Recommendations

RC39

for fire risk management in the printing industry

Part 1: Printing processes: General principles

FPA
Fire Protection Association

InFiReS

LOSS PREVENTION RECOMMENDATIONS

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CONTENTS

SCOPE

These recommendations provide guidance on the prevention of fire and the mitigation of the effects of fire in printing processes; the document does not consider other hazards, such as trimming, gluing and binding, that follow this process. The document is intended for use by insurance surveyors and managers and others responsible for fire risk management in printing works and in other establishments in which printing processes are carried out.

The document does not apply to the use or storage of aerosol products or spraying, for which more specific guidance is available (see refs. 1, 2 and 3).

Legislation may impose requirements additional to the provisions contained in this document. Due regard should also be given to considerations of environmental protection (see refs. 4 to 7).

The guidance set out here should be taken into consideration when risk assessments are carried out in compliance with the Regulatory Reform (Fire Safety) Order 2005 (and the equivalent legislation in Scotland and Northern Ireland (refs. 8 to 11)) and the Dangerous Substances and Explosive Atmospheres Regulations (DSEAR) 2002 (ref. 12).

SYNOPSIS

These recommendations describe some of the more common printing processes and the hazards associated with them. Advice is set out to minimise the hazards by: storing flammable solvents and combustible materials safely, training staff, and maintaining good housekeeping practices. Recommendations include features to minimise disruption to the business in case of fire. These should be noted when carrying out a fire risk assessment.

DEFINITIONS

Blanket wash

Part of the offset lithographic printing process involves an intermediate stage where the print is transferred onto a composite of a fabric and a rubber facing (compressible versions containing an air layer). These fabric carcasses are laminated using a rubber adhesive. To maintain the quality of the print it is necessary to clean or wash this 'blanket' frequently. The solvent used for this purpose is referred to as blanket wash. Automatic blanket washing is now commonly encountered because it reduces wash time and limits the quantity of wash solution necessary for the operation.

Classification of hazardous areas (DSEAR (ref. 12) and BS EN 60079-10: 2003 (ref. 13))

(This classification refers to areas in which open processes are carried out. Areas in which closed processes are undertaken should be subject to a risk assessment.)

Zone 0: An area in which an explosive gas atmosphere is present continuously or for long periods.

Zone 1: An area in which an explosive gas atmosphere is likely to occur in normal operation.

Zone 2: An area in which an explosive gas atmosphere is not likely to occur in normal operation and, if it does occur, is likely to do so only infrequently and will exist for a short period only.

Flammable liquid

A liquid as defined for highly flammable liquid (see below) but with a flashpoint up to 55°C.

Highly flammable liquid

The definition of a 'highly flammable liquid' in the Fire Certificates (Special Premises) Regulations 1976 (since revoked by the Regulatory Reform (Fire Safety) Order 2005) has been amended in the Dangerous Substances and Explosive Atmospheres Regulations (DSEAR) 2002 (ref. 12) as follows:

'Highly Flammable Liquid' means any liquid, liquid solution, emulsion or suspension, other than aqueous ammonia, liquefied flammable gas, and liquefied petroleum gas which:

(a) when tested in accordance with Part A.9 of the Annex to the Directive has a flashpoint of less than 32°C; and

(b) when tested at 50°C using the procedure referred to in Appendix B to the 'Approved requirements and test methods for the classification and packaging of dangerous goods for carriage' (ref. 14) with a heating time of 60 seconds supports combustion.

Thermal oxidation

Thermal oxidation is the process whereby solvent vapours evaporated from ink solutions in the drying sections of a printing press are converted into harmless gases by heating in an oxidation chamber.

INTRODUCTION

It is important for organisations to appreciate that the printing industry has always had to deal with significant fire hazards due to the nature of the materials involved. Large amounts of combustible paper or various forms of packaging are always present and highly flammable and flammable liquids are commonly used during the processes. As in most industries, however, the printing industry has been subject to major changes in technology. Some changes, such as the development of water-based and low-solvent inks have tended to reduce fire hazards, whereas others – such as the reliance on large, complex, high-value machines and computers – have increased the risk of major disruption to the normal course of business as a result of a fire. These recommendations are intended to provide guidance on reducing and managing these threats.

While many of the recommendations are directed towards large organisations they should also be considered for application in smaller businesses. (It is generally accepted that the majority of printing companies employ fewer than 40 staff.) The size and criticality of the business should be taken into consideration when assessing the need for sprinklers and other fire protection systems, some of which may be impractical in small operations. In a similar way, the provision of a dedicated flammable liquid store may also be unnecessary; the quantity of these products kept on site warranting the use of a fire-resistant flammable liquid cabinet for this purpose.

Despite the presence of flammable liquids and large quantities of combustible materials, good housekeeping and rigid compliance with accepted health and safety practices will reduce the risk of fire and the consequent threat to the survival of the business should an incident occur.

The potential for a fire will depend on the hazards associated with the process but the threat to the business will to a large extent depend on any loss of electronic data that will influence the organisation's database, communications and plant control facilities. Security of the electronic records is of paramount importance as the loss of these records in fire can be very detrimental to profitability and recovery. These issues are addressed in other recommendations in this series (ref. 15).

Fire hazards

Fire hazards in the printing industry include:

- highly flammable and flammable liquids;
- dusts;
- combustible materials, such as paper and packaging materials awaiting printing or having been printed;
- potential sources of ignition;
- lift trucks; and
- the printing process.

Highly flammable and flammable liquids

Although there has been significant movement away from the use of inks and solvents based on flammable liquids in favour of aqueous solutions, flammable liquids remain in use in the printing industry for many purposes. These include:

- as solvents for inks, for example: hexane, methylethylketone, acetone, propyl acetate, n-butyl alcohol, isopropanol;
- for cleaning, hydrocarbon-based solvents used as blanket wash – for example, ethylbenzene, methanol, toluene, xylenes. White spirit or paraffin are still in common use and alcohol-based solvents may also be used. The latter occurs in platemaking in offset and letterpress processes. There are three common types of automatic blanket washer units, using spray, brush and cloth techniques;
- for washing photopolymer plates in flexography and in screen-cleaning operations in screen printing – for example, perchloroethylene; and
- as inks: many of the inks used are now water-based, particularly if the substrate is paper. Substitutes for the common solvent-based inks include ultraviolet curable inks, electron beam inks and vegetable-based inks (such as soy oil). Where the substrate is plastic or a metal foil, flammable solvents with flashpoints in the 150° to 200°C range may be used; although these are not defined as flammable liquids they are included here as they are stored in tanks of up to 38m^3 in large plants such as newspaper production lines. These materials are not fluid but often have the consistency of molasses at normal temperatures.

Although the inks used in the letterpress and lithograph presses may present a relatively low fire hazard, high-speed printing on rotogravure presses and flexography presses requires the use of fast drying inks containing low flashpoint solvents (between -6°C and 50°C). These present a serious fire and explosion danger and can be ignited by sparks and static discharges. These hazards are particularly prevalent where drying tunnels are in operations, and these are fed by automatic blanket wash units.

