



Reducing the risk of fire or explosion during the manufacture of fibre-reinforced plastic (FRP) products

Plastics Processing Sheet No 15

Introduction

This information sheet was produced by the Health and Safety Executive (HSE) in consultation with the Plastics Processors' Health and Safety Liaison Committee (PPHSLC). The Committee includes HSE and representatives of employers and employees in the plastics industry.

This sheet is one of a series dealing with hazards in specific processes in the plastics industry. It covers the control of fire and explosion hazards in fibre laminating and can be used to help you carry out risk assessments and decide what control measures are needed to comply with the law.

It does not deal with the health hazards associated with exposure to styrene from the laminating process itself (see Plastics Processing Sheet PPS14 *Assessing and controlling styrene levels during contact moulding of fibre-reinforced plastic (FRP) products*¹) or health hazards from other materials such as catalysts and accelerators. Additional useful information on the various substances can be found in the Material Safety Data Sheets available from suppliers on request.

Hazards

In any laminating workshop, there are a number of materials which pose a significant fire risk and, given the correct circumstances, the risk of an explosion:

- Catalysts often contain peroxides. Peroxides can autodecompose to generate large amounts of heat, and under certain circumstances can also auto-ignite. They contain 'free' oxygen so can burn intensely even in the absence of air. A small fire can therefore rapidly get out of control and is difficult to fight.
 - Most resins are pre-accelerated, but if you add your own accelerator, it is usually supplied in a solvent carrier such as toluene which is highly flammable.
 - Styrene and acetone have low flashpoints and therefore present a significant fire risk if not properly controlled. Acetone is a greater hazard than styrene because it ignites more easily. Any flammable material ignited in a confined space can cause an explosion. Explosive atmospheres can exist during routine activities if the workspace is not adequately ventilated.
 - Dust released during trimming of mouldings is combustible. A 'cloud' of combustible dust can also cause an explosion if ignited.
- There are five general principles for ensuring that the risks of fire and explosion from the storage of flammable liquids in containers are controlled and minimised:
- Ventilation - Is there plenty of fresh air where containers are stored?
 - Ignition - Have all the ignition sources been removed from the storage area?
 - Containment - Are the flammable liquids stored in suitable containers? Can any spillage be contained?
 - Exchange - Can you exchange a flammable liquid for a less flammable one?
 - Separation - Are flammable liquids stored well away from other processes and general storage areas?

Control measures

Table 1 Control measures for preventing a fire or explosion in fibre laminating

<i>Material</i>	<i>Category</i>	<i>Storage control measures</i>	<i>Control measures during use</i>	<i>Ignition sources</i>	<i>Spillage, recovery and disposal</i>
Catalysts (eg methyl ethyl ketone peroxide)	Oxidising agent	Keep quantity to the minimum possible (1 x 30 kg carboy). Store separately from other flammables (eg acetone, resins)* and accelerators.	Use a small proprietary dropper-type container for liquids. Use in mixing area only. Remove to store immediately after laminating. Inspect containers for seepage. Close storage containers immediately after use. Keep spatulas, jugs, ladles etc free from contamination.	Keep away from cardboard, paper and any other material that will burn.	Use polythene sheet or 3 mm embossed polypropylene sheet as a floor covering, or hardboard if polythene introduces a slip hazard. Remove spillages immediately (use sand or vermiculite, not natural organic materials such as paper or cloth). Do not put into skips containing cardboard, natural organic materials, or rusty drums (replace hardboard when contaminated).
Accelerators (eg cobalt in toluene solution)	Flammable	Store separately from catalysts, in fire-resistant store, suitably sited.**	Only trained, competent personnel to handle materials. Add accelerator to resin before catalyst is added. Use accelerator with as high a flashpoint as possible.	The areas close to the use or storage of flammable materials are classified into three 'zones'. ^{3, 5, 6, 7, 8} The type of electrical equipment that can be used within those zones is dependent on the category of zone. Zoning should be carried out by a competent person and electrical equipment should be selected as appropriate (see BS EN 60079-10: 2003). ⁹	Remove spillages immediately as above.
Acetone	Flammable	Store in the open air or in a suitable fire-resistant store.**	Use fully sealable lidded containers for brush soaking. Keep only the minimum amount needed for use. Return to the store after use. Static control measures - use earthing clips and suitable metal containers.	Smoking and other sources of ignition should be prohibited within the defined zones.	Store as for full drums until disposal due to vapour/air hazard (unless cleaned and emptied). Dispose of soaked rags in metal bins. Solvent recovery - acetone can undergo violent or explosive reactions with peroxides often found in catalysts. Never recover acetone into reclaimed catalyst containers. Use dedicated steel solvent recovery containers or 25 l steel tighthead drums (closed-top). Recovery should only be carried out by suitably trained personnel.

Maintaining control measures

When the control measures described in Table 1 are in place, you will need to maintain them. The following checks and frequencies are recommended when setting up such a system, although they can be amended and refined in the light of experience:

Daily checks

- Have all containers of resins, acetone, catalyst and accelerator been properly sealed and returned to the correct store after use?
- Have all spillages been removed and is there a sufficient supply of spillage absorber?

