

Health, Safety and Environment (HSE)

Carbon fibre information sheet

This information sheet is to provide advice on managing risks associated with working with carbon fibre.

1. About Carbon Fibre

Carbon fibres are man-made fibres of high carbon content formed from an organic precursor. Carbon fibres are chemically inert, heat resistant, have high electrical conductivity and high tensile strength. This information sheet does not cover carbon nanotubes, refer to [UNSW Working with nanomaterials guideline](#).

2. Hazards

Carbon fibre doesn't pose a risk when in a dry fabric form or when cured in a resin matrix. However, some tasks may release airborne fibres. Where possible, eliminate work with carbon fibre that will release fibres, or substitute it for another material. If this is not possible, then workers need to be aware of the following hazards and control strategies:

2.1 Dust exposure

Carbon fibres can become a fine dust released into the atmosphere during cutting, machining or mechanical finishing. These fibres may irritate the skin or mucous members, such as eyes and lungs. Carbon fibre dust generally has a diameter of 6-10 μ m and length 37.5 μ m. If they spilt length-ways during machining they could produce fibres <5 μ m.

There is no Australian Workplace Exposure Limit for carbon fibre. Where there is no exposure standard and the substance is both of inherently low toxicity and free from toxic impurities, exposure to dusts should be maintained below 10 mg/m³, measured as inhalable dust (8-hour TWA).

2.2 Chemical exposure

Carbon fibres are often coated with a substance that may be hazardous, for example epoxy resin. The solvents used in the coating may be volatile, flammable, and known to be an irritant. The binding material that holds the carbon fibres together and coats their surface may be an important determinant of the cytotoxicity. Follow the advice in the Safety Data Sheet (SDS) for the relevant substance.

2.3 Electrical

Carbon fibres are electrically conductive, therefore sealed or air-purged equipment should be used when processing or machining carbon fibre. If the dust reaches electrical components, short circuits or electric shock may occur.

Surrounding equipment should be covered to prevent exposure. Dust proof outlets should be used in areas where carbon fibre dust may be generated.

2.4 Machine damage

Dust generated from machining carbon fibre may enter the equipment and cause damage. The dust can penetrate small spaces, prolonged contact with the abrasive dust, especially with any moving parts (such as bearings, ball screws) can lead to wear and tear of the equipment.

3 General work practices

- 3.1 Write a local Risk Management Form (RMF) for the task.
- 3.2 Identify the hazards and controls based on the type of work carried out. For example, are you cutting or grinding.
- 3.3 Review the Safety Data Sheet (SDS) from the supplier and follow recommended precautions.
- 3.4 Provide engineering controls, such as local exhaust ventilation (LEV).
- 3.5 Rotate workers to reduce time working with the hazard.
- 3.6 Restrict access to work areas handling the hazard to only essential workers.
- 3.7 Provide Personal Protective Equipment (PPE) based on the type of hazard.

4 Specific work practices

4.1 Handling only

- 4.1.1 Fully cured carbon fibre is considered chemically inert and direct exposure does not pose a threat. However, work gloves should be worn if the ends may be sharp or there may be splinters on unfinished/rough material.

4.2 Sanding/grinding

- 4.2.1 Machining generates significant amounts of airborne dust and fumes and must be avoided or extracted to reduce exposure. The suggestions here need to be considered and applied where possible for your application.
- 4.2.2 It is best to capture aerosols at the point of generation preventing release into the air.
- 4.2.3 Total tool enclosure provides the highest level of control.
- 4.2.4 Wet cutting significantly reduces generation of airborne dust, and should be used where possible.
- 4.2.5 When machining, use local exhaust ventilation that is attached to a high-vacuum dust collection system. For example, shroud, hood, suction nozzle. High-vacuum dust collection systems create a negative pressure at the extraction point, capturing the majority of dust in the worker's breathing zone.
- 4.2.6 Reduce the cutting speed while maintaining the feed constant significantly reduces dust emission.
- 4.2.7 Choose tools with fewer cutting edges/teeth, these produce coarser and less harmful dust.
- 4.2.8 Choose non-powered tools.
- 4.2.9 Avoid excessive heating during sanding/grinding to reduce hazardous dust.
- 4.2.10 If the composite fibres are aligned in one direction (not randomly aligned), cut parallel to the fibre axis, so as to reduce the likelihood of smaller dust particles.

- 4.2.11 Keep work area clean with regular wet cleaning or HEPA filter vacuuming.
- 4.2.12 HEPA Filter Classification indicates there are four performance grades of filters: Grade 1 (lowest protection) – 4 (highest protection). The grade needed will depend on the risk.
- 4.2.13 Have hand wash and eye wash stations available.

4.3 Laser cutting

- 4.3.1 Dust generated is more likely to be respirable during laser cutting, due to the heat.
- 4.3.2 Gaseous compounds may also be emitted during laser cutting.
- 4.3.3 Most of the aerosol emissions occur at the bottom of the workpiece. This may be the most effective position for local exhaust air extraction to be positioned.
- 4.3.4 Reduce the temperature at the cutting front. Reduce beam power, increase traverse speed.

4.4 Burning/furnace

- 4.4.1 During burning carbon fibre dust could become thin and long. Respirable dust is likely to be generated during any heating process, therefore good engineering controls are needed. High-protection PPE may also be needed (refer to section 5).

5 Personal Protective Equipment (PPE)

- 5.1 The level of PPE needed will depend on the task being carried out and the level of control measures already in place to reduce the amount of dust in the atmosphere.
- 5.2 All clean PPE must be kept separate from the work area, for example in a cupboard. If re-useable PPE is used, wipe it down with wet-wipe after each use. Never leave PPE in the work area where dust may gather on it.
- 5.3 PPE types:
 - 5.3.1 Hand protection: If you are handling only then wear work gloves. Otherwise wear disposable Nitrile gloves. If there are resins involved refer to the Safety Data Sheet for specific glove advice.
 - 5.3.2 Body protection: A lab coat with elastic cuffs should be worn as a minimum. In particularly dusty atmospheres disposable over coat or full Tyvek body suit and disposable foot covers may be needed.
 - 5.3.3 Eye protection: Standard safety glasses can be used for most operations. Enclosed goggles should be worn when machining.
 - 5.3.4 Respiratory protection: If it is only carbon fibre dust is generated then P2 particle respirator is recommended. If other gases or fumes could be generated then a P2 or P3 combined particle and vapour respirator is recommended.

Image 1. Work gloves example



6 Waste disposal

- 6.1 Never incinerate carbon fibre waste.
- 6.2 Dry fibres and cured laminates should be double bagged and put in a waste bin that that is designated for landfill.
- 6.3 Where un-cured epoxy resins may be present (an environmental hazard), these should be collected as chemical waste (solid or liquid, depending on the form) and disposed of using UNSW chemical waste stream.
- 6.4 Dust waste collection has the possibility of dust exposure, follow the manufacturer's guidance on how to safely remove collected dust and dispose of as above.

7 Emergency management

- 7.1 Spills: Dry fabric form can be handled normally, wear work gloves if there are sharp edges. A spill of dust must be handled with disposable PPE, as outlined in the PPE section above.
- 7.2 First aid: Make use of hand wash and eye wash (flush eyes for at least 15 minutes).
- 7.3 Fire: An electrical fire is most likely due to the damage carbon fibre dust can do to electrical components. Ensure there is a powder or carbon dioxide extinguisher near-by, only fight a fire if trained to do so.