Dusts

Anti-offset powder, used mainly in sheet-fed offset presses, is a very fine, non-toxic powder that is emitted from the final roller. This powder contains maize starch, calcium carbonate and tripolite. It normally settles on exposed surfaces in the pressroom. It is classified as a nuisance dust with a potential for dust explosion. In addition, it constitutes a potential health hazard, in particular chronic bronchitis.

Small clouds of dust from paper could ignite and explode and, in turn, cause further accumulated dusts to dislodge and result in an even more powerful secondary explosion. Dislodgment and explosion of accumulated dusts represent a significant safety hazard in the printing industry. In large folding and cutting units, dust may accumulate on horizontal surfaces, which is particularly dangerous in the event of fire. The dust explosion hazards should be considered as part of the DSEAR assessment.

Combustible materials

- *Paper and cardboard:* both as starting material and finished product, is the most significant combustible material likely to be present in a printing works. This may be present as bulk stores in reel form or as sheets. The tight rolling of the paper layers in reels and tight packing of sheets reduces the ignitability of this type of storage but once on fire, paper in reels (especially those stacked vertically) or sheets will make a significant contribution to the fuel load. Loose paper and damaged reels are more easily ignited and present an even greater hazard.
- *Non-paper-based print media:* paper is not the only substrate used to take print. Most plastics, particularly in the form of thin film, are also combustible, as is the rubber used in plate preparation. Other substrates include printed circuit boards, clothing and other textiles.
- *Packaging:* packaging materials usually also contain large proportions of paper, card and plastics, all of which are readily ignited and burn well.
- *Cleaning materials:* rags and cloths used in the cleaning processes present a hazard particularly if contaminated with flammable liquids or mineral oils. The hazard from mineral oils arises from the increased ignitability due to wick effects when dispersed on cloths or rags. Mineral oils do not self-heat to present a spontaneous ignition hazard as is the case with vegetable oils such as linseed oil; vegetable oils are not normally used in the printing industry.

  Some cleaning chemicals are oxidising chemicals and may react with combustible materials and produce heat.
- *Waste:* generally includes significant proportions of combustible material and dusts, some of which may be contaminated with flammable liquids.
- *Pallets:* are a particular form of waste material that are a common feature in printing premises and these require careful management to ensure that their numbers are minimised and that idle pallets are stored safely, at least 10m away from the buildings in which the printing processes and stored materials are housed.
- *Hydraulic fluids:* presses may have hydraulic systems such as those provided for the rewind turret and for the printing deck lock-up that brings the printing plate roll into contact with the substrate.
- *Anti-set-off sprays:* very small quantities of starch are used in this process and are consequently not viewed as a significant hazard.
- *Hydrocarbon-based lubricants:* although not readily ignited, these materials will make contribution to a fire, albeit only small quantities of up to 4 litres may be present to lubricate the bearings for drum and plate cylinders.
- *Metal powders:* such as aluminium, may be used in metallic inks or on decorative products, such as glitter on greetings cards. The use of unconfined powders may introduce an explosion hazard.

Potential sources of ignition

There are various potential ignition sources present in most industrial processes and these are also present in the printing industry. There are some potential ignition sources, however, that are particularly significant in the printing industry. Among these are the various drying processes that involve the application of heat to ink-bearing substrates. The substrate, such as paper or plastic, is almost always combustible and some inks may contain flammable solvents.

Static electricity is also a significant potential ignition source particularly associated with high-speed presses. The hazard will depend on the form of printing ink, the substrate, the nature of the process used and the operating parameters, such as the press speed.

Potential ignition sources that may be encountered in the printing industry therefore include:

- hot work, such as cutting, welding and brazing (see 7.1);

- faulty electrical wiring and equipment and the lack of maintenance (see 7.3).
- sparks and heat caused by friction – for example, from rotating machinery if poorly maintained (see 7.4);
- smoking (see 7.5);
- static electricity (see 7.6);
- drying processes (see 7.7); and
- arson.

Lift trucks

Although not part of the printing process, lift trucks may be in use in the premises and the impact of the hazards associated with the LPG gas cylinders, diesel fuel and battery charging areas must be taken into account during the fire risk assessment of the premises.

Further information is set out in RC11: *Recommendations for the use of fork lift trucks* (ref. 16)

Printing processes

In the printing industry there are various types of processes each with their own related fire risks:

- ***Lithography***

This is the most widely used printing process. In this process the image to be printed is represented on the printing plate by oleophillic (oil-attracting) and water repelling areas and the non-image areas of the plate are hydrophilic surfaces that readily accept water-based coating but repel the oil-based ink.

The usual form of this process is offset lithographic printing, but the terms planography and offset printing are also used. In this process, an intermediate surface, usually a fabric and rubber blanket supported on a metal cylinder is used. The blanket allows the print to be applied to a wide variety of substrates including metal and plastics. To maintain quality of print, the blanket is washed frequently using blanket wash solutions which are usually hydrocarbon-based liquids and moderately volatile and flammable.

A damping solution is applied to the plate and then the ink is applied. The damping applies the moisture that takes onto the non-print areas. Although water-based, damping solutions may contain alcohol, butyl cellusolve and glycol ethers.

The fire safety issues related to lithography are primarily those concerned with the use of flammable liquids for blanket washing, the use of alcohols and other substances in the damping solution and the combustible nature of the rubber blankets.

- ***Flexography***

This is may be sheet- or web-fed, using exposed flexible plates that are processed in an acid bath with raised images coming into contact with the substrate during printing. The plates can be used directly for letterpress or to mould a flexible plastics/rubber master. Alcohol inks are generally used. Flexography is used for medium to long multi-colour runs on heavy paper, fibreboard and metal and plastics foil. Typically packaging, food cartons and gift wraps are produced by this method.

Flexograph printing (also known as 'flexo' printing) can be potentially hazardous when low flashpoint inks are used. The hazard, however, may be less than that associated with rotogravure presses because of lower operating speeds.

- ***Letterpress printing***

This is older technology often being replaced with lithographic or flexographic processes. Similar to flexography, it uses metal or plastic raised plates (relief printing plates). Other forms of letterpresses include platen presses, flatbed cylinder presses, sheet or roll-fed (web) rotary and direct wraparound presses. Letterpress uses solvent-based (40% by volume), viscous, heatset inks, similar to lithographic printing. It is used for short runs to print books, business cards and stationery.

Hazards are often related to the fact that many presses are old, so leaking oil and grease presents a housekeeping problem. Paper dust from slitters is an added problem.

This plant is also often used for related processes such as embossing, die-cutting, numbering, perforating and foil stamping.

