

The dangers of cellulose nitrate film



HSE

**Health & Safety
Executive**

This leaflet is aimed at private individuals and voluntary groups who have or find old film in domestic or other non-workplace premises. It gives advice on:

- how to identify cellulose nitrate films and negatives;
- why cellulose nitrate film is hazardous;
- how to recognise signs of decomposition;
- what to do if you have cellulose nitrate film; and
- contact points for information and advice.

The leaflet **does not** cover requirements for the storage and handling of a large number of cellulose nitrate films and negatives such as may be found in archives on commercial or industrial premises or in museums. Exacting standards are defined for such activity (see British Standard, BS ISO 10356:1996 and National Fire Protection Association Code, NFPA 40), and it is covered by workplace health, safety and fire legislation including the *Dangerous Substances and Explosive Atmospheres Regulations 2002* (DSEAR).

THE DANGERS OF CELLULOSE NITRATE FILM

Cellulose nitrate film is extremely dangerous. It catches fire very easily and once alight is difficult to put out. Fires involving cellulose nitrate burn extremely quickly with a hot, intense flame and the smoke is particularly toxic, containing large quantities of poisonous gases.

Any cellulose nitrate film that you come across now will be extremely old. This is a problem because the high fire risk from cellulose nitrate film increases as it ages.

Old cinematographic film and old photographic negatives (including X-ray film) may be made from cellulose nitrate (which means they contain nitrated cellulose, or other nitrated product). These films are sometimes referred to as 'nitrate', 'nitrate-based', 'nitro-cellulose based' or 'celluloid' film (although the term 'celluloid' is often used these days to refer to film in general, it may not actually contain cellulose nitrate – see identification methods later in the leaflet).

What is cellulose nitrate?

Cellulose nitrate is the plastic commonly used for film-base photographic materials (stills, movie and X-ray films) manufactured up to the early 1950s. It contains a high proportion of nitro-cellulose, otherwise known as celluloid.

Cellulose nitrate is extremely flammable.

More modern film is acetate or polyester-based, which is not so hazardous.

Why is cellulose nitrate film dangerous?

It is the nitro-cellulose that makes cellulose nitrate-based film so dangerous to store and handle. It is hazardous because:

- ❖ it can start to decompose and become unstable at temperatures as low as 38°C, giving off large quantities of poisonous gases, which could cause an explosion. Warmth and humidity (moisture) accelerate this decomposition;
- ❖ it catches fire very easily and burns extremely quickly, with a hot and intense flame;

