Technology: Risk Assessment Title: PCB Etching/Processing OCTOBER2015

**This is a generic Risk Assessment that must be modified to suit your place of work**. The Risk Assessment modifications should take into consideration the activity, age/stage/pupil ability, department/working environment and the experience of the teacher in charge. If Control Measures Required as described are implemented the risk is reduced to an acceptable level for mainstream students.

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| **Identify the Hazards** | **Who is at Risk?** | **What is the Harm?** | **Activity Taking Place** | **Control Measures Required** | **Additional Information** |
| **Employees and learners should be made aware of the following hazards.**  Ferric Chloride  [iron (III) chloride]  1. Irritant  Sodium Persulfate  1. Irritant  2. Toxic Chlorine Gas  3. Chemical Tank Spill | Technology teachers, technicians and pupils  Technology teachers, technicians and pupils  Technology teachers, technicians and pupils  Technology teachers, technicians and pupils | **Ferric chloride [iron (III) chloride] is irritant and harmful.**  **Sodium Persulfate is an oxidizing agent and an irritant.**  **Ferric Chloride and Sodium Persulfate produce toxic Chlorine Gas when mixed together**  **Chemical spills can happen due to unstable tanks or containers.** | Electric circuit board etching  Electric circuit board etching  Mixing different types of chemicals in order to produce an etched copper product (PCB)  Storing chemicals in tanks or containers | **Mixing ferric chloride with sodium persulfate should be avoided as toxic chlorine gas will be released.**  SSERC/CLEAPPS recommends that the two chemicals should not be available together in a Design and Technology department.  Proper control measures should be applied to the use of chemicals in schools and similar establishments to minimise hazards.  Appropriate PPE should be provided and used by teachers, technicians and pupils.  Only sufficient amounts of chemicals required for immediate use should be kept in the work area.  Suitable eye protection PPE, conforming to BS EN 166:2002 3, and protective gloves should be used when preparing Ferric Chloride [iron (III) chloride] solutions and emptying tanks. Skin contact should be avoided. If skin contact occurs, the solution should be washed off with plenty of water immediately.  If etching is carried out in bubble tanks, the lids should be fitted to contain any mist within.  Suitable eye protection PPE, conforming to BS EN 166:2002 3, and protective gloves should be used when preparing and disposing of Sodium Persulfate solutions.  Crystals should be kept away from combustible materials and sources of heat. Solutions should not be stored in airtight containers as oxygen is released.  When emptying tanks, suitable eye protection and protective gloves should be used. Skin contact should be avoided. If skin contact occurs, the solution should be washed off with plenty of water.  If etching is carried out in bubble tank, the lids should be fitted to contain any mist.  Ferric Chloride and Sodium Persulfate perform a similar etching task. These solutions should never be mixed as toxic chlorine gas is produced on mixing. It is highly recommended that only one of the chemicals is ever used and the two chemicals should not be available together in a Technology department.  As a general rule, if chemical etching is required within a school department, only one type of etchant should ever be made available (no mixing should taking place.)  Alternate PCB production methods are suggested /highly recommended in order to avoid the use of a chemical etchant.  CAD/CAM systems use CAD in the design process and then either a printer or vinyl cutter is used to produce copper foil ‘sticky’ backed material for placing onto a suitable substrate (acrylic, card, etc).  Alternatively, tracks may be engraved as part of the CAM process, which also includes the drilling of holes directly onto PCB material.  **Hydrofluoric Acid is not recommended for any school activities.**  Tanks should be stable on a secure flat surface throughout the PCB etching process. Additional base boards may be attached, or the tanks may be contained within a suitable frame to ensure chemical spills do not occur.  Chemical tanks should not be moved when chemicals are inside.  Preparing the solution  Wear goggles BS EN 166:2002 (3) and gloves. To make 100cm3, add 50g of Iron III chloride (ferric chloride) to 50 cm3 of hot water (tap-hot 50C). Stir until dissolved and then top up with more water to 100 cm3.  CLEAPSS recipe suggests 20g of Iron III chloride (ferric chloride) in 100 cm3 of 2.5M hydrochloric acid (20 cm3 concentrated acid + 80 cm3 water).  Etching  Wear goggles BS EN 166:2002 (3) and gloves. Place the pre-prepared board in a small tray/tank, floating in another tray of water at around 40 - 45°C. Add the etching solution and rock gently to ensure the solution flows evenly over the board. It should be fully etched in 5 - 8 minutes (depending on temperature etc.)  Finishing  Remove the etch-resistant design with an appropriate solvent (probably propanone and inspect the finished product.)  Disposal  Wear goggles BS EN166:2002 (3) and gloves. Pour the solution into a large beaker. Add hydrated sodium carbonate (solid) a bit at a time until there is no more fizzing. (For 50g of Iron III chloride (ferric chloride), you will probably need around 75g of sodium carbonate). Pour the resultant solution into a bucket or other container and leave to form slurry of rust.  This can be then washed to waste with plenty of cold running water (do not let it sit in the sink as it will stain). Alternatively, the solid from of the slurry can be left to settle and then scooped out into a plastic bag which can then go in the normal waste. | All chemicals should be handled with care. Up to date information on chemical hazards should be retained and used. Employees and learners should be made aware of the hazards associated with chemicals. Warning labels on chemical bottles, chemical supplier’s hazard data sheets and model risk assessments from CLEAPPS or SSERC should also be regularly consulted, and risk assessments made specific to the department.  Reference BS 4163:2014  http://www.sserc.org.uk/index.php/o-to-p183/597-peroxodisulphatesvi  Guidance on disposal of used solutions is available from SSERC.  Warning labels must be clearly displayed on any bottles or containers used to contain chemicals or mixes.  Guidance on disposal of used solutions is available from SSERC.  Warning labels must be clearly displayed on any bottles or containers used.  An etching chemical requires storage in a well ventilated and secure room.  Ferric Chloride and Sodium Persulfate are very harmful if swallowed. Seek immediate medical attention if this occurs.  Damp sodium peroxodisulfate releases oxygen slowly (fire risk.)  Disposable gloves should be used with sensitive or cut skin.  Plastic tongs should be used with wet boards  Tank emptying – siphon pump recommended. Tanks must be completely cleaned before switching to a different etching chemical.  Technology departments should also seek advice and assistance from the school Science department as they are commonly a source of experience and safe practice.  Technique – boards are immersed in an chemical etching solution  <http://www.sserc.org.uk/index.php/chemistry/hazardous-chemicals276/uses277/i-to-k/814-iron-compounds99#Fe10>  <http://www.sserc.org.uk/index.php/chemistry-health-a-safety138/background-info208/banned-restricted-chemicals/sserc-restricted>  **If any further help/advice is required contact SSERC on 01383 626070** |
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