



THE UNIVERSITY
OF BIRMINGHAM

Health and Safety Guidance

Guidance for Risk Assessment in Laboratories

GUIDANCE/2/RAL/98

This Guidance is issued to assist those who are carrying out risk assessments in laboratories. It identifies a wide range of hazards that can be present in a laboratory and model controls that may be appropriate to control these hazards. However, this document does not identify all possible hazards. Assessors should ensure that they have identified **all** the hazards that are associated with their particular activities.

The Guidance should be used in conjunction with the University Risk Assessment Guidance GUIDANCE/17/RA/00.

Further information and advice may be obtained from the Health and Safety Unit.

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The Legislation, Policies and Guidance referenced were up to date when this Guidance was issued. Details of revisions can be obtained from the University Health and Safety Unit or by accessing <http://www.hsu.bham.ac.uk/univ/univdocs.htm> on the World Wide Web.

1. Hazardous Substances

Hazard	Possible harm	Model Controls
Use/production of hazardous substances	Exposure to dust, fume, vapour Contamination from contact Fire, explosion	COSHH assessments (may include LEV), use of ppe, information, hygiene arrangements, good supervision Key refs: Assessment, <i>Pro forma</i> and guidance: UHSP/15/HS/00, S 2 Making a Chemical Hazard & Risk Assessment USP/90/CHRA/16 Control Measures, Good Chemical Practice: UHSP/15/HS/00, S 3.1 Control Measures, Enhanced Good Chemical Practice for Work with Chemical Carcinogens: UHSP/15/HS/00, S 3.3 Control Measures, Enhanced Good Chemical Practice for Work with Cyanides: UHSP/15/HS/00, S 3.4 Control Measures, Enhanced Good Chemical Practice for Work with Hydrogen fluoride and Hydrofluoric Acid: UHSP/15/HS/00, S 3.5 Control Measures, Enhanced Good Chemical Practice for Work with Phenol: UHSP/15/HS/00, S 3.6 Control Measures, Enhanced Good Chemical Practice for Work with Peroxidisable Substances: UHSP/15/HS/00, S 3.7 Control Measures, Enhanced Good Chemical Practice for Work with Very Low Boiling Point Liquefied Gases: UHSP/15/HS/00, S 3.12 Safety Supervision, Out of Hours Activities and Unattended Equipment & Apparatus: UHSP/8/SSOHA/96
Storage of hazardous substances	As above, spillage	As above, arrangements to control stock, correct storage both in labs and bulk stores, arrangements to deal with spillages, releases etc Key refs: As above Identification and Storage, Arrangements for Keeping and Storage of Hazardous Substances: UHSP/15/HS/00, S 5 The Keeping of Liquefied Petroleum Gases (LPG) in Cylinders & Cartridges: USP/88/LPG/10
Transport of hazardous substances from stores to labs and around labs	As above	Use correct carrying/moving equipment, ensure route clear, carry out a Manual Handling Assessment Key ref: Manual Handling Operations UHSP/6/MHO/95
Transport of hazardous substances in vehicles	As above	Follow guidance Key ref: Transport, The Carriage of Hazardous Substances by Road: UHSP/15/HS/00, S 6

2. Compressed Gases

Hazard	Possible harm	Model Controls
Use of compressed gases	Fire or explosion Asphyxiation due to oxygen enriched atmosphere or excess quantity of shielding gases Toxic effects	All equipment to be maintained in good condition Use of flashback arrestors Good general ventilation COSHH assessment of toxic effects Key ref: Assessment, <i>Pro forma</i> and guidance: UHSP/15/HS/00, S 2
Storage of compressed gases	As above Injury from falling cylinders	Store cylinders outside where possible Ensure cylinders secure Key ref: Identification and Storage, Arrangements for Keeping and Storage of Hazardous Substances: UHSP/15/HS/00, S 5 The Keeping of Liquefied Petroleum Gases (LPG) in Cylinders and Cartridges: USP/88/LPG/10
Transport of hazardous substances from stores to labs and around labs	As above	Use correct carrying/moving equipment, ensure route clear, carry out a Manual Handling Assessment Key ref: Manual Handling Operations UHSP/6/MHO/95
Transport of hazardous substances in vehicles	As above	Follow guidance Key ref: Transport, The Carriage of Hazardous Substances by Road: UHSP/15/HS/00, S 61