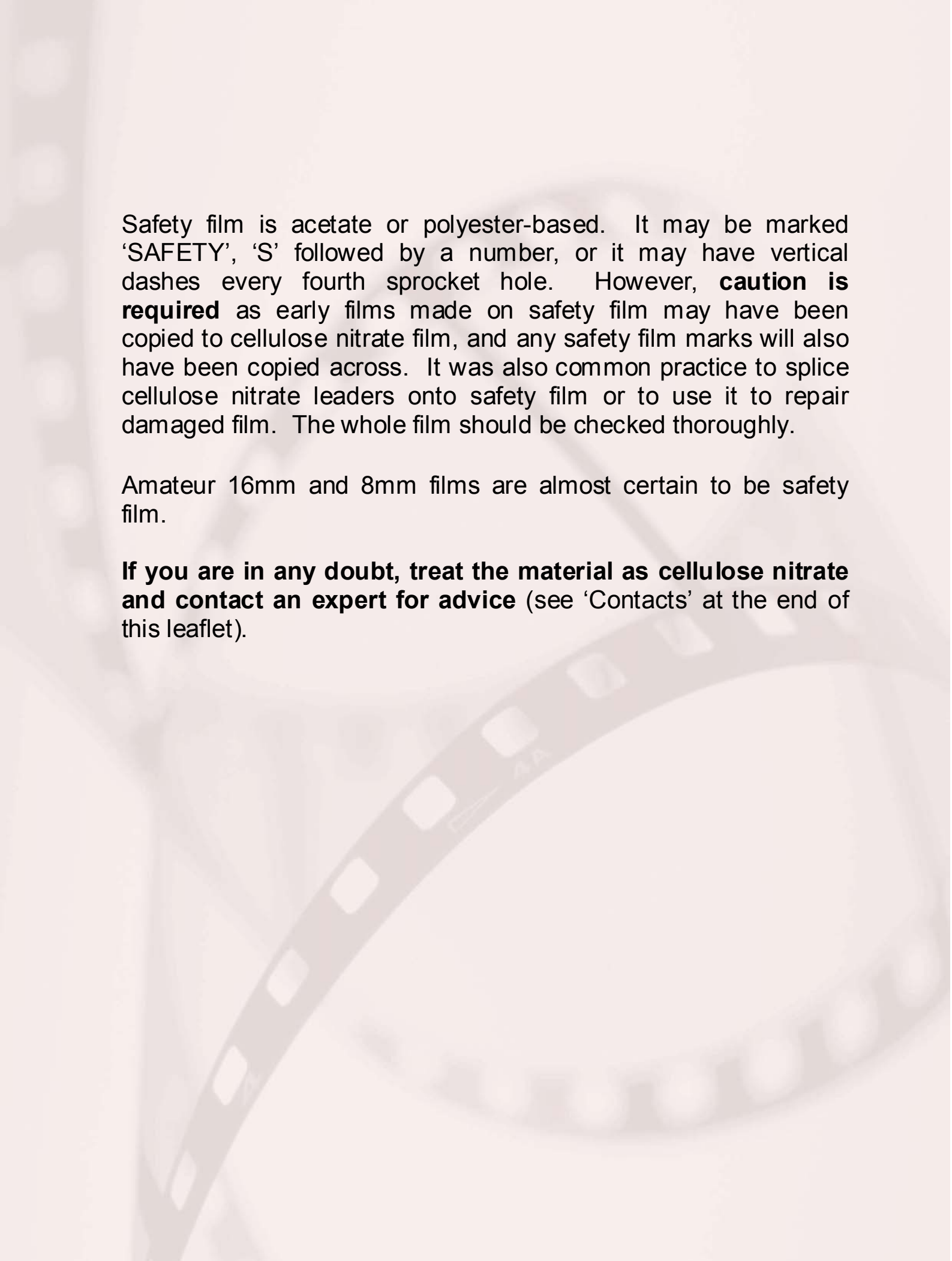
- ❖ it produces very dense, poisonous smoke containing copious amounts of choking nitrogen dioxide fumes; and
- ❖ unlike many other flammable materials, nitro-cellulose does not need the oxygen in the air to keep burning and once it is burning it is extremely difficult to put out. Immersing burning film in water may not extinguish the fire and it could actually increase the amount of smoke produced.

Cellulose nitrate film should, because of its age and the likelihood that it has not been stored in ideal conditions, be treated as being potentially dangerous. If you have film or negatives made from cellulose nitrate (or you think they may be made from cellulose nitrate) **keep them well away from any source of heat** (eg radiators and lightbulbs). Do not run film through a projector or put negatives on an enlarger; they can catch fire simply by the heat from the lamp or from friction caused by the film passing over the projector sprockets.

How can I tell if my films or negatives may be cellulose nitrate?

Cellulose nitrate was used for 35 mm photographic roll film and photographic sheets up to about 1940, but it continued to be used for popular (amateur) formats and aerial photography up to about 1950. Most early cellulose nitrate-based cinematographic film is 35 mm gauge and it was used up to about 1951 in the UK, although old film stock may have been used after this date. Cellulose nitrate-based film continued to be in common use abroad for a number of years. It was also common practice for 35 mm cinematographic film to be cut down and used for still photography.

Silent film, where the frames occupy the full width between the sprocket holes, is almost certainly cellulose nitrate film. A star printed on the edge of the film denotes cellulose nitrate film. Sound film, which has the soundtrack between the single set of sprocket holes and picture frames, may be marked 'NITRATE FILM', 'NITRATE' or 'N' along its edge and/or have horizontal dashes between every fourth sprocket hole.



Safety film is acetate or polyester-based. It may be marked 'SAFETY', 'S' followed by a number, or it may have vertical dashes every fourth sprocket hole. However, **caution is required** as early films made on safety film may have been copied to cellulose nitrate film, and any safety film marks will also have been copied across. It was also common practice to splice cellulose nitrate leaders onto safety film or to use it to repair damaged film. The whole film should be checked thoroughly.

Amateur 16mm and 8mm films are almost certain to be safety film.