<i>Material</i>	<i>Category</i>	<i>Storage control measures</i>	<i>Control measures during use</i>	<i>Ignition sources</i>	<i>Spillage, recovery and disposal</i>
Resins containing styrene	Flammable	Store in the open air or in a suitably constructed and ventilated fire-resistant store.**	Keep only the minimum amount needed for use. Return to the store after use if practicable. Extract from confined areas (eg inside hulls) to prevent build-up. (NB extraction equipment must be flameproof (see BS EN 60079-10: 2003) ⁹ or of a suitable design). See PPS14 for more details on extraction.	Lay-up in booth/spraying in booth - see information on zoning opposite for selection of electrical equipment. Hand lay-up elsewhere - manage the work to avoid the need for zoning.†	Empty drums should be stored under the same conditions as full drums until disposal due to vapour/air hazard (unless properly cleaned and emptied). Empty drums should not be used as trestles/workstands.
Dust generated by trimming, drilling and sawing	Combustible	N/A	Design moulds to minimise the need for trimming. Use extracted trimming equipment and/or 'air benches' for small mouldings or a trimming booth for large mouldings over 2 m ² . Use low-dust trimming methods.††	Small amounts of trimming done occasionally (max 1 hour/day) - manage the work to avoid the need for zoning (see BS EN 50281-3: 2002 ¹⁰ and DSEAR Schedule 2 ⁸). Regular trimming (more than 1 hour/day and/or large mouldings) - electrical equipment suitable for use in explosive atmospheres with light fittings to IP54 (or fitted behind a sealed Georgian wired glass panel) and flameproof motors.	Vacuum cleaners used to remove dust from floors etc must be capable of operating safely in a flammable atmosphere. Brushing and air blowing of dust should be prohibited. Dust extraction units and vacuum cleaners should be emptied at regular and frequent intervals. Dust extraction units should be maintained in good working order to prevent expulsion of dust into the workplace/environment and fitted with explosion relief where necessary.

* Quantities of organic peroxide catalyst greater than 150 kg must be stored in a separate concrete bunker (bundled to contain 110% of the maximum stored quantity).²

** For full requirements for the storage and handling of flammable materials, see the 'References' section.^{3,4,5,6,7}

† The need for zoning can be avoided if laying up is not done directly beneath light fittings (at least 2 m from them) and is done at least 4 m from other sources of ignition such as electrical equipment. 'Safe zones' should be clearly marked out on floors and indicated as such. Plan drawings of defined zoned areas should be posted in working areas and also archived in the main office for reference.

†† Disc sanding will produce more dust than most other processes. In descending order of dustiness are disc sanding, sawing and cutting, drilling, and orbital sanding.

- Check dispenser bottles for damage and replace as necessary.
- Check brushes are not left in open containers, nor in containers that will spill easily if knocked over.
- Have all empty containers been returned to the correct store to await collection?
- Check there are no catalyst containers outside the mixing area.
- Check no work is being done outside the designated 'safe zone'.
- Check no catalyst containers have been put into general rubbish skips.

Monthly checks

- Are all stores properly marked up, properly used, and in good condition?
- Check dropper containers are not seeping.
- Check there is no inappropriate electrical equipment or other potential sources of ignition in zoned areas.
- Is extraction working properly on equipment to remove dust? (This is also a legal requirement if dust is a health hazard.¹¹)

Annual checks

- A competent person should check that electrical equipment seals are not damaged, and that flameproof gaps are being maintained.

References

- 1 *Assessing and controlling styrene levels during contact moulding of fibre-reinforced plastic (FRP) products* Plastics Processing Information Sheet PPS14 HSE Books 2003
- 2 *The storage and handling of organic peroxides* Chemical Safety Guidance Note CS21 HSE Books 1991 ISBN 0 7176 2403 X
- 3 *The storage of flammable liquids in containers* HSG51 (Second edition) HSE Books 1998 ISBN 0 7176 1471 9
- 4 *Chemical warehousing: The storage of packaged dangerous substances* HSG71 (Second edition) HSE Books 1998 ISBN 0 7176 1484 0
- 5 *Safe use and handling of flammable liquids* HSG140 HSE Books 1996 ISBN 0 7176 0967 7
- 6 *The storage of flammable liquids in tanks* HSG176 HSE Books 1998 ISBN 0 7176 1470 0
- 7 *The spraying of flammable liquids* HSG178 HSE Books 1998 ISBN 0 7176 1483 2
- 8 *The Dangerous Substances and Explosive Atmospheres Regulations 2002* (DSEAR) SI 2002/2776 ISBN 0 11 042957 5 (HSE guidance will be published later in 2003)

9 BS EN 60079-10: 2003 *Electrical apparatus for explosive gas atmospheres: Classification of hazardous areas*

10 BS EN 50281-3: 2002 *Electrical apparatus for use in the presence of combustible dust. Classification of areas where combustible dusts are or may be present*

11 *Control of substances hazardous to health. The Control of Substances Hazardous to Health Regulations 2002. Approved Code of Practice and guidance L5* (Fourth edition) HSE Books 2002 ISBN 0 7176 2534 6

12 *Safe handling of combustible dusts: Precautions against explosions* HSG103 (Second edition) HSE Books 2003 ISBN 0 7176 2726 8

Further information

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This leaflet contains notes on good practice which are not compulsory but which you may find helpful in considering what you need to do.

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