

Recommendations

for fire safety in
shrink-wrapping
processes

RC17

LOSS PREVENTION RECOMMENDATIONS

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CONTENTS

Scope	3
Introduction	3
RECOMMENDATIONS	4
1 Location and ventilation	4
2 Equipment	4
3 Operation	5
4 General	5
5 Fire extinguishment	6
6 Further information	6
References	6

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SCOPE

These recommendations present measures for fire safety in the heat-shrinking of film plastics for the packaging of various goods and materials.

INTRODUCTION

Shrink-wrapping is used for packaging a variety of articles, including combustible materials, but is generally employed in connection with palletised goods. The goods are covered with a plastic film which shrinks on heating to take up even the most irregular shapes, thus holding the goods securely in place. Low density polyethylene (LDPE) is the most common shrink-wrap film but polypropylene (PP) and polyvinylchloride (PVC) can be used.

Wherever possible, methods of wrapping that do not involve the production of heat should be adopted. These include stretch wrapping and spiral wrapping.

Shrink-wrapping (stretch-wrapping) is used primarily for the packaging of trays and packs of small products. This was born of a need to identify contents readily and to expedite transportation of small goods stacked onto pallets. Small packs are not sufficiently stable to permit the use of spiral wrapping - the binding of products onto pallets under tension without heat application - although that method is used on large, stable stacks of products like bricks, cement and even sugar bags.

The application of shrink-wrapping of commodities has increased with developing technology and it is used for the storage and transportation of palletted goods as diverse as bricks and glass bottles. The practice facilitates good housekeeping and stack stability. Fire safety, too, is enhanced because of the reduced fire load of the wrapping film compared with more traditional packaging materials such as paper, cloth and timber. It is difficult to ignite a sustainable fire involving polyethylene sheeting encapsulating pallets or packages, particularly when the wrapped product is non-combustible.

There are four main types of shrink-wrapping equipment which utilise heat:

Batch units are essentially ovens which are either lowered over a loaded pallet or into which a pallet is placed.

Tunnels are the safest means of encapsulating products. Goods are moved by conveyor through a tunnel-shaped oven typically measuring 1000mm long x 600mm wide. Tunnels can vary from small mobile units to those which can encapsulate mattresses and even furniture. The constant, shielded convection heat is contained inside the machine and does not involve the production of sparks. Typical electrically-operated machines draw anything from 6kW to 36kW of power. Machines large enough to encapsulate mattresses can draw up to 150kW. Conveyors are usually steel mesh, though steel

rollers are common and sometimes these rollers are insulated when used for heat-sensitive products, where marking of the product could occur through conduction from the steel rollers.

Pillar shrink systems comprise a row of hot-air guns mounted on a pillar. These can be either fixed, in which case the pallet is rotated on a turntable in front of the guns, or mobile, in which case the equipment is mounted on a trolley and is moved around the pallet.

Portable hot-air guns are hand-held guns which the operator uses to project a stream of hot air onto the film. Whether heated by gas or electrically, the temperature around the gun is hot and care is needed in handling them.

The fixed shrink-wrapping equipment can be fuelled by gas - including liquefied petroleum gas (LPG), natural gas and town gas - or electricity or oil. Portable and mobile equipment is often fuelled by LPG although electrically powered hot-air guns are available.

Shrink-wrapping equipment operates in the region of 210°C, although much higher temperatures are attained nearer the heat source. The temperature at the outlet nozzle of some hot-air guns, for instance, may reach 900°C. Tunnel oven temperatures are adjustable and tunnels are even used for wrapping butter, chocolates and newspapers.

The use of equipment where flames are produced should be avoided.

The hazards associated with shrink-wrapping include:

- the use of equipment in hazardous locations:
 - in flammable or dust-laden atmospheres or
 - in close proximity to combustible materials;
- the use of equipment upon unsuitable goods, for example, flammable materials; and
- the malfunction or maloperation of the equipment.

Much has been done to reduce the hazards associated with the shrink-wrapping of aerosols in electrically heated tunnels; such tunnels have shielded elements and enclosed connections to electrical conductors. Infra-red detectors rapidly detect flames and activate alarms and mechanisms to eject packages from the tunnel. Film failure detection is needed to cut off the heat and to prevent new packages from entering the machine. Automatic fire suppression is required for the protection of aerosol shrink-wrapping machines.

Shrink-wrap is a very efficient heat insulator which increases the risk of overheating during its passage through a tunnel. Containers, too, can have efficient heat sinks and even the contents of aerosol containers may have low specific heats which collectively increase the accumulation of dangerous temperatures.

The hazards involved are greater when the temperature, timing and distances between the goods and the heat source are not properly controlled, for example, when portable equipment is used. The dangers are even more pronounced for portable equipment in which a flame projects beyond the end of the gun(s) as this may result in direct flame impingement upon the shrink-wrap film.