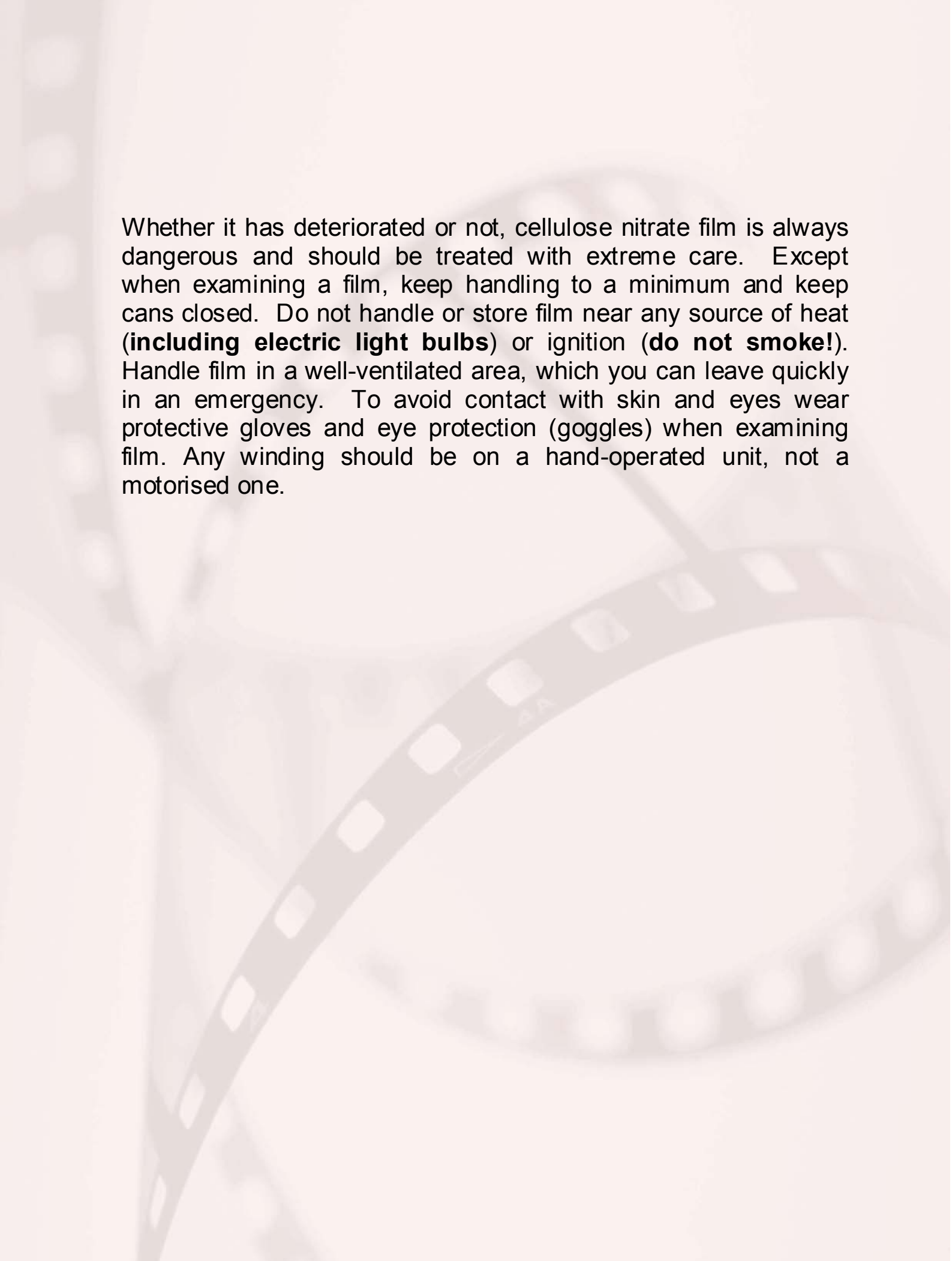
If you are in any doubt, treat the material as cellulose nitrate and contact an expert for advice (see 'Contacts' at the end of this leaflet).

How can I tell if my cellulose nitrate film has degraded?

Visual evidence and smell can be used to identify cellulose nitrate film or negatives, which are degrading. The following signs of deterioration may be present:

- ❖ amber, brown or yellowish discolouration of the film and faded image affecting anything from a small patch to the entire film;
- ❖ the film is 'tacky' or 'sticky', possibly stuck together and feels soft;
- ❖ there is blistering or bubbling of the surface of the film, possibly with yellowish froth;
- ❖ a noticeable acrid odour that may range from being a faintly irritating smell to strongly irritating fumes;
- ❖ the film is decomposed beyond recognition into a brittle residue.

Decomposing films stored in metal film cans may also be covered in quantities of very fine brown powder as a result of a reaction between the can and the film. A ring of rust on the inside of the metal film can is also a sign that cellulose nitrate film is possibly degrading.