3. Use of Cutting & Rotating Machinery

Hazard	Possible harm	Model Controls
Contact with cutting parts	Cuts Entanglement	Correct guarding in place Authorised users only who are competent having had instruction and training. No loose clothing or jewellery, long hair tied back. Use of eye protection Key refs: Abrasive Wheels HS(G)17 Drilling machines HS(G)44 Turning NIS/10/02 Combination machines NIS/10/13 Sawing NIS/10/12 Guillotines HSG(42) Bending/rolling NIS/10/07
Contact with other moving parts	Cuts Entanglement Crush	
Hit by ejected material or equipment	Cuts, fracture (machine tools) Cuts, bruising (materials) Cuts (waste)	
Injury from lifting and handling materials and tools	Back strain etc	Manual handling assessment/training Key ref: Manual Handling Policy UHSP/6/MHO/95
	Cuts/abrasions/crush	PPE, gloves & boots (remove gloves when machining)
	Toxic/contamination (material, swarf, oils etc)	COSHH assessment, information, hygiene arrangements Key ref: Assessment, <i>Pro forma</i> and guidance: UHSP/15/HS/00, S 2
Exposure to harmful substances	Dermatitis from contact with cutting fluids/lubricants	COSHH assessment, information, hygiene arrangements Key ref: as above
	Exposure to dust/fume	COSHH assessments, controls may include LEV and PPE Key ref: as above
Physical hazards from the machine environment	Loss of hearing from noise	Noise assessment, ppe (If you cannot hear clearly what someone is saying in a normal voice 2m away a noise assessment is required.)
	White finger from vibration	Correct design/installation
	Burns from hot machine parts and material	Machine guarding, warning signs, authorised users who are competent
	Cuts, bruising etc (slips, trips)	Good housekeeping
Poor workstation design including space and working position	Muscle or joint damage, fatigue etc	Assess work station design Key ref: Guidance on Workstation Design GUIDANCE/5/WD/98
Exposure to dust from material being machined	Fire/explosion	Authorised users only who are competent, LEV, design, maintenance, good housekeeping

4. General Work Equipment

Hazard	Possible harm	Model Controls
		Key ref: Guidance on Equipment Provided For Use At Work GUIDANCE/1/EPUW/99
Poor standard of design/construction	Various injuries/ill health	Choose equipment carefully and from a reputable source. All new equipment should have a 'CE' mark
Equipment being used in an unsuitable environment	Various injuries/ill health	Assess risks before choosing equipment. Ensure equipment is suitable
Equipment not used for the purpose it was designed for or being used beyond its design capabilities	Various injuries/ill health	Ensure the right equipment is used for each job
Lack of maintenance	Various injuries/ill health	Ensure equipment is maintained in a safe condition
Lack of instruction, information and training	Various injuries/ill health	Ensure appropriate people knows how to use, operate, maintain etc equipment safely and know the hazards associated with specific equipment. Normal operating conditions and foreseeable possible abnormal conditions must be considered

5. Hot & Cold Work

Hazard	Possible harm	Model Controls
Use of cryogenic liquids	Cold burns, asphyxiation Particular liquids may have other associated hazards eg fire causing burns	Correct procedures, use off ppe, adequate ventilation Key refs: Control Measures, Enhanced Good Chemical Practice for Work with Very Low Boiling Point Liquefied Gases: UHSP/15/HS/00, S 3.12 Assessment, <i>Pro forma</i> and guidance: UHSP/15/HS/00, S 2
Work in cold rooms	Frostbite, low body temperatures etc	Correct procedures, means of checking on individuals if working alone, ppe
Hot surfaces, equipment, materials etc generation of heat of heat	Burns/scalds from contact with flames, material, surfaces etc.	Correct procedures, enclosures, guarding, ppe etc
	Fire, explosion	Correct procedures, keep flammable/explosive materials away, good housekeeping
Work in hot rooms	Heat stroke, fainting etc	Correct procedures, means of checking on individuals if working alone, ppe