- ***Gravure printing***

Also known as rotogravure, an image is etched or electromechanically engraved into a cylinder surface. Newer methods of etching use computer assisted laser or electron-beam etching; generally web-fed presses with cylinders plated with copper. Normally, solvent-based inks are used. Inks are fluid and applied to the cylinder; the excess scraped off by a doctor blade. Hot air dryers are used to dry inks and solvents. Used for medium-quality jobs like catalogues, magazines and wallpapers.

Rotogravure presses are capable of working at speeds exceeding 600m/min. Colours are separately printed and dried so that printing units are arranged in series to complete a multi-colour run. On small presses, ink is manually applied by an operator at the top of the press. On larger presses, the lower part of the print cylinder rotates in an ink trough. Ink is circulated by a pump and solvent is added automatically to control the viscosity. The trough can contain more than 300 litres of ink. Drying is by hot air dryers and may include solvent recovery.

Fires can be frequent because of the flammable inks and the speed of the presses. Ink troughs are likely to be shielded from sprinkler water by the press itself.

The rotogravure press is a significant static electricity generator. Here, a rubber roll presses against a copper etched roll which revolves in heavy, volatile ink. Paper passes between the two rolls that are duplicated

for each colour. Pressroom humidification is used and a static eliminator covering the full width of the web at the delivery side of each impression roller is typical.

- *Digital printing*

Although many types of printing processes are now controlled to some extent by computers, digital printing is somewhat different in that it is printed output that is imaged onto a blanket, plate or substrate directly from an electronic file, there is no intermediate film stage. The device can vary text and images on a page-by-page basis.

There are three technologies for providing process colour digital print:

- *electrophotographic:* in which a dry or liquid toner is deposited on the substrate by varying its electrostatic properties and then fixed by absorption, chemical reaction or heat (used in xerographic photocopiers);
- *ink-jet based:* in which a special liquid ink is sprayed onto the substrate, or an intermediate blanket; and
- *di-litho:* which use a computer-to-plate device to image a plate on press and then print through a normal litho process.

Modern digital printing processes use toners rather than traditional ink formulations. Toners come in two forms – dry or liquid. Dry forms, as the name implies, do not have a liquid component and are based on fine powders. The liquid forms comprise a solid powder, providing the pigmentation, on a liquid carrier that is usually a hydrocarbon or polar solvent. Either form of solvent will be flammable.

- *Screen printing*

Also known as silk screen printing, the printing ink, coating or adhesive material is passed through a taut web or fabric to which a stencil that defines the image is applied. Inks used are determined by the substrate to be printed and will thus depend on whether textiles, plastics, metals or paper are involved. Inks are water based or solvent based and UV cured.

The washing solvents used in cleaning the screens can be volatile and because the inks have a high consistency, it is fairly common to have drying ovens connected to the press. The hazards presented are associated with flammable vapours in the presence of hot surfaces.

- *Other forms of printing*

Other forms of printing that may be encountered include:

- *reprography:* as in the case of photocopying machines, this process is based on the electrostatic transfer of toner to and from a charged photoconductor surface;
- *block printing:* this is similar to letterpress printing in that an engraved block is used to produce an impression either in ink or through metal foil or pigmented transfer. Inks are generally of high viscosity and may be oil- or water-based. Solvents for oil-based inks are white spirit based (a flammable liquid) but occasionally methylethyketone is used, this is highly flammable. The hazards associated with the process are thus the flammable solvents, spontaneous combustion of dirty wipes and accumulations of waste; and
- *perfector:* in this method paper is turned over during the colour printing process to allow printing (and associated drying measures) to be applied to both sides of the paper. Fires in this process have occurred as a result of the drying process and poor housekeeping. As the machines tend to be very large, claims are also usually very high.

RECOMMENDATIONS

1. Fire risk assessment

1.1 It is a statutory duty for the 'responsible person' to carry out a suitable and sufficient fire risk assessment in their workplace. This duty is set out in the Regulatory Reform (Fire Safety) Order 2005 (ref. 8). The main purpose of this assessment is to assess the risks to which relevant persons are exposed and to identify the general fire precautions that should be put in place to ensure the safety of employees (and, in respect of non-employees, ensure that the premises are safe).

1.2 The assessment should be reviewed if new printing methods are undertaken, new machinery is purchased, or changes are made to the processes in use. When new equipment is installed or there is a change to a hazardous area, then the verification process required by DSEAR should be observed. (Such changes may involve, for example, a change to digital printing from more conventional methods such as offset lithography.) Further advice is set out in refs. 17 and 18.

1.3 The fire risk assessment should be extended beyond the minimum legal requirement of life safety to include property protection. This aspect is considered in more detail in section 2 of this document.

1.4 The business fire risk assessment should identify plant that is essential to the business but may be unique or difficult to replace. Equipment of high intrinsic value should also be identified. An action plan should be prepared to reduce the risk of damage from fire to such equipment or installations. If necessary a suitable contingency plan should be prepared with measures taken such as the keeping of critical spare parts off site. Further guidance on the preparation of such a plan can be found in *Business resilience. A guide to protecting your business and its people* (ref. 15).

2. Identification and protection of high value plant and processes

2.1 Some printing equipment may be of high intrinsic value. Such equipment, together with any communication equipment that allows control of the processes from remote locations, should be identified and protected accordingly.

2.2 It is also important to identify essential equipment that – while not of high monetary value – would, if damaged by fire, seriously impair the operation of the business. For example, a machine may have unique features or there may be difficulties in sourcing replacement parts and this could, in the event of a fire, put the equipment out of use for a significant length of time causing severe disruption and loss of business. It is important to identify such equipment and protect it accordingly.

2.3 Similarly, most processes are controlled by computer or microprocessor-based systems which if damaged by fire would render a process inoperative. Although such control systems may be readily replaced, the impact of damage to such systems should be assessed.

2.4 Computer-based systems controlling processes should be assessed and protected in accordance with RC3-1: *Recommendations for loss prevention in electronic equipment installations: fire prevention* (ref. 19).

2.5 Duplicate software for computer-controlled systems should be kept securely off site.

2.6 Similarly, all records relating to customers, orders, process details and similar business critical information should be backed up routinely off site.

2.7 Printing machinery of high intrinsic value should be protected against fire spread from other areas.

2.8 If practical, high value equipment should be separated from other parts of the works by fire resisting elements of construction offering at least 120 minutes' fire resistance (insulation and integrity). Where services pass through the compartment wall, holes around cables and the like should be fire-stopped with suitable materials to maintain the integrity of the wall and to prevent the spread of smoke and hot gases. Further guidance is given in The *FPA Design Guide for the Fire Protection of Buildings* (ref. 20).

2.9 All ducting within the printing, solvent recovery and thermal oxidation areas should provide 60 minutes' fire resistance.

3. Storage of paper and other substrates

3.1 The general principle that should be applied is that storage areas should be separated from process areas.

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Vertical gaps between the reels and the holes in the centre of reels form chimneys that promote rapid vertical spread of fire

3.2 All buildings designated as stores for combustible materials should be of non-combustible construction. More guidance on the design of large storage areas is given in the FPA *Design Guide for the Fire Safety of Buildings: Warehouses and Storage Buildings 1: Design Principles* (ref. 21). The fire suppression measures to be provided in the facility will also depend on the weight and mode of storage of the paper (see 8.3).