Whether it has deteriorated or not, cellulose nitrate film is always dangerous and should be treated with extreme care. Except when examining a film, keep handling to a minimum and keep cans closed. Do not handle or store film near any source of heat (**including electric light bulbs**) or ignition (**do not smoke!**). Handle film in a well-ventilated area, which you can leave quickly in an emergency. To avoid contact with skin and eyes wear protective gloves and eye protection (goggles) when examining film. Any winding should be on a hand-operated unit, not a motorised one.

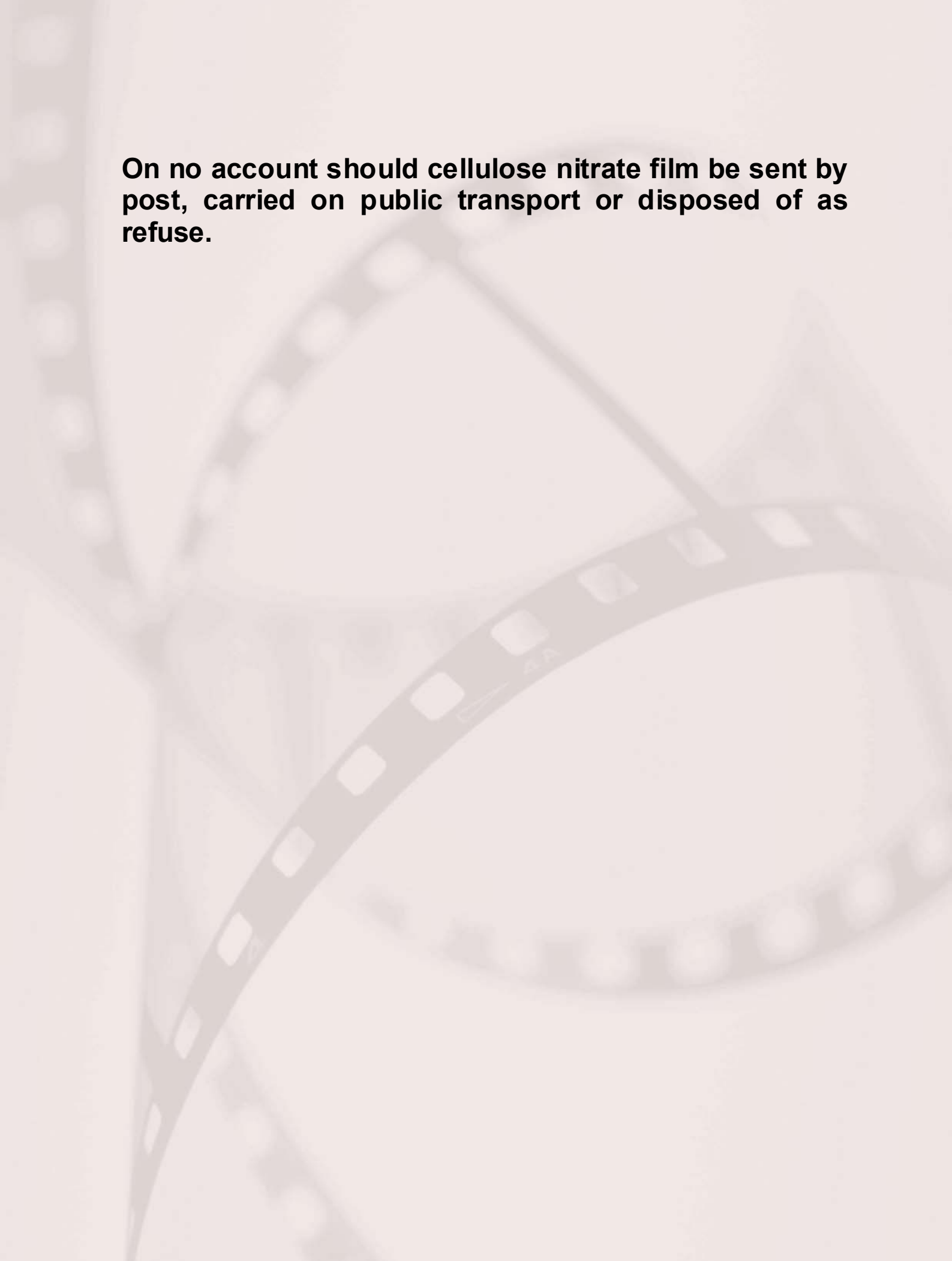
What should I do if I have old film?