6. Handling & Storage

Hazard	Possible harm	Model Controls
Heavy and awkward loads, difficult travelling routes, awkward unloading and storage positions	Sprains, strains etc to various parts of body	Carry out manual handling assessments including eliminating, mechanising and minimising manual handling. Suitable steps etc Key ref: Manual handling Operations UHSP/6/MHO/96 The Use and Control of Portable Ladders UHSP/2/UCL/94
Materials with rough surfaces and sharp edges/points	Cuts mainly to hands	Eliminate/cover rough surfaces if possible Use/dispose of sharps with care Wear suitable PPE including gloves
Unsuitable storage (not strong enough unstable, too high etc)	Injury due to collapse etc	Ensure storage arrangements suitable eg do not overload, put heavy items at bottom, minimise height etc
Use of lifting equipment	Injury due to failure of the equipment etc	Ensure equipment is not overloaded and is regularly inspected and maintained. (Lifting equipment must be inspected every 14 months)
	Injury due to lack of training	Authorised users who are competent and have had instruction and training

7. Assembly of Components

Hazard	Possible harm	Model Controls
Use of adhesives	Skin contact, inhalation of fumes	COSHH assessment Key ref: Assessment, <i>Pro forma</i> and guidance: UHSP/15/HS/00, S 2
Finishing work (including cleaning, painting etc)	Inhalation of dust and fumes	COSHH assessment Key ref: Assessment, <i>Pro forma</i> and guidance: UHSP/15/HS/00, S 2
Poor workstation design including space and working position	Muscle or joint damage, fatigue etc	Assess work station design Key ref: Guidance on Workstation Design GUIDANCE/5/WD/98
Manual Handling	Strain/sprains, cuts	Manual handling assessment Key ref: Manual handling operations UHSP/6/MHO/96
Use of lifting equipment	Injury due to failure of the equipment etc	Ensure equipment is not overloaded and is regularly inspected and maintained (Lifting equipment must be inspected every 14 months)
	Injury due to lack of training	Authorised users who are competent and have had instruction and training

8. Pressure & Vacuum Systems

Hazard	Possible harm	Model Controls
Rupture of vessels, pipework, valves etc due to excessive pressure	Exposure to ejected parts of the system Exposure to the release of fume, dust, vapour Fire	Use the minimum pressure necessary Ensure all operators are adequately trained Ensure all equipment is well designed and well maintained Equipment may need a written scheme of examination Key ref: Pressure systems UHSP/10/PS/97
Implosion of vessels	Exposure to the release of fume, dust, vapour	Use the minimum vacuum necessary Ensure all operators are adequately trained Ensure all equipment is well designed and well maintained

9. The Working Environment

Hazard	Possible harm	Model Controls
Working in a confined space	Asphyxiation and poisoning due to the atmosphere Fire, drowning, contamination, general injury	If possible eliminate the need to enter the confined space If elimination is not possible, plan work, ensure a safe system of work including rescue arrangements. Consult the Health and Safety Unit Key refs: Guidance on safe Work in Confined Spaces GUIDANCE/8/SWCS/98 Confined Spaces Regulations 1997
Slipping and tripping	Cuts, bruising, fractures etc	Good layout and sufficient space. Dry, non slip floors Tidy access routes and work areas. Non slip footwear Regular removal of waste and rubbish Key refs: Workplace (Health, Safety & Welfare) Regs 1992 Safety Footwear-Policies & Procedures USP/90/SF/17
Unsuitable lighting eg: insufficient, glare, dazzle, strobe effects	Injury from contact with machinery Slipping and tripping Eye strain	Good lighting design and maintenance/cleaning of lights. Carry out lighting survey if necessary Key refs: Workplace (Health, Safety & Welfare) Regs 1992 Lighting at work HS(G)38
Poor general ventilation	Build up of dust/fume, excessive heat	Ensure ventilation system is adequate and is regularly maintained. Carry out ventilation survey if necessary Key ref: Workplace (Health, Safety & Welfare) Regs 1992
Unsuitable work stations	Musculoskeletal problems	Assess suitability of work stations Key ref: Guidance on Workstation Design GUIDANCE/5/WD/98
Incorrect use of display screen equipment	Musculoskeletal problems Eyestrain etc	Assess use of display screen equipment Key ref: Display Screen Equipment Use UHSP/7/DSE/96
Lack of/inadequate maintenance of equipment	Shock, burn from electrical equipment Cut, bruise or fracture etc mechanical equipment	Maintenance system in place and up to date Key ref: Guidance on Equipment Provided for Use at Work GUIDANCE/1/EPUW/99 Checking, Inspecting and Testing of Electrical Equipment (Equipment Rated up to 240v) UHSP/5/CITEE/95 Inspection and Testing of Electrical Equipment (Equipment rated over 240v and up to and including 415v) UHSP/12/ITEE/97
Use of hand tools	Cut, bruise or fracture etc	Keep tools in good condition Authorised users only who are competent having had instruction and training
Entry, use of equipment by unauthorised persons	Injury from machinery, chemicals, etc	Only authorised persons allowed entry and to use equipment Key ref: Guidance on Equipment Provided for Use at Work GUIDANCE/1/EPUW/99
Inadequate hygiene arrangements	Contamination of the skin	Good washing facilities available. Clean overalls/coats available Key ref: Workplace (Health, Safety & Welfare) Regs 1992
Unsuitable work patterns	Injury due to fatigue, lack of concentration	Suitable work patterns
Excessive noise levels	Damage to hearing	Ensure noise levels reduced as low as possible. If over 85db noise assessment required. (As a guide if you have to shout to speak to someone 2m away from the noise source.) Ear defenders should only be used as a last resort. Health and Safety Unit will carry out survey
Irritating noises	Lack of concentration, stress	Take care where equipment and people are sited Consider working patterns