It should be noted that if an LPG cylinder is used to provide the fuel for the heat source, it can, if exposed to fire, present an explosion hazard. A full cylinder of propane is in danger of exploding if its temperature is raised to 90°C.

Electrical panels controlling the machines and associated conveyors, pneumatic lifters and nudge bars, comprise typical electronic and electrical components including transformers, which are unlikely to cause fires even during failure.

RECOMMENDATIONS

1. Location and ventilation

- 1.1 Shrink-wrapping should preferably be performed in a detached building of non-combustible construction or in a building separated from the manufacturing and warehousing areas by walls of non-combustible construction having a fire resistance of at least 30 minutes. All openings therein should be protected by fire-resisting doorsets or shutter assemblies (tested to methods 6, 7 or 8 of BS 476: Part 22 or to BS EN 1634: Part 1 (refs. 1 and 2)). Such products should in any case be tested and certified by a nationally accredited, third-party certification body to an appropriate technical standard. An example might be LPCB approval to Loss Prevention Standard 1056 (ref. 3). Similarly such products should be inspected and serviced on a regular basis, in accordance with manufacturers' instructions. All maintenance and repair work should be undertaken by a company certified under a nationally recognised, third-party certification scheme. An example might be LPCB certification to Loss Prevention Standard 1197 (ref. 4).

Should flame-producing shrink-wrapping processes be necessary within the manufacturing area, a designated area comprising a clear space of at least 2m radius should be maintained around the equipment and pallet or article being wrapped. This space should be surrounded with non-combustible screens. Profiled steel sheeting at least as tall as the machine is suitable for this purpose and acts as an efficient radiant heat deflector. Floors, benches and trestles etc. located or used in any area where shrink-wrapping is undertaken should be non-combustible.

A fire risk assessment should be conducted for the use of shrink-wrapping equipment in production and storage areas. This should include assessing if alternative methods, not using heat, may be suitable.

- 1.2 Under no circumstances should shrink-wrapping, or repairs to the wrappings, be performed in storage areas, except in a designated area (as in 1.1).
- 1.3 Under no circumstances should shrink-wrapping, or repairs to the wrappings, be performed on goods in stacks or racks.
- 1.4 Shrink-wrapping should not be operated in areas where flammable gases, vapours, mists or dusts are present.
- 1.5 Processed and unprocessed loads should not be allowed to accumulate in the vicinity of shrink-wrapping equipment.
- 1.6 Shrink-wrapping equipment should be operated in a well-ventilated but draught-free area. In particular, equipment using gaseous or liquid fuels will require considerable quantities of air for combustion purposes and will produce quantities of carbon monoxide and carbon dioxide.
- 1.7 Only equipment designed for use in the open or in draughty conditions should be used in such conditions.

2. Equipment

2.1 General

- 2.1.1 Equipment burning oil should be in accordance with the *LPC Recommendations for oil fired installations* (ref. 5).
- 2.1.2 Storage and use of LPG cylinders should conform to RC 8, *Recommendations for the storage, use and handling of common industrial gases in cylinders including LPG* (ref. 6).
- 2.1.3 Ignition of oil-fired and gas-fired burners in shrink-wrapping equipment must be automatic, for example, by piezo crystal system for gas burners or the more sophisticated automatic electric igniters. Manual igniters (spark or LPG), matches, lighters, etc. should never be used.
- 2.1.4 It is essential that only the type of fuel specified by the manufacturer of the equipment is used.

2.2 Fixed equipment

- 2.2.1 The operating temperature of enclosed equipment (batch units and tunnels) should be thermostatically controlled and a safety thermal cut-off device should be incorporated to prevent excessive heating in the event of malfunction.
- 2.2.2 The heat supply should be cut off automatically if:
- an overhead unit fails to lift after the appropriate heating period,
 - the wrapping film snags on the workpiece on lowering,