3.3 It may be necessary to keep large volumes of combustible materials on site. Where this is unavoidable, such storage should be in designated, detached buildings away from the printing process.

3.4 If it is not practical to store large stocks of combustible materials in detached buildings, storage areas for combustible materials such as paper reels, paper sheets and packaging should be

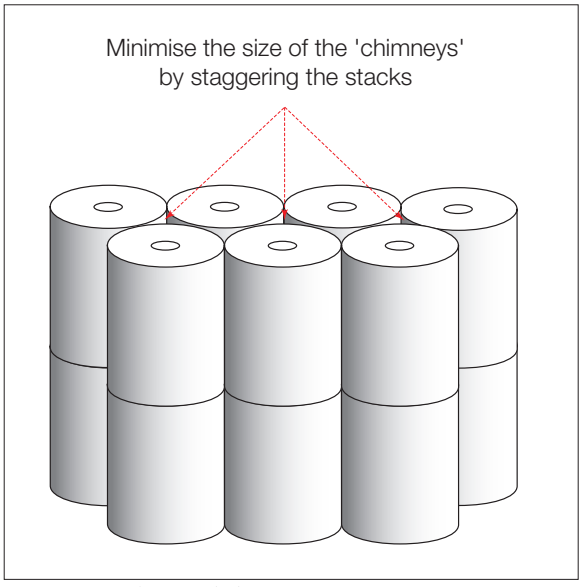

Figure 1: Stacking reeled paper

separated from process areas by compartment walls offering at least 120 minutes' fire resistance. As indicated above, holes around services passing through the compartment wall between the two areas should be fire-stopped with suitable materials to maintain the integrity of the wall and prevent the spread of smoke and hot gases.

3.5 Particular care is needed when bulk paper is stored in reels as the topology of stacked reels is such that vertical gaps between the reels and the holes in the centre of reels form chimneys that promote rapid vertical spread of fire with the heat plume velocities sufficient to preclude penetration of water from sprinkler systems.

The chimney effect can be reduced by staggering the stacks. A maximum spacing of 100mm will reduce the risk of reel peeling in the event of fire. A maximum spacing of 25mm between stacks will reduce the risk of a chimney effect developing in a fire. Close stacking, however, should only be put in place where the stacking and retrieval methods are suitable and prevent the dislodging of reels during stock movements.

3.6 Reel peeling spreads fire by reels unwinding ('peeling') under fire conditions. Wrapped roll paper tends to reduce the initial fire intensity with the paper taking on the fire development characteristics of the wrapper. Unwrapped reels should be stored horizontally and be bound to prevent the peeling of outer layers of paper.

3.7 Although on-end stacking of paper reels should be avoided where possible it is recognised that horizontal storage of reels is uncommon as it can cause damage (in the form of 'flats') to the reels. In these cases, the fire risk assessment may determine that storage be in a detached building (see 3.3 above) and/or a sprinkler system with fast response heads should be installed in order to automatically fight a fire at the earliest possible time (see section 8).

3.8 In order to prevent heat radiation and re-radiation between stacks that promotes intense fires, and also to facilitate the handling of the reels, suitable walkways for use by pedestrians and lift trucks should be provided in storage areas. To facilitate escape in case of fire, walkways should not have dead ends. Alternatively, stacks of reels should be separated by a fire-resisting structure.

3.9 Because of the likelihood of rapid fire spread within stacks of paper reels, offices and similar occupied inner rooms should not be provided in stores containing stacked reels of paper, unless an alternative exit (which does not pass through the reel store) is available from the inner room.

3.10 Ignition sources should, as far as possible, be eliminated from storage areas.

3.11 In all storage areas, gangways and aisles should be kept clear. In particular, escape routes must not be obstructed and access should be adequate for firefighting purposes.

3.12 Waste, damaged products, returns and similar items should be kept in separate areas, preferably outside in a designated compound at least 10m from any process or storage building. If this is not practical, then the separation recommendations in paragraph 4.7.1 should be applied.

4. Storage and use of flammable solvents

4.1 At the outset, attention should always be given to eliminating flammable and highly flammable liquids from the workplace wherever possible. Serious consideration should be given to the need for the use of such liquids in the process and the possibility of replacing them with non-combustible liquids as alternatives – or at least with those having a flashpoint above 55°C.

Despite efforts to replace flammable liquids it is recognised that at present not all may be eliminated and thus suitable provision needs to be made for the safe storage and use of necessary flammable solvents, blanket washes and inks.

4.2 Flammable liquids should be stored and handled in accordance with the advice set out in RC20-1: *Recommendations for fire safety in the storage and use of highly flammable and flammable liquids. General principles* (ref. 22). Flammable solvents and inks should be stored in purpose-built stores or flammable liquid cabinets as set out in RC20-2: *Storage in drums and containers other than fixed external tanks* (ref. 23).

4.3 Small containers of flammable liquids kept in the workplace should be stored in a purpose-built flammable liquid cabinet. Quantities of flammable liquids held in any working area should be kept to a minimum and be subject to a DSEAR risk assessment. In all cases, the volumes should not exceed the requirements for the day or shift being worked. The risk assessment must ensure that less than 50 litres of highly flammable liquid or 250 litres of flammable liquid are kept in the working area at any time.

4.4 Cupboards designed for the storage of flammable liquids should also be subject to a DSEAR risk assessment and:

- be constructed of non-combustible materials;
- have trays at each level to limit the spread of liquid should a spillage occur;

- have a sill at the lowest level to prevent spilled liquid leaking from the cupboard;
- be conspicuously signed to indicate the nature of their contents; and
- not contain incompatible materials that may react together if contamination, leakage or spillage occurs.

4.5 Drums and large containers of flammable liquids should be stored safely in the open air. Where this is not practical, owing to limitations of space or for reasons of security, small volumes suitable for the immediate work period may be kept in the workplace but larger quantities should be kept in suitable storage buildings (see ref. 22).

4.6 Where external storage is not possible, large containers of flammable liquids may be stored inside, preferably in a detached building.

4.6.1 Unless of fire-resisting construction, storage buildings should be located not less than 4m from any boundary fence or adjacent buildings (for quantities <100,000 litres).

4.6.2 Storage should not be above ground level or on the roof unless the local authority approves a suitable non-combustible store with additional requirements for drainage and ventilation.

4.6.3 The storage buildings should be single storey and of non-combustible construction. Further information is set out in RC20-2 (ref. 23).

4.7 If it is not possible to store flammable liquids in a detached building, storage may be permitted in a designated compartment within a building. To facilitate ventilation, at least one wall of the compartment should be an external wall.