10. Competence, Supervision, Out of Hours Work & Unattended Equipment & Apparatus

Hazard	Possible harm	Model Controls
Not being competent to safely carry out the work, operate the equipment correctly etc. Not being able to respond correctly in the event of an emergency if the work or equipment goes wrong.	Various injuries/ill health	Ensure that staff, students and others who are working in laboratories have sufficient information, instruction and training to ensure competence and a record is kept This should be regularly reviewed to ensure competence is maintained
Inadequate supervision	Various injuries/ill health	Ensure adequate supervision and that supervisors are competent and aware of their duties. Ensure they are aware of the action to be taken in an emergency Key refs: Guidance for Academic Supervisors and Others who may be Supervising Academic Work: GUIDANCE/16/SAW/00
Out of hours activities	Various injuries/ill health	Ensure only authorised work is carried out by authorised persons and that they are aware of emergency procedures Key ref:, Out of Hours Activities and Unattended equipment and apparatus UHSP/8/SSOHA/96
Unattended apparatus and equipment left running	Various injuries/ill health	Work should be planned if possible to avoid the need to apparatus or equipment unattended. Ensure nothing is left running accidentally If it is unavoidable then the unattended running must be authorised by the Head of Budget Centre, security, maintenance and emergency staff must have enough information to be able to take action in an emergency and the equipment must fail to safety

11. Emergencies

Hazard	Possible harm	Model Controls
Accident	Various injuries	First aiders available Procedures in place and people aware of them
Fire	Various injuries	Procedures in place and people aware of them. Fire training up to date. Suitable fire fighting equipment available and in good condition Key ref: Fire Safety UHSP/4/FS/01
Bomb threats	Various injuries	Procedures in place and people aware of them
Chemical spills	Contamination of skin and eyes Inhalation of vapour or fumes	Procedures in place and people aware of them Remedial equipment available COSHH assessment Key ref: Assessment, <i>Pro forma</i> and guidance: UHSP/15/HS/00, S 2
Lone/out of hours working	Being injured but no one being aware that help is required	Assess if work is suitable to be done alone (Machinery, electrical work, welding etc should not be done alone) Key ref:, out of hours activities and unattended equipment and apparatus UHSP/8/SSOHA/96

12. Electricity

Hazard	Possible harm	Model Controls
Use of electrical equipment	Shock, burn, fire	Ensure equipment is maintained in good condition, used in suitable locations, sockets are not overloaded, repairs are only carried out by competent persons, users are trained to look for defects. Key ref: Checking, Inspecting & Testing of Electrical Equipment (Equipment rated up to 240 volts) UHSP/5/CITEE/95 Inspection and Testing of Electrical Equipment (Equipment rated over 240v and up to and including 415v) UHSP/12/ITEE/97
Experimental work involving electricity	Shock, burn, fire	Ensure work correctly planned and supervised. Use lowest voltage possible Shroud etc all live equipment, terminals etc

