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## Department of Engineering – Risk Assessment

Ref No.

<b>Title of project/experiment/activity</b> <b>Supervised Undergraduate Use of Laser Cutters (Dyson Centre for Engineering Design)</b> (Two separate document will likely be submitted in the future [1] concerning unsupervised undergraduate use of same; and [2] any servicing procedures beyond simple oiling and dirt removal, i.e. those which require the unit to be switched on, or require hatches to be unlocked.)			
<b>Location of activity</b> Dyson Centre for Engineering Design		<b>Start and end dates</b> Ongoing from signature dates on rear of form	
<b>Brief description (or attach procedure/protocol)</b>  Use of a pair of <a href="#">HPC Laser Ltd, LS 6090 PRO Laser engraving and cutting machines</a> (the 80 Watt laser tube version) by undergraduates, supervised by one of six people trained by a representative of HPC Laser Ltd, to cut and engrave a range of permitted materials.  The seven trained people are: Diana Thomas-McEwen (Dyson Centre Technicain), Richard Roebuck (Dyson Centre Manager), Barny Coles* (Lab Manager), Jeremy Penfold* (Technician), Kevin Bullman* (Technician), Matt Stewart* (Apprentice Technician), Adam Greig (Postgraduate student undertaking PhD). All were trained by the HPC representative in normal use of the machine. All bar Adam Greig were also trained in the weekly and monthly routine servicing of the machine (annual servicing will be carried out by HPC).  Four keys are available for the machines (each key can turn on the power for either machine) and these keys will be retained between the six trained people listed above.  A Safe System of Work for this activity has also been written, and is attached to the rear of this document.			
Hazard	Effect	Control measures	Residual risk
Exposure to invisible 80 Watt laser beam	Burns, cuts (and effects resulting from), blindness	<ul style="list-style-type: none"><li>• Keep all hatches locks – hatch keys secured away and controlled by one person (Centre Manager).</li><li>• Check hatches secure before turning power on.</li><li>• Check machine, including lid, for damage before turning power on.</li><li>• Interlock should turn off invisible laser beam when lid is lifted (though doesn't stop cutting head moving side-to-side and front-to-back).</li><li>• Press "Pause" or "Stop" before lifting lid, even in the event of an emergency (i.e. fire starting in machine).</li><li>• Test lid interlock functions by periodic checking that observed cutting stops when lid is lifted (no hands should be placed into the machine during this test). Suggest undertaken during weekly maintenance of machine, whilst wearing laser goggles suitable for protection against 10.6 micron lasers.</li></ul>	These control measures should remove this potential hazard.

Hazard	Effect	Control measures	Residual risk
<p>Entrapment of hand or arm by moving cutting head.</p> <p>Note: operations which require the placing of fingers, hand/s, arm/s in its path:</p> <ol style="list-style-type: none"> <li>1. Inserting sheet to be cut.</li> <li>2. Adjusting height of cutting head.</li> <li>3. Removing cut sheet and pieces.</li> </ol> <p>When extinguishing a flame (no need to be in cutting heads path in this instance).</p>	<p>Crush injuries – likely severity unknown as force available from drive mechanism is unknown – though it is capable of relatively high rates of acceleration.</p>	<ul style="list-style-type: none"> <li>• Always pause the movement of the cutting head before lifting the lid of the machine, if it is part way through a cutting operation (the interlock on the lid will turn the lid off, but the pause button need to be pressed to stop the cutting head moving).</li> <li>• Only have one person operating the machine at any one time, to prevent one operator unpausing the machine whilst the other has the lid lifted.</li> <li>• Don't place hands or arms in the potential path of the cutting head unnecessarily – it should only be necessary when initially inserting and finally removing materials and when setting the cutting head height.</li> <li>• Take care to not push the wrong button whilst setting the cutting head height (ie pressing "Test" will move the cutting head side-to-side and/or front-to-back, when the user should have only been pressing "Up" and/or "Down" to slowly raise or lower the bed).</li> <li>• Use a cutting head height gauge which avoids having to place any body parts in the way of the potential path of the cutting head.</li> </ul>	<p>If the control measures are observed, residual risk of injury comes from operator error or machine malfunction.</p> <p>It may be possible to make a cover to prevent the wrong button being pressed, though it is suspected that the cover would frequently be disregarded, though may be worth pursuing.</p>
<p>Complications when extinguishing flames caused by laser locally heating up material being cut.</p>	<p>Risk of burns.</p>	<ul style="list-style-type: none"> <li>• Don't cut highly flammable materials (e.g. tissue paper).</li> <li>• Don't leave the machine unattended and always watch for flames developing.</li> <li>• When cutting plastic/wood, only small flames are likely, and those which don't auto-extinguish should be blown out manually by pausing the machine and lifting the lid first.</li> <li>• When cutting card, care should be taken to sensibly minimise the rate at which energy is put into the material to avoid risk of fire.</li> <li>• When blowing out flames, care should be taken to avoid getting dangerously close.</li> <li>• Flames which are too large shouldn't be tackled, and the last resort fire extinguisher should be used.</li> </ul>	<p>Residual risk comes from operator still getting close to flames or tackling flames which are too large, or cutting prohibited materials (either accidentally or deliberately).</p>