4.7.1 The storage compartment should preferably be within a single-storey part of the building. Where it is only possible to provide storage in a multi-storey building it should be at ground level. In each case there should be fire-resistant compartment walls and floors separating the storage area from the rest of the building, in accordance with the guidance set out in RC20-2 (ref. 23).

4.7.2 There should preferably be no direct access to the internal store from the building in which it is located. All doorways from the designated storage compartment should lead to the open.

4.7.3 Production equipment using large volumes of flammable solvents, such as rotogravure plants, should be separated from other printing, production and storage areas by fire walls providing at least 120 minutes' fire resistance.

4.7.4 Where inks are mixed or diluted, a dedicated fire-resisting room providing at least 30 minutes' fire separation from production and storage areas should be provided for mixing or diluting inks. The room should be equipped with appropriate fire extinguishing provisions.

Pollution control

4.8 For business economy, as well as to minimise the release of flammable solvents, solvent recovery processes should be used to recover unused solvents and ink for subsequent re-use. To minimise large volumes of solvent being required for cleaning operations, the presses, where possible, should be run from light to dark colours.

Various processes may be employed, depending on the size and type of plant installed. In general, they involve solvent-laden air from the presses being transported to a plant where the solvent is recovered by condensation or absorption onto activated carbon. In the latter case, the carbon is subsequently heated by steam with the vapours being condensed to recover the solvent.

4.8.1 The solvent recovery plant should be sited outside the building in which the printing is undertaken. The plant enclosure should provide at least 120 minutes' fire resistance.

4.8.2 The recovery plant should have adequate natural and/or mechanical ventilation.

4.8.3 The recovery plant should be sited on an impervious base with provisions for retention of any spillage.

4.8.4 Connections to the presses should be of rigid construction, with flexible links being kept to a minimum.

4.8.5 All parts of the recovery plant should be constructed of materials that are resistant to the solvents and other materials with which they may come into contact.

4.8.6 High level alarms should be fitted to recovery tanks and robust procedures implemented to manage the hazard.

4.8.7 Dipping of recovery tanks is not acceptable.

4.8.8 An alarm should also be fitted to monitor the flow of the cooling water used in the process

4.8.9 Where pressure relief valves are fitted these should vent the vapours to a safe location in the open air.

4.8.10 The temperature of all parts of the recovery system must be at least 30°C below the auto-ignition temperature of the solvent being recovered.

4.8.11 All electrical equipment in the vicinity of the recovery plant should be of a design suitable for use in the hazard zone in which it is installed.

4.8.12 Where possible recovery plant should be constructed of non-conducting materials. All conducting elements of the recovery plant should be bonded and earthed to prevent the build up of static charges.

4.9 Where solvent recovery is not practical, the release of volatile organic solvents to the atmosphere from printing processes may be controlled by a thermal oxidiser.

4.9.1 Where a thermal oxidiser is to be employed it should be installed in a fire compartment providing at least 60 minutes' fire resistance, separate from that containing the printing plant.

4.9.2 Suitable fire-resisting dampers should be installed in the ducts conveying the solvent vapours from the presses to the thermal oxidiser at the point where they pass through the walls of the fire compartment.

4.9.3 The ducts, dampers and parts of the thermal oxidiser plant with which the vapours come into contact should be constructed of materials that are resistant to the effects of solvents.

4.9.4 Vented gases from the oxidiser should be released to a safe location in the open air.

5. Powders and dusts

5.1 Measures should be taken to minimise the release of dusts to the environment. Control strategies should include prevention of anti-offset powder emissions by:

- reducing use, generation, and emission of particles with diameters less than 10μm;
- the use of enhanced spraying units to reduce the amount of powder used; and
- use of local exhaust ventilation and control with dust filters and appropriate design and velocity.

5.2 Measures should be taken to prevent and control the production of dusts in order to minimise the likelihood of an explosion. Measures should include the following:

- dust deposition on horizontal surfaces should be monitored and removed by vacuum cleaning techniques that avoid the use of sweeping, compressed air and blowing systems;
- improving ventilation to limit dispersion of volatile organic compounds or dusts throughout the premises;
- installing dust filters; and
- installing dust and explosion mitigation measures in areas where the prevention or control of emissions to safe levels is not feasible.

6. Fire safety management

6.1 Good housekeeping is essential in industries where large amounts of combustible materials are in use.

6.2 Wherever possible, use should be made of cleaning agents based on soap or detergent solutions and vegetable oils esterified with alcohol for solvent-free cleaning operations, rather than with non-aqueous solvents. Cleaning agents should have a minimum flashpoint of 100°C for fire safety.

6.3 Combustible waste and used cleaning rags should be removed from production and storage areas regularly to avoid the accumulation of large quantities. Non-combustible containers should be provided for the temporary holding of rags before their removal from the building. Combustible waste should be stored in non-combustible bins with tight-fitting lids, outside the building to minimise the hazards of spontaneous combustion while awaiting disposal. Cloths, wipes and gloves contaminated with inks and solvents should be disposed of as hazardous waste.

6.4 Combustible materials ancillary to the production process, such as packaging, should be kept in dedicated stores. It should not be stored in production areas, flammable liquid stores or rooms in which computer control equipment is located.

6.5 Where combustible materials are needed for production processes only sufficient amounts for immediate use should be kept in the production area.

6.6 Escape and circulation routes must be kept clear of combustible materials, waste bins and all other obstructions.

7. Control of ignition sources

7.1 The need for hot working on site should be minimised with alternative methods being used where possible. Contractors working on the premises should be strictly controlled and the conditions of hot work permits observed.

7.2 Any unavoidable hot work processes should be subject to a hot work permit system. The conditions of the permit should include an inspection to ensure that all paper waste has been removed from the area (including from beneath any machines), before work commences. Further advice and a sample of a hot work permit can be found in RC7 (ref. 24).

7.3 All electrical equipment and wiring must be suitable for the zone in which it is installed or to be used (see refs. 12 and 13):

7.3.1 Electrical equipment and wiring should be certified as suitable for use within the zone in which the flammable liquid is being stored or processed (ref. 13) as determined by a risk assessment.

7.3.2 The fixed installation should be inspected and tested periodically in accordance with BS 7671 (ref. 25) with suitable records being kept.

7.3.3 Serious consideration should be given to undertaking thermographic analysis of control panels and similar equipment periodically. All remedial actions taken should again be recorded.

7.3.4 To reduce the hazard, electrical wiring and equipment should be located outside the building in which the flammable liquids are being stored or handled.

7.3.5 Electrical equipment and wiring should comply with the provisions of the Electricity at Work Regulations 1989 (ref. 26). All electrical installations and equipment in a hazardous zone and the maintenance thereof should comply with BS EN 60079-14 (ref. 27).

7.4 Lack of maintenance can result in:

- development of faulty wiring;
- friction from rotating parts not properly lubricated;
- wear and failure of parts that could cause sparks; or
- waste items stored under machinery.

7.4.1 Friction sparks can also be caused by hot bearings or the use of tools on machinery in which flammable vapours are present.