13. Biological Hazards

Activity	Hazard - Possible harm	Model Controls
Working intentionally with infectious agents (including GMOs)	<p>Infection ACDP/ACGM Hazards Category 2 Category 3 (Category 4 work is not allowed at the University)</p> <p>Allergy: respiratory and skin</p> <p>Toxicity</p> <p>Carcinogenicity</p> <p>Environmental damage from plant and animal pathogens</p>	<p>COSHH (biological) or Genetic Modification assessment; good micro biological practice, appropriate containment facilities to match the hazard category, use of micro-biological safety cabinets, appropriate PPE, health surveillance including appropriate immunisation, and consideration of special risks to pregnant or feeding mothers and immunocompromised persons</p> <p>Key refs: Biological safety UHSP/9/BS/96 and associated guidance (including assessment pro-formas) Assessment, <i>Pro forma</i> and guidance: UHSP/15/HS/00, S 2 ACDP Categorisation of biological agents according to hazard and categories of containment (Appendix 20 for plant and animal pathogens) ACDP Precautions for work with human and animal transmissible spongiform encephalopathies ACDP Protection against blood-borne infections in the workplace: HIV and hepatitis ACGM Guidance notes</p>
Work with biological materials potentially containing infectious agents	Presence of pathogens as above	<p>COSHH assessment as above, working at containment category 2 as minimum for routine unscreened human material or higher standard where increased risk of presence of hazard 3 organisms</p> <p>Key refs: As above especially blood-borne viruses and transmissible spongiform encephalopathies</p>
Work with animals and animal tissues (including transgenic animals)	<p>Allergy to fur/dander of mammals or scale etc. of insects leading to occ. asthma or other respiratory problems</p> <p>Physical injury from animal bite, scratch, butt and possible infection of wounds</p> <p>Venomous bite/sting</p> <p>Allergic dermatitis to e.g. rodent urine</p> <p>Infection from presence of zoonoses, as above</p> <p>Environmental harm from plant or animal pests</p>	<p>COSHH assessment: LEV/control of airborne risk, ppe General risk assessment for hazardous animals (including manual handling for larger animals)</p> <p>Key refs.: Biological Safety UHSP/9/BS/96 Assessment, <i>Pro forma</i> and guidance: UHSP/15/HS/00, S 2 Risk Assessment GUIDANCE/17/RA/00 Manual Handling operations UHSP/6/MH/96 BMSU Animal House Safety Notes</p>
Work with cell-culture (incl GMOs)	<p>Presence of pathogens, as above</p> <p>Toxic/allergenic/carcinogenic cell products, as above</p>	As above and in particular Appendix 13 of ACDP categorisation of biological agents
Work with plant materials	<p>Allergenic/toxic/caustic from pollen, spores, saps etc.</p> <p>Environmental hazard from presence of plant pests</p>	As above
Storage	Spillage and loss of containment	As above, correct labelling/identification appropriate storage and arrangements for dealing with leakage.
Transport	Spillage and loss of containment possible spread of agent to public/environment	As above, using appropriate containers with secondary containment where infection risk or environmental risk

