Smoke and vapour effects used in entertainment

Entertainment Sheet No 3 - *HSE information sheet*

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In this information sheet '**must**' denotes a legal obligation. Words such as 'do', 'should' etc are used to give advice on good practice.

Introduction

This information sheet is one of a series produced in consultation with the Joint Advisory Committee for Broadcasting and Performing Arts. Smoke and vapour effects are used for a range of purposes within the entertainment industry. The main methods and types are briefly outlined below.

Dry ice When dry ice, solid carbon dioxide (CO_2), is immersed in hot water or steam, the cold gas that comes off causes the water vapour in the air to condense, creating a water mist. The effect is a heavy 'mist' that lies on the stage. A similar effect can be created using liquid nitrogen.
Oil mist Oil mists are used for lighting effects, accentuating the effect of spotlights. They are produced by passing compressed air through a reservoir of highly refined mineral oil.

Glycol or mineral oil smoke 'Smoke guns' all work on the same principles although their size, precise method of operation and the chemical used do vary. The basic principle is that a mineral oil or glycol based substance is heated, atomising the substance. This is then forced out of the machine under pressure.

Pyrotechnic smoke effects Occasionally pyrotechnic smoke effects are used. They give off a range of by-products which are harmful. The storage and use of pyrotechnics is specialised and may be subject to specific legislation concerning explosives. Details of more specific guidance is contained in *Useful reading*.

Hazards

Smoke and vapour effects can give rise to a variety of hazards depending on the substances used. Manufacturers and suppliers **must** provide information about the hazards which may arise from their products. This information should be obtained and used when carrying out risk assessments.

The following general hazards may need to be considered:

- Freeze burns or frostbite caused by skin contact with liquid nitrogen or blocks of dry ice
- Skin irritation from mineral oils or glycols
- Asphyxiation due to high concentrations of carbon dioxide or nitrogen gases

- The presence of toxic substances in the smoke or vapour
- Smoke or vapour may obscure visibility and so increase the possibility of slips, trips or falls.
- Slips due to spilt oil

Some of the substances used to create these effects may have Occupational Exposure Standards (OESs) assigned to them. The current levels are given in guidance note *EH 40* and should be referred to in the manufacturer's information. Exposure below these levels should cause no ill effects in most people although asthmatics and small children may be at greater risk.

Risk assessment

However the smoke or vapour effect is produced, certain requirements remain constant. Work with smoke effects will be subject to the Control of Substances Hazardous to Health Regulations 1994 (COSHH) if adverse health effects are possible. An assessment should be carried out on the substances used to produce the smoke and on the smoke itself. The risks identified in these assessments **must** be eliminated or controlled so far as is reasonably practicable. Any person operating such effects should be provided with appropriate information and training. Suppliers and manufacturers should provide the required information on demand to allow you to complete your assessment.

If there is any doubt about the level of exposure that may result from using a particular effect, on-site monitoring should be used.

The Management of Health and Safety at Work Regulations also require a general risk assessment to be carried out for all activities where there is a potential risk other than the chemical hazards identified in the COSHH assessment.

These assessments should consider all those people who may be affected, not just the machine operators but also the artists, the audience and other employees; special attention should be given to those who may be affected more severely, eg children, asthmatics and the elderly.

Areas of special note to be considered when performing the risk assessment are the possibility of fire escapes and associated signs being obscured by smoke, how the smoke will be directed to the desired area, the potential slip hazards from spilt oil, the risk of burns from hot smoke etc. It will also be necessary to assess the impact of weather conditions if effects are being used outdoors.

Precautionary measures

The first priority is to eliminate the risks, eg by using effects that contain no harmful substances. Smoke effects should be under the control of people competent in that activity. Good planning and regular maintenance is essential in the safe use of these effects. The risk assessment should be discussed with the person in charge of the production. People involved in the production should be warned in advance that smoke effects are to be used. Where possible a full rehearsal should be carried out to ensure that no unforeseen risks have emerged, eg problems due to reduced visibility.

Preventing exposure Correct usage of these smoke and vapour effects should allow you to limit the number of people exposed. It should be possible to prevent exposure to the audience and certain members of the production team if care is taken to minimise the amount of smoke used, and to control and direct the smoke.

Since CO_2 is heavier than air, particular attention should be paid to low-lying areas, basements, orchestra pits and under-stage areas. It may be necessary to arrange for a competent person to monitor the CO_2 and oxygen levels in these areas if they are to be occupied by any person.
Controlling exposure On-site monitoring has indicated that it is very easy to exceed the OESs laid down in guidance note *EH 40*. The following precautions should allow you to control and minimise exposure.

- Always use the minimum amount of smoke required
- Ventilate areas well immediately after use
- Minimise the exposure time of those concerned
- Keep people away from areas in front of all machines since concentrations are at their highest here

Personal protection PPE should only ever be used as a last resort when it is not possible to reduce the risk by other means. It may occasionally be necessary to use Respiratory Protective Equipment for the machine operators. If this is the case respirators may be sufficient for oil or glycol effects, but full breathing apparatus may be required for CO_2. Those using dry ice or liquid nitrogen should always wear well insulated impervious gloves to protect against freeze burns. The use of tongs should be considered. Goggles or visors should be worn to prevent eye injuries.

Audiences

As productions have no control over the composition of their audiences special care needs to be taken to minimise risks to the audience. Exposure to the effects should ideally be avoided altogether. The person in charge of the production should know if smoke is likely to reach the audience. If this is the case the following precautions should be considered:

- Limit the amount of smoke/vapour to the minimum necessary for the desired effect
- Direct and control smoke effects to the desired place to prevent overspill into audience areas
- Printed warnings on or with the tickets
- Warning notices on the premises (reinforced by verbal warnings before the performance if this is considered necessary)

All warnings should indicate the type of persons who may be particularly at risk.

Useful reading and further information

Management of health and safety at work Management of Health and Safety at Work Regulations 1992. Approved Code of Practice HSE Books ISBN 0 7176 0412 8

Control of Substances Hazardous to Health Regulations 1994. General Approved Code of Practice L5 HSE Books ISBN 0 7176 0819 0

EH 40/96 *Occupational exposure limits* HSE Books ISBN 0 7176 1021 7

Guide to fire precautions in existing places of entertainment and like premises HMSO ISBN 0 11 340907 9

Code of practice for pyrotechnics and smoke effects Association of British Theatre Technicians, 47 Bermondsey Street, London SE1 3XT, tel 0171 403 3778

Guide to health, safety and welfare at pop concerts and similar events HMSO ISBN 0 11 341072 7

Additional copies of this information sheet are available from HSE Books.

Further advice can be obtained from HSE offices (see under Health and Safety Executive in the telephone directory). For other enquiries, ring HSE's Infoline Tel: 0845 345 0055 , or write to HSE's Information Centre, Broad Lane, Sheffield S3 7HQ.

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