- a tunnel conveyor belt stops,
 - a turntable stops,
 - an air circulating fan fails.
- 2.2.3 Although standby power is recommended to energise conveyors in the event of power failure, generators can take too long to operate. A far better option is the provision of an air motor fed from a compressed air tank on the machine and interconnected with the conveyor motor. When power is interrupted, it operates instantly and is capable of displacing the conveyor belt twice its length to eject packages from the machine.
- 2.2.4 Flame-failure devices should be installed to cut off the fuel supply in the event of flame failure.
- 2.2.5 Direct contact between the goods and the heat source should be prevented by the fitting of guards, shields or other barriers.
- 2.2.6 All shrink-wrapping machines should be earthed, whether they are free-standing, secured to the floor or mobile.
- 2.3 *Portable and mobile equipment*
- 2.3.1 A 'deadman's handle' or automatic-closing mechanism should be incorporated to shut off the gas or electricity supply to the heating units when the operator's grip on the unit equipment is released.
- 2.3.2 A non-combustible stand should be provided on which to place hot, portable shrink-wrap guns. Some shrink-wrapping gas cylinder trolleys incorporate a holster for the gun and this is a recommended feature.
- 2.3.3 A trolley should be provided on which to transport any LPG cylinder. Care should be taken that no tension is applied to any LPG hose.
- 2.3.4 Only suitable screw-connections and hose (conforming to BS 3212 (ref. 7)) should be used with LPG-burning equipment. Electrical equipment should use a heavy duty flexible cable.
- 2.3.5 A hose-break shut-off valve (excess flow valve) should be incorporated in LPG-burning equipment to shut off the gas supply in the event of gas leakage from the hose or an excess flow of gas.
- 2.3.6 Care should be taken to ensure that the operating pressure for LPG-burning equipment does not fall below the minimum specified by the manufacturer. A pressure-indicating device should be provided.
- 2.3.7 After use, the gas supply to LPG-burning equipment should be turned off at the stop valve on the top of the cylinder and the residual gas in the hose should be exhausted in a safe manner.
- 2.3.8 When using electrical equipment, care should be taken that the air inlet to the fan is not covered.

A thermal safety cut-off device should be incorporated to prevent excessive heating in the event of an interruption of the air supply.

- 2.3.9 Care should be taken to ensure that trailing cables, hoses and air lines do not suffer mechanical damage, for example, from fork-lift trucks, and are not affected by spillage of corrosive or other materials.

- 2.3.10 Care should be taken to prevent hoses, cables etc being exposed to direct heat.

3. Operation

- 3.1 Shrink-wrapping equipment should only be operated by personnel who have undergone training in the use of such equipment.
- 3.2 When gas or oil fuels are used, two or more appropriately trained persons should be present during shrink-wrapping operations and should be provided with heat-resisting gloves. Rather than use a pusher rod with a flat plate at the end manually to eject collations and products in the event of conveyor failure, the provision of an air motor as described in 2.2.3 is preferred.
- 3.3 With regard to fixed equipment, alarms should be provided to activate in the event of unplanned stoppage.
- 3.4 Shrink-wrapping equipment should only be used for the purpose for which it was designed.
- 3.5 Adjustments to the controls of the equipment should only be made by authorised personnel in accordance with the manufacturer's instructions.
- 3.6 Users should strictly adhere to the manufacturer's operating instructions.

4. General

- 4.1 Flame-operated shrink-wrapping machines should not be used when packaging flammable goods, such as aerosols with flammable propellants, and should preferably be avoided for other goods.
- 4.2 Goods being prepared for shrink-wrapping should be stacked on pallets with care. There should be no protuberances, damaged or leaking containers/bags or 'loose ends' and the load should be stable.
- 4.3 It is essential that a high standard of housekeeping be maintained. Floors should be kept clear of all loose packing materials and combustible waste, while the machines and associated conveyors should be regularly cleared of debris. An accumulation of plastics debris in equipment may indicate poor housekeeping procedures or that the timing controls need adjusting.

- 4.4 Where possible, pre-formed film covers can be used to obviate tangles in the sheeting and accumulations of off-cuts etc.
- 4.5 An automatic 'cooling-off' period of 20 minutes should be allowed after shrink-wrapping of goods and before moving them into the warehousing area.
- 4.6 A close inspection of the area for smouldering material should be made at the end of each shift or working day.
- 4.7 When not in use portable and mobile shrink-wrapping equipment should be stored in a safe place, preferably under lock and key.
- 4.8 A regular programme of equipment maintenance should be undertaken in accordance with the manufacturer's instructions.

In addition, periodic inspection of portable electrical equipment should be undertaken. HS(G)107 (ref. 8) provides guidance on intervals and inspection and test procedures.

5. Fire extinguishment

- 5.1 At least two portable extinguishers, each having a minimum rating of 13A, or a hose-reel, should be provided at the site of operation for dealing with fires in combustible materials such as packaging. Such portable extinguishers should be approved and certified by an independent, third-party certification body and be installed and maintained in accordance with BS 5306: Part 3 (ref. 9). Carbon dioxide extinguishers are ideal for fires in electrically heated equipment. In the case of oil-burning equipment, dry powder extinguishers should be available.
- 5.2 In general, it is preferable that fires involving gas should only be controlled and not extinguished until such time as the gas supply can be shut off.

6. Further information

Further details of products and companies certified under the standards listed as references 3 and 4 below, can be found on the BRE Certification web site: www.redbooklive.com.

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RC17

for fire safety in shrink-wrapping processes

Recommendations