14. Ionising Radiation

Hazard	Possible harm	Model Controls Key refs: Radiation Safety – Ionising and Non-ionising: UHSP/13/RADS/98 Use of Ionising Radiation: GUIDANCE/19/UIR/01
Work with ionising radiation	Exposure to radiation which is dependant on the source of radiation. Effects can be short term or long term depending on radiation doses received The level of harm can range from minor to major/fatal	Depending on the work exposure to radiation may not be the only hazard, all risks need to be assessed and prioritised. All persons working with ionising radiation must have received training and instruction and should work to a protocol/system of work. Dose assessments need to be carried out. COSHH and Genetic Modification assessment where applicable and appropriate.
Sealed/closed sources	External hazard only Dependant on dose rate and exposure time The level of harm can range from insignificant to major/fatal	Smallest sources should be used For sources with a dose rate greater than $1 \mu\text{Sv h}^{-1}$ a dose assessment should be carried out Protection control measures include time, distance and shielding. Use of handling tools, avoidance of direct handling of sources Classification of working areas into designated Controlled, Supervised or Low Level areas Warning signs Designation of persons as "classified" if the potential annual dose could be greater than 15 mSv (whole body) or 150 mSv (extremity) Appropriate supervision, training and instruction. Where provided, dosimetry is used to monitor exposure Appropriate records for source movements Disposal via appropriate authorised routes
Radiation generators, x-ray diffraction and fluoroscopy	External hazard only Dependant on dose rate and exposure time The level of harm can range from insignificant to major/fatal	Where appropriate, radiation monitoring is to be carried out to ensure that any radiation leakage from enclosed systems is eliminated or minimised to as low as practicable For sources with a dose rate greater than $1 \mu\text{Sv h}^{-1}$ a dose assessment should be carried out Protection control measures include time, distance and shielding Classification of working areas into designated Controlled, Supervised or Low Level areas Warning signs Designation of persons as "classified" if the potential annual dose could be greater than 15 mSv (whole body) or 150 mSv (extremity) Appropriate supervision, training and instruction. Where provided, dosimetry is used to monitor exposure
Open sources Weak beta emitters, e.g. H-3, C-14, S-35. Very limited quantities of weak γ emitters, e.g. I-125	External/Internal hazard $< 3.7 \text{ MBq } (< 100 \mu\text{Ci})$ H-3, C-14 & S-35 $< 185 \text{ kBq } (< 5 \mu\text{Ci})$ I-125. Not a significant hazard	Good laboratory practice Appropriate supervision, training and instruction. Record keeping requirements Disposal via appropriate authorised route
Open sources Significant quantities, e.g. $> 3.7 \text{ MBq } (> 100 \mu\text{Ci})$ H-3, C-14 & S-35. $> 37 \text{ kBq } (> 1 \mu\text{Ci})$ I-125 and other sources	External/Internal hazard The degree of harm is dependant on the quantities involved	Smallest sources should be used A dose assessment should be carried out Protection control measures include time, distance, shielding and minimisation of contamination Use of handling tools, avoidance of direct handling of sources with high dose rates Finger TLDs should be used to monitor extremity doses where large quantities greater than 37 MBq (1 mCi) of P-32, I-125 and Cr-51 are used Classification of working areas into designated Controlled, Supervised or Low Level areas Warning signs Designation of persons as "classified" if the potential annual dose could be greater than 15 mSv (whole body) or 150 mSv (extremity) Appropriate supervision, training and instruction Where provided, dosimetry is used to monitor exposure Good laboratory practice Appropriate records for source movements Disposal via appropriate authorised routes

15. Non-Ionising Radiation (excluding Lasers)

Hazard	Possible harm	Model Controls
		Key ref: Radiation Safety – Ionising and Non-ionising: UHSP/13/RADS/98
Work which involves non-ionising radiation. Non-ionising radiation can be split into two categories, i.e. optical radiation and electromagnetic fields	The risk from exposure to non-ionising radiation is dependant on the type of radiation and the exposure time and level The level of harm can range from insignificant to major	The controls in place are dependant on the type of non-ionising radiation and potential exposure time and levels. Exposure to non-ionising radiation should be kept as low as reasonably practicable. Engineering and administrative controls should be used to limit exposure. Personal protective equipment may be appropriate were necessary. University policy/guidance exists and copies should be available
Optical radiation - Ultraviolet radiation Potential sources: UV lamps/equipment, electric arc welding, tanning equipment, tungsten halogen lamps and the sun	Short term effects are to the eyes (arc eye) and reddening of the skin (erythema) Longer term effects include skin cancer and cataracts	To eliminate or reduce as low as reasonably practicable the exposure levels below international guidelines Where necessary, the use of correct Personal Protective Equipment (e.g. eyewear, visors and appropriate clothing)
Optical radiation - Visible light Potential sources include power light sources and welding	Short term bright light can injure the eye Long term exposure can cause degradation of the retina	To eliminate or reduce as low as reasonably practicable the exposure levels below international guidelines Where necessary, the use of correct Personal Protective Equipment (e.g. eyewear or visors)
Optical radiation - Infra red radiation Potential sources include molten materials, welding arcs, hot surfaces and IR lamps	Short term effects are skin burns Long term effects include cataracts	To eliminate or reduce as low as reasonably practicable the exposure levels below international guidelines Where necessary, the use of correct Personal Protective Equipment (e.g. eyewear, visors and appropriate clothing)
Electromagnetic radiation - Microwaves Potential sources include ovens, communications systems and radar	Microwave energy can be absorbed at the body surface including the eyes causing cataracts Overheating of materials in ovens may lead to possible contact burns, fire or even explosion	To eliminate or reduce as low as reasonably practicable the exposure levels below NRPB guidelines. For ovens: doors, catches and seals need to be checked for damage. Seals are to be kept clean. Instructions for proper use should be available Where necessary, restriction of access or barriers may be required for other types of equipment. Radiation/fields may be required to be measured. Appropriate controls will the need to be detailed in local rules for work. Warning notices may need to be displayed
Electromagnetic radiation - Radio frequency (RF) Potential sources include PVC welding equipment, RF transmitters	Energy absorption by the body. Potential for internal (sub-surface) electrical burns in extreme cases Persons with cardiac pacemakers or implants may be at risk The level of harm is dependant on the frequency and exposure	To eliminate or reduce as low as reasonably practicable the exposure levels below NRPB guidelines Radiation/fields may be required to be measured. Appropriate controls will the need to be detailed in local rules for work. Warning notices may need to be displayed
Electromagnetic radiation - Static Fields Static electric fields. Static magnetic fields, e.g. powerful magnets	Static electric fields can result in harmless but momentary powerful shocks Very strong static magnetic fields can lead to biological effects, this is minimised by restricting the level of exposure Persons with cardiac pacemakers or implants may be at risk The level of harm ranges from insignificant to major	To eliminate or reduce as low as reasonably practicable the exposure levels below NRPB and international (ICNIRP) guidelines Radiation/fields may be required to be measured. Appropriate controls will the need to be detailed in local rules for work. Warning notices may need to be displayed