7.4.2 Noisy or vibrating fans or machinery normally indicates a problem and should be investigated and repaired to prevent the building up of heat by friction. All machinery with moving parts should be subject to planned preventive maintenance to reduce the likelihood of heat build-up by friction.

7.5 Following the implementation of legislation across the UK requiring public places and workplaces to become smoke free, it may be appropriate to provide external smoking areas or shelters for staff who wish to smoke.

7.5.1 Smoking shelters must comply with the relevant legislation relating to design. In relation to the fire risk they may present, smoking shelters must be:

- subject to a specific fire risk assessment;
- constructed of non-combustible materials;
- where practicable, sited at least 10m away from any building or structure;
- provided with suitable metal ashtrays and a separate metal waste bin with a fitted lid; and
- subject to a system under which waste receptacles of smokers' materials and general waste are regularly and safely emptied (Note: waste 'smoking materials' must NOT be disposed of with general rubbish unless appropriate precautions have been taken – for example, damping down).

7.5.2 The immediate area around the shelter and the shelter itself should be kept clear of combustible materials, including windblown debris and vegetation.

7.5.3 Raised, slatted floors/decking should not be used, and concealed or semi-open spaces should be sealed to ensure combustible debris cannot accumulate beneath the shelter. The use of combustible curtains, canopies and drapes must also be avoided. If the use of portable heaters is proposed, the guidance contained in RC15: *Recommendations for the use of portable and transportable heaters in commercial and industrial premises* (ref. 28) should be followed.

7.5.4 In order to satisfy both legislation and fire protection to property, the shelter must not be sited near to:

- windows;
- ventilation intakes/extracts;
- entrances and exits from premises;
- hazardous materials;
- waste storage containers (such as skips or bins); or
- beneath a canopy or low slung eaves.

7.6 Paper and some other substrates readily accumulate static charges and measures should be in place to eliminate dangerous static charges. The hazard of static electricity should be considered as part of the DSEAR assessment and the following should be considered:

7.6.1 *Bonding and earthing:* all presses and paper handling equipment should be electrically bonded and earthed using mechanically strong, uninsulated wiring to enable easy visual inspection.

Shafts that turn at high speeds should be bonded to the journal housing.

Containers used in dispensing operations should be bonded together and earthed.

7.6.2 *Humidification of pressroom atmospheres:* A relative humidity of between 45% to 60% is usually adequate to reduce the likelihood of a fire resulting from static electricity but the type of paper being used will dictate the exact level of humidity required.

7.6.3 *Static neutralisers:* these may be needed in proximity to running paper to supplement the electrical grounding provisions on the machines. Typical static neutralisers are tinsel and grounded needle points. Tinsel must be replaced when damaged or when coated with wax, oil or lint.

7.6.4 *Ionisation by heat* is sometimes used on printing presses to eliminate static electricity on paper. A row of small gas flames are arranged across the delivery end of the presses. This method must be confined to presses using high flashpoint solvents only. In all cases, the burner should be interlocked with the press so that the flame will cut out automatically when the press is stopped.

7.6.5 *Radioactive sources* are also used to reduce static charge by inducing local ionisation of the air. Such radioactive sources will need to be considered when preparing contingency plans as their presence after a fire may lead to contamination issues that will need to be addressed.

7.7 Drying processes may involve:

- *hot air:* normally used on lithographic offset presses, the often enclosed hot air dryers may need ventilation fans to prevent the accumulation of vapours when the press stops and restarts. Wherever possible, recovery methods should be used for economy, safety and to protect the working environment;
- *ultraviolet light:* may be used to cure some inks – for example, in digital ink jet printing. Where this process is used a good standard of ventilation should be provided and other health and safety issues rigorously observed (ref. 29);
- *infra-red dryers:* where lamps provide the heat necessary for evaporation of the ink carrier;
- *ultrasonic dryers:* are a modern technology with a low inherent hazard as the method does not involve the direct application of heat to the substrate; or
- *absorption:* a non-heating process used for drying vegetable oil inks on newspaper presses.

The use of 'homemade' drying equipment should be avoided; drying equipment should not incorporate combustible materials, portable or other unsuitable heating appliances, or inadequate fire safety controls.

7.8 Where solvent-based inks are in use, suitable fume extraction should be provided for the drying processes. Care should be taken that there is no build up of flammable vapour in the system that will exceed the lower explosive limit (LEL) of the solvent, especially where feed from auto blanket wash units is handled. In practice, the design parameters should aim to ensure that the vapours will not accumulate in excess of 25% of the LEL and appropriate monitoring systems are incorporated. The process should be subject to a DSEAR risk assessment.

8. Fire protection

8.1 Printing facilities should be protected by automatic fire detection and alarm systems (AFD) complying with BS 5839-1 (ref. 30). They should also be serviced and maintained according to this standard. Serious consideration should be given to the benefits of the enhanced property protection afforded by linking the AFD installation to a remote alarm receiving centre.

8.2 If not already installed, serious consideration should be given to installing automatic sprinklers to protect large printing works and storage areas. In the case of the latter, the design of the suppression system will depend on the materials being stored and the orientation of the storage. The review of the fire risk assessment that is undertaken when there is a change in the products to be stored must also address these issues.

8.3 The hazards associated with the storage of large volumes of paper may require enhanced sprinkler coverage and, where a change of use of an existing sprinklered area is being considered for this purpose, specialist advice should be sought.

8.4 Sprinkler installations should be installed and maintained in compliance with the current rules for sprinkler installations. (Currently BS EN 12845 (ref. 31).)

8.5 Consideration should also be given to the application of local suppression systems, especially at the drying end of the process. Water mist or gas suppression systems may be suitable. Installations should be in accordance with recognised best practice and be maintained in accordance with the installer's recommendations.

8.6 An adequate number of appropriate portable fire extinguishers should be provided in accordance with BS 5306-8 (ref. 32). They should be serviced annually by a competent engineer in accordance with BS 5306-3 (ref. 33).

8.7 Where hose reels are installed, these should be provided and maintained in accordance with BS 5306-1 (ref. 34).

8.8 In areas where metal powders are used, special, dedicated powder extinguishers should be provided and staff trained in their use. Conventional extinguishers should not be provided in the immediate vicinity of areas where metal powder fires may occur as conventional extinguishing media are ineffective on such fires and some may react violently with burning metals. Extreme care must be exercised to ensure that the type of specialist powder extinguishing agent is compatible with the type of metal powder present. The advice of a competent extinguisher supplier should be sought.

9. Staff training

9.1 All staff should receive induction training on their first day at work with more in-depth fire safety training as soon as possible thereafter. This should be followed by periodic refresher training in accordance with the findings of the fire risk assessment for the premises.

9.2 All staff should be familiar with the hazards associated with the products used, the necessary precautions and the action to be followed in the event of fire or spillage. These include how to:

- raise the alarm;
- call the fire brigade;
- evacuate the premises and report to the assembly point; and
- attack the fire if safe to do so.