Your choices depend on the state of the film (see previous section). If the film still has viewable images, you should contact a film archive (see 'Contacts') for advice on having the film archived and transferred to safety film. If the film has reached the stage where the image is badly faded and the film is stuck together, a film archive will be able to give an expert assessment of its historical importance.

If a film archive is willing to take the film, someone will come and assess it and make arrangements for its collection. If the archive does not want the film, and you wish to retain a copy of the image, they or the National Museum of Photography, Film and Television can advise you of a licensed laboratory that can transfer the image/s to safety film.

Where the film has deteriorated so much that it must be disposed of, or where it is of no further use to you or to an archive, you will need to dispose of it **safely**. You should contact the environmental health department of your local council for advice on the disposal of dangerous waste. They will be able to make arrangements for its collection or put you in contact with a company authorised to transport and dispose of such waste. You should also contact the fire safety officer from your local fire brigade to discuss what general fire safety precautions you should take while the film is being stored awaiting collection, in addition to the steps specified in the next section on short-term storage.

On no account should cellulose nitrate film be sent by post, carried on public transport or disposed of as refuse.



How should I store my cellulose nitrate film while I'm waiting for it to be collected or disposed of?

The first concern must be safety; because of the high risk of a serious fire and the production of toxic gases, the best and safest course of action is **not** to store cellulose nitrate film. Storing cellulose nitrate film may invalidate your insurance. Long-term storage of cellulose nitrate film is best left to institutions that have the necessary expertise and specialised facilities, and where it can be examined regularly for signs of any deterioration.

However, short-term storage may be unavoidable while you are seeking advice or arranging for the film's disposal. If the film still has images which can be copied, it should be:

- ❖ stored away from occupied buildings, where possible;
- ❖ separated from other film media and stored away from combustible or acidic materials (eg paper, textiles, flammable solvents, cleaning materials);
- ❖ kept in closed metal containers, ideally with loose-fitting lids that will prevent the accumulation of the acidic gases that accelerate the decomposition process. Film cans should be stacked horizontally, no more than six high, preferably in steel drawers or a steel cupboard (these will provide some additional fire-resistance); and

- ❖ stored in a cool (less than 20°C), very well ventilated, dry place, away from doors and windows and away from any sources of heat or ignition (radiators, hot-water pipes, light-fittings, fires etc).

Where film has deteriorated to the point where images cannot be retrieved, or where it has no historical value:

- ❖ carefully place the film in its open can in a container of water, ensuring that the water covers the film to a depth of at least 5 cm; and
- ❖ store the container somewhere safe; check it regularly and maintain the water level until it can be collected and safely disposed of.

At all times, observe the handling precautions and wear protective gloves and goggles.

If you decide, despite the dangers, to retain your old cellulose nitrate film for long-term storage, you must comply with the relevant parts of the Celluloid and Cinematographic Film Act 1922 (and for the self-employed, the *Dangerous Substances and Explosive Atmospheres Regulations 2002*). You should also **seek expert advice**, including contacting your local council and fire authority.

Contacts

You can obtain general advice on cellulose nitrate film and local archives from:

British Film Institute, 21 Stephen Street,
London W1T 1LN Tel: 020 7255 1444
Website: www.bfi.org.uk/

The Film Archive Forum
c/o British Universities Film and Video Council,
77 Wells Street, London W1T 3QJ
Tel: 020 7393 1508 Fax: 020 7393 1555
Website: www.bufvc.ac.uk/faf/

National Museum of Photography, Film and Television,
Bradford, West Yorkshire BD1 1NQ
Tel: 01274 202030 Fax: 01274 723155
Website: www.nmpft.org.uk

Imperial War Museum Film and Video Archive,
Lambeth Road, London SE1 6HZ
Tel: 020 7416 5000 Fax: 020 7416 5299
Website: www.iwm.org.uk

For advice on safe disposal, contact the environmental health department of your local council.

For advice on fire safety, contact the community fire safety officer of your local fire authority.

Further information

Additional copies of this leaflet are available from HSE, Tel:0151 951 3214 or it can be downloaded from HSE's DSEAR website at www.hse.gov.uk/spd/dsear.htm

See also HSE's website at www.hse.gov.uk

For information about health and safety ring HSE's Infoline Tel: 08701 545500 Fax: 02920 859260 e-mail: hseinformationservices@natbrit.com or write to HSE Information Services, Caerphilly Business Park, Caerphilly CF83 3GG.

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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