16. Non-Ionising Radiation (Lasers)

Hazard	Possible harm	Model Controls
Optical Hazard Lasers are classified on the basis of a maximum permissible exposure (MPE).	Damage to eye(s) or even loss of sight (exposure to Class 2 to 4). Additional hazard of damage to skin and fire with Class 4 lasers	Schools/Departments are required to keep an up to date list of all lasers which are classified as Class 2 and above. Class 1 Instruments, excluding CD players and laser printers, which contain a higher classification of laser which is accessible when the cover is removed should also be listed. Lasers should be appropriately labelled. Where necessary, usually where Class 3A lasers are used, written local rules should be available and persons receive training Key refs: Radiation Safety – Ionising and Non-ionising: UHSP/13/RADS/98 Safe Use of Lasers: GUIDANCE/18/SUL/01 CVCP Notes of Guidance Part 2:1 Lasers Revised 1992 BS EN 60825-1:1994
Associated hazards - Chemical/Fume Mechanical Electrical Cryogenic coolants Compressed gases Water cooling/Electricity combination	Depending on the associated hazard it can range from harmful to lethal.	To ensure that associated hazards are identified and the appropriate controls are in place, it is vital that a full and proper risk assessment is carried out on all potential hazards.

17. Classification of Lasers - Optical Hazards

Class	Scope of classification	Hazard
Class 1	Safe under reasonable foreseeable conditions of operation -low output power or safe by 'engineering design', i.e. the system is totally enclosed	Safe No hazard to eyes or skin
Class 2	Visible low power devices protection against which is afforded by blink aversion response (blink reflex 0.25 seconds) and turning the head away	Eye hazard, possible if eye exposed for more than 0.25 seconds No skin hazard
Class 3A	Visible and invisible low/medium power lasers. Protection may be given by natural aversion process, direct intrabeam viewing using optical aids may be hazardous	Eye hazard if viewing with optical aids. No skin hazard
Class 3B	Visible and invisible low/medium power lasers. Direct intrabeam viewing is always hazardous. Diffuse reflections from some lasers may be a hazard	Eye hazard. Possible eye hazard from diffuse reflections. No skin hazard.
Class 4	High power lasers. Specular and diffuse reflections are a hazard	Serious Eye hazard Skin hazard Fire hazard

18. Summary of Precautions for the Optical Radiation Hazard

Precaution	Class 1	Class 2	Class 3A	Class 3B	Class 4
Laser labels	Lasers should be labelled (there may sometimes be an exception for some Class 1)				
Beam Stop		Laser beam to be terminated at the end of its useful path			
Door signs			Warning signs on door should be displayed.		
Training			Appropriate instruction and training is required to be given		
Eye Protection			Required if engineering and administrative controls not practicable and MPE exceeded		
Protective Clothing				possibly for UV/IR	specific requirement
Remote Interlock				Laser operation interlocked to door or enclosure	
Key Control				Key control for authorised persons	
Emission Indicator				Indicates laser is energised (may be outside door)	
Beam Shutter				Shutter closed when beam is not needed	
Beam Enclosure				Beam enclosure, where necessary, to avoid against unintentional reflections	
Procedure for emergency eye examination				Instructions must be available locally so that any person exposed may be seen by a specialist within 24 hours of injury	

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