9.3 Staff should be aware of any ventilation measures that are provided, their objectives and mode of operation. Ventilation is provided to dissipate heat during normal operations rather than to effect provision of oxygen in the event of a fire.

9.4 The workforce should be made aware of the presence and use of flammable liquids and the fire safety hazards involved with these and the processes in the buildings in which they are working.

9.5 Staff handling flammable liquids should receive specialist training in good practice relating to the opening, handling and disposal of containers. This should include, for example, that containers should be opened correctly rather than punctured. Instruction should also be provided as to how staff should control spillages and dispose of contaminated materials in a safe manner.

9.6 A scheme should be established and monitored for the training and refresher training of everyone who uses or may use flammable liquids.

9.7 Staff should be made aware of the possibility of deliberate fire-raising, which may be carried out both by colleagues and intruders.

9.8 Flammable liquids and containers should not be accessible to intruders; suitable security measures should be in place.

9.9 Operators of printing presses should be trained in appropriate emergency actions to shut off machines safely in the event of fire. Written operation procedures and emergency shutdown procedures should be provided and displayed near the press. These measures should be included in the fire and health and safety risk assessments.

9.10 Staff training should also include an awareness of the hazardous materials on site, the hazards involved in the processes on which they work and the controls in place to minimise the impact of these on day-to-day operations. Staff should be informed of the results of the fire risk assessment in compliance with the requirements of the Regulatory Reform (Fire Safety) Order 2005 (ref. 8).

10. Checklist

		Yes	No	N/A	Action required	Due date	Sign on completion
10.1	**Fire risk assessment**						
10.1.1	Have suitable and sufficient risk assessments been undertaken in compliance with the Regulatory Reform (Fire Safety) Order 2005 and the Dangerous Substances and Explosive Atmospheres Regulations (DSEAR) 2002?						
10.1.2	Is there a policy for these assessments to be reviewed periodically?						
10.1.3	Do the assessments consider elements of property protection and business interruption as well as life safety?						
10.2	**Identification of high value plant and processes**						
10.2.1	Have items of plant with high intrinsic value been identified and plans made for their protection?						
10.2.2	Have other items that are critical to the continued smooth-running of the business been identified and protected?						
10.2.3	Has the impact of fire on computer-based control systems been assessed and copies of software and databases, together with plans for replacing the equipment, held away from the site?						
10.2.4	Does all ducting within the printing, solvent recovery and thermal oxidation areas provide 60 minutes' fire resistance?						
10.3	**Storage of paper and other substrates**						
10.3.1	Are areas used for the storage of paper and other substrates located in detached buildings or suitably separated from process areas?						
10.3.2	Are buildings and areas used for the storage of combustible materials of non-combustible construction?						
10.3.3	Where reeled paper is stored, are the reels stored horizontally wherever possible?						
10.3.4	Where reels have to be stacked vertically, are they stacked in a staggered formation so as to minimise the 'chimney' effect in the even of a fire?						
10.3.5	Are gangways between stacks kept clear of obstructions and of sufficient width to allow staff to escape and trucks to manoeuvre?						

		Yes	No	N/A	Action required	Due date	Sign on completion
10.3.6	If the presence of an inner room in an area where combustible materials are stored cannot be avoided is there an alternative exit from this area?						
10.3.7	Are waste and damaged products stored in a separate area away from the building, or in a separate fire compartment where this is not possible?						
10.4	**Storage and use of flammable solvents**						
10.4.1	Has the use of highly flammable and flammable liquids been eliminated from the workplace as far as possible?						
10.4.2	Where flammable liquids have to be used, are they stored and handled in accordance with best practice as set out in RC20 (refs 22 and 23)?						
10.4.3	Is any store for flammable liquids suitably separated from process and storage areas with access only being available from the open?						
10.4.4	Are production areas where flammable liquids are used separated from other production and storage areas by a form of construction providing at least 120 minutes' fire resistance?						
10.5	**Pollution control**						
10.5.1	Are solvent recovery processes used and presses arranged to run from light to dark colours?						
10.5.2	Is the solvent recovery plant sited outside the building in which the printing is undertaken and the plant enclosure constructed to provide at least 120 minutes' fire resistance?						
10.5.3	Does the recovery plant have adequate natural and/or mechanical ventilation?						
10.5.4	Is the recovery plant sited on an impervious base with provisions for retention of any spillage?						
10.5.5	Are the connections to the presses of rigid construction, with flexible links kept to a minimum?						
10.5.6	Are all parts of the recovery plant constructed of materials that are resistant to the solvents and other materials with which they may come into contact?						

		Yes	No	N/A	Action required	Due date	Sign on completion
10.5.7	Are high level alarms fitted to recovery tanks and robust procedures implemented to manage the hazard?						
10.5.8	There is no dipping of recovery tanks.						
10.5.9	Is an alarm fitted to monitor the flow of the cooling water used in the process?						
10.5.10	Where pressure relief valves are fitted, do they vent the vapours to a safe location in the open air?						
10.5.11	Is the temperature of all parts of the recovery system at least 30°C below the auto-ignition temperature of the solvent being recovered?						
10.5.12	Is all electrical equipment in the vicinity of the recovery plant of a design suitable for use in the hazard zone in which it is installed?						
10.5.13	Where possible is the recovery plant constructed of non-conducting materials?						
10.5.14	Are all conducting elements of the recovery plant bonded and earthed to prevent the build up of static charges?						
10.6	Where solvent recovery is not practical, is the release of volatile organic solvents to the atmosphere from printing processes controlled by a thermal oxidiser?						
10.6.2	Where a thermal oxidiser is to be employed, is it installed in a fire compartment providing at least 120 minutes' fire resistance, separate from that containing the printing plant?						
10.6.3	Are suitable fire-resisting dampers installed in the ducts conveying the solvent vapours from the presses to the thermal oxidiser at the point where they pass through the walls of the fire compartment?						
10.6.4	Are the ducts, dampers and parts of the thermal oxidiser plant with which the vapours come into contact constructed of materials that are resistant to the effects of solvents?						
10.6.5	Are gases vented from the oxidiser released to a safe location in the open air?						
10.7	**Powders and dusts**						
10.7.1	Have adequate measures been taken to prevent the production of dusts and minimise their release where their use or production cannot be avoided?						

