried out to ensure all the specified nodes are present and functioning. If any nodes are missing or tampered with, the laser system will remain disabled and the operator will be informed of the location of the problem. If all is well, the system tests the interlocks attached to the nodes. If all the interlock switchgear is in the closed (enabled) state, the iNTELLILOCK enables the laser. If an interlock is open (disabled), the laser is disabled and the operator informed of the location of the interlock. The cycle is then repeated at >100 Hz. In addition to the software interrogation of the node/interlock pairs, the interlock switchgear is still series linked in a hardwired circuit allowing immediate disabling of the laser when required.

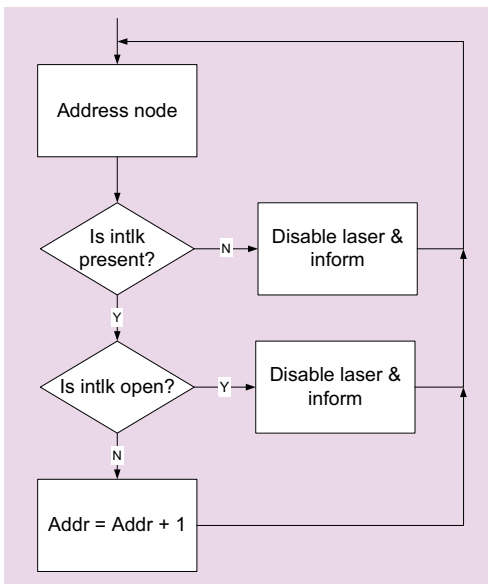


Figure 5 Operational flowchart

switched from cabinet/enclosure mode to override/room mode. In the override/room mode the key cannot be removed. In the normal cabinet/enclosure mode the key is not required and should be stored in a key cabinet. The high visibility LEDs on the controller show whether the interlocks have been enabled/disabled or the system is in override/room mode. The laser output is an independent isolated circuit with dry relay contacts.

The scalability and reconfiguration capability of the iNTELLILOCK allows the system to interrogate a range of sensors as well as output information to displays and enable/disable shutters. A list of sensors is shown below but is by no means exhaustive. Any sensory requirement can be developed for the system. The output from these sensors will be binary based on set thresholds providing a pass/fail condition.

- Primary wavelength scatter detection – guarding monitor
- Temperature
- Acoustic
- Gas – plastics processing
- Particulate byproducts – size distribution
- Assist gas flow rate
- Assist gas pressure
- Backscatter and emission (diffractive beam splitter)
- Smoke
- Fire

The iNTELLILOCK provides the foundation for an informative and robust safety system but is scalable to achieve process feedback and provides an architecture capable of integrating these variables into the overall safety system.





## New Website Coming Soon

Many of you may remember and still use the CVCP Guide Part 2:1 Lasers which was published in 1992. This guide was designed to assist people responsible for the use of lasers in universities to ensure that work was carried out safely and in accordance with BS EN 60825:1992. There have been several amendments to the British Standard since then, the most important being the revised laser classification scheme. With this in mind, a revised guide is needed to reflect those changes.

Instead of producing the guide in hard copy format, it has been decided that an online version be published to enable cheap and instant access for a greater number of laser users. A specially designed website, [www.lasersafetyguide.org](http://www.lasersafetyguide.org), is in the process of being constructed and it is hoped that this will be available soon. It will be hosted by the HPA Radiation Protection Division. The website is intended for those working in a research environment although the information could be useful for those working in other sectors.

## Training

### NIR Training in 2006

#### AT BURLEIGH COURT

##### Laser Safety Management Course

5 day course, Monday – Friday  
9 – 13 October 2006

##### Laser Safety Course

2 day course, Tuesday – Wednesday  
21 – 22 November 2006

##### Laser Safety Forum

Tuesday 12 September 2006

##### Laser Safety Refresher Course

Wednesday 13 September 2006

#### AT HPA RADIATION PROTECTION DIVISION

##### NIR Awareness

Tuesday 27 June 2006 – Leeds  
Monday 17 July 2006 – Chilton

##### RF Awareness

Tuesday 20 June 2006 – Chilton

##### Laser Safety for Medical and Cosmetic Applications

Wednesday 19 July 2006 – Chilton  
Tuesday 28 November 2006 – Leeds

##### Sun, Sunbeds and Lasers

Tuesday 18 July 2006 – Leeds

### Laser Safety Training in 2007

#### AT BURLEIGH COURT

##### Laser Safety Management Course

4.5 day course, Monday – Friday  
5 – 9 February 2007  
4 – 8 June 2007  
1 – 5 October 2007

##### Laser Safety Course

2 day course, Tuesday – Wednesday  
1 – 2 May 2007  
6 – 7 November 2007

##### Laser Safety Forum

Tuesday 4 September 2007

##### Laser Safety Refresher Course

Wednesday 5 September 2007

#### If you are interested in attending any of these courses please contact:

Training Centre  
Health Protection Agency  
Radiation Protection Division  
Chilton  
Didcot  
Oxon OX11 0RQ  
United Kingdom

Tel: +44 (0)1235 822701  
Fax: +44 (0)1235 822601  
Email: [training@hpa-rp.org.uk](mailto:training@hpa-rp.org.uk)

## LASER SAFETY FORUM

The Laser Safety Forum is open to anyone with an interest in laser safety. Membership is currently free. You can join by sending your postal address to [laser@hpa-rp.org.uk](mailto:laser@hpa-rp.org.uk).