Hazard	Effect	Control measures	Residual risk
Fumes from materials being cut.	Poisoning/gassing from fumes.	<p>Ensure fume filter is running at sufficient feed to draw visible emissions from cutting to back of laser cutting machine and to avoid smells emanating from the laser cutting machine – it is recommended that at least three lights are list on the fume filter (number of lights indicates extraction rate).</p> <p>The system should refuse to run if the filters are clogged.</p> <p>If the operator starts to feel unwell, or become aware of smells in the atmosphere around the machine, they should stop the machine immediately.</p> <p>Materials which produce dangerous/damaging fumes should never be cut on the machine.</p>	Residual risk remains from failure of machine safeguards, operator error, or operator cutting prohibited materials (either accidentally or deliberately).
Presence of water based cooling systems in a 240V electrical machine.	Risk of electrocution from water making contact with live circuits and operator.	<p>Machine presence in a lab with RCDs (Residual Current Devices) fitted on all electrical circuits.</p> <p>Operator should not interact with the water container with the power switched on.</p> <p>Power should be turned off immediately if any water is spotted leaking from the machine, taking care not to pass through any water on the floor.</p> <p>If the power off can't be reached, help should be summoned to the area, without leaving the area unguarded.</p>	With the exception of freak occurrences, the control measures to the left are felt to remove the hazard.

**Personal Protective Equipment required** [*eye/face protection, respiratory protection, gloves, lab coat etc*]

According to the training provided by HPC Laser Ltd, no PPE is required. However, we are considering the purchase of some laser goggles suitable for protection against lasers of 10.6micron wavelength.

**Emergency Instructions & First Aid**

Emergency instructions relating to fire are detailed in the Safe System of Work.

In the case of first aid being required, normal procedures should be adopted, re burns, seeking a first aider if necessary, etc.

<p><b>Any special monitoring required</b> [e.g. hearing test, vibration monitoring, health surveillance]</p> <p>No such monitoring is felt to be required – see Safe System of Work for suggested details for operation</p>
<p><b>Further control measures required? If yes, list with actions.</b></p> <p>Please see Safe System of Work for details of control measures.</p>
<p><b>Biological/Laser/Radiation Approval</b> [requires relevant Specialist Safety Officer signature and date]</p> <p>Laser cutter hence involving the Department’s Laser Safety Officer in Health and Safety paperwork and process.</p>
<p><b>Out of hours/Lone working</b></p> <p>Out of normal departmental hours working may be possible, as, of those trained, the Dyson Centre Manager does not have a fixed hours contract and is frequently present till later into the evenings on week days and sometimes attends the department during the weekend; additionally Adam Greig is a PhD student and also works outside of standard departmental hours.</p> <p>Lone working involving equipment, tools, etc. in the Dyson Centre is not allowed – people are suggested to always work in threes as a minimum: if one gets injured, then one person can assist them and the third person can guide help to them from the front of the building.</p>

Signature to confirm that this is a suitable and sufficient assessment of risk and that stated control measures are in place. This risk assessment should be reviewed if additional risks not covered in this assessment are identified or if there is any reason to indicate that the control measures are insufficient.

**THE FOLLOWING LIST OF SIGNATORIES HAS BEEN MODIFIED, AS THE STANDARD LIST OF ASSESSOR, NAME OF SUPERVISOR, LOCAL SAFETY COORDINATOR AND DEPARTMENTAL SAFETY OFFICER WAS NOT FELT TO BE A GOOD FIT WITH DIVISION W’S STRUCTURE OR THE PLANNED ACTIVITY.**

<p><b>Dr Richard Roebuck (Assessor):</b>  <b>Manager of the Dyson Centre</b>                  Email: <a href="mailto:rlr20@cam.ac.uk">rlr20@cam.ac.uk</a></p>	<p><b>Signature/Digital-Signature</b></p>	<p><b>Date</b></p>
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