		Yes	No	N/A	Action required	Due date	Sign on completion
10.8	**Fire safety management**						
10.8.1	Have solvent-based cleaning agents been replaced with aqueous alternatives where possible?						
10.8.2	Are cleaning rags and combustible waste removed from the production and storage areas regularly and stored safely outside the buildings to await removal from site?						
10.8.3	Are all escape routes and circulation areas kept free of combustible materials, waste and other obstructions?						
10.9	**Control of ignition sources**						
10.9.1	Are contractors strictly controlled and hot work avoided wherever possible?						
10.9.2	Where hot work has to be undertaken, is a hot work permit scheme in operation?						
10.9.3	Is all electrical equipment and wiring suitable for the hazard zone in which it is situated?						
10.9.4	Is the fixed wiring inspected and tested periodically in compliance with BS 7671?						
10.9.5	Is thermographic analysis of control panels undertaken periodically?						
10.9.6	Is plant serviced and inspected regularly to minimise the production of heat by friction?						
10.9.7	Is smoking prohibited in the premises with dedicated area(s) provided outside?						
10.9.8	Have suitable measures (such as bonding and earthing, humidification and ionisation) been taken to address any potential build up of static electricity?						
10.9.9	Is drying equipment professionally made and maintained in accordance with the manufacturers' recommendations?						
10.9.10	Where solvent-based inks are used, is suitable fume extraction equipment provided, designed to prevent excessive build up of flammable vapours?						

10.10	Fire protection	Yes	No	N/A	Action required	Due date	Sign on completion
10.10.1	Has an automatic fire detection and alarm system – installed and maintained in compliance with BS 5839-1 – been installed in the workplace?						
10.10.2	Are the process and storage areas protected by an automatic sprinkler installation designed to address the specific hazards present ?						
10.10.3	Are local suppression systems (such as water mist or gas) installed at the drying end of the processes?						
10.10.4	Is there an appropriate number of suitable fire extinguishers available?						
10.10.5	If metal powders are in use, has expert advice been taken regarding the provision of specialist powder extinguishers?						
10.10.6	Have relevant staff been trained in the use of the firefighting equipment?						
10.11	**Staff training**						
10.11.1	Do all staff receive induction training on their first day at work and periodic refresher training thereafter?						
10.11.2	Are staff aware of any ventilation measures that are provided to dissipate heat during normal operations?						
10.11.3	Have staff who handle flammable liquids been trained in good practice in relation to the opening, handling and disposal of containers?						
10.11.4	Have staff been trained in the appropriate emergency actions to shut down machines in the event of fire?						
10.11.5	Have staff been made aware of the findings of the fire risk assessments carried out under the Regulatory Reform (Fire Safety) Order and DSEAR?						

Signature	**Name**	**Date**

REFERENCES

1. RC19: *Recommendations for the storage of aerosol products,* 2004, Fire Protection Association.
2. RC32: *Recommendations for the fire safety in spray painting processes (excluding automotive refinishing),* 2001, Fire Protection Association.
3. RC31: *Recommendations for fire safety in automotive refinishing and spraying processes,* 2000, Fire Protection Association.
4. Control of Substances Hazardous to Health Regulations 2002, SI 2002 No. 2677 (as amended), The Stationery Office.
5. Chemicals (Hazard Information and Packaging for Supply) Regulations 2002, (CHIPS 3), SI 2002/1689, as amended by the Chemicals (Hazard Information and Packaging for Supply) (Amendment) Regulations 2005, SI 2005 No. 2571, The Stationery Office.
6. Health and Safety (Safety Signs and Signals) Regulations 1996, SI 1996 No. 341, The Stationery Office.
7. Oil Pollution (Oil Storage) (England) Regulations 2001, SI 2001 No. 2954, The Stationery Office.
8. Regulatory Reform (Fire Safety) Order 2005, SI 2004 No. 1541, The Stationery Office.
9. Fire (Scotland) Act 2005, asp 5, The Stationery Office.
10. Fire Safety (Scotland) Regulations 2006, Scottish SI 2006 No. 456, The Stationery Office.
11. Fire and Rescue Services (Northern Ireland) Order 2006, SI 2006 No. 1254 (NI9), The Stationery Office.
12. Dangerous Substances and Explosive Atmospheres Regulations 2002 SI 2002 No. 2776, The Stationery Office.
13. BS EN 60079-10: 2003: *Electrical apparatus for explosive gas atmospheres. Classification of hazardous areas,* British Standards Institution.
14. L88: *Approved Requirements and Test Methods for the Classification and Packaging of Dangerous Goods for Carriage,* 1996, Health and Safety Executive.
15. *Business resilience. A guide to protecting your business and its people,* 2005, Fire Protection Association.
16. RC11: *Recommendations for the use of fork lift trucks,* 2005, Fire Protection Association.
17. *Fire risk management in the workplace,* Lewis and Dailey, third edition, 2006, Fire Protection Association.
18. *Fire safety risk assessment – factories and warehouses,* 2006, Department for Communities and Local Government.
19. RC3-1: *Recommendations for loss prevention in electronic equipment installations: Fire prevention,* 2003, Fire Protection Association.
20. *Design Guide for the Fire Protection of Buildings,* 2003, Fire Protection Association.
21. *FPA Design guide for the fire protection of buildings: Warehouses and storage buildings 1: Design principles,* 2007, Fire Protection Association.
22. RC20-1: *Recommendations for fire safety in the storage and use of highly flammable and flammable liquids. General principles,* 2005, Fire Protection Association.
23. RC20-2: *Recommendations for fire safety in the storage and use of highly flammable and flammable liquids. Storage in drums and containers other than fixed external tanks,* 2007, Fire Protection Association.
24. RC7: *Recommendations for hot work,* 2001, Fire Protection Association.
25. BS 7671: 1992: *Requirements for electrical installations,* British Standards Institution.
26. Electricity at Work Regulations 1989, SI 1989 No. 635, The Stationery Office.
27. BE EN 60079-14: 2003: *Electrical apparatus for explosive gas atmospheres. Electrical installations in hazardous areas (other than mines),* British Standards Institution.
28. RC15: *Recommendations for the use of portable and transportable heaters in industrial and commercial premises,* 2006, Fire Protection Association.
29. P40, *Wide-format printing with UV-curable inks,* 2005, Health and Safety Executive.
30. BS 5839-1: 2002: *Fire detection and alarm systems for buildings. Code of practice for system design, installation, commissioning and maintenance,* British Standards Institution.
31. *LPC Rules for automatic sprinkler installations incorporating BS EN 12845,* 2003, Fire Protection Association.
32. BS 5306-8: 2000: *Fire extinguishing installations and equipment on premises. Selection and installation of portable fire extinguishers. Code of practice,* British Standards Institution.
33. BS 5306-3: 2000: *Fire extinguishing installations and equipment on premises. Code of practice for the inspection and maintenance of portable fire extinguishers,* British Standards Institution.
34. BS 5306-1: 2006: *Code of practice for fire extinguishing installations and equipment on premises. Hose reels and foam inlets,* British Standards Institution.

FURTHER READING

1. *Environment, Health and Safety Guidelines for Printing,* 2006, International Finance Corporation.
2. *The printer's guide to health and safety (Second edition),* 2002, HSE Books.
3. *Roll paper storage,* September 2003, FM Global Property Loss Prevention Data Sheets.
4. *Static electricity,* January 2001, FM Global Property Loss Prevention Data Sheets

RC39

for fire risk management in the printing industry

Part 1: Printing processes: General principles

Recommendations

FPA
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InFiReS