

Smoke and vapour effects used in entertainment

HSE information sheet

Entertainment Information Sheet No 3 (Revision 1)

Introduction

In this information sheet, '**must**' denotes a legal obligation. Words such as 'do', 'should' etc are used to give advice on good practice and are not compulsory.

This information sheet is one of a series produced in consultation with the Joint Advisory Committee for Entertainment (JACE). It gives general guidance on the risks associated with the use of smoke and vapour in entertainment situations.

Legislation

The general legislation covering the use of these substances is contained in the Health and Safety at Work etc Act 1974.

Smoke and vapour effects are used for a range of purposes within the entertainment industry and some of the substances used to create these effects may fall under the Control of Substances Hazardous to Health Regulations 2002 (COSHH) as amended.

Under the Regulations, the level of airborne contaminants in the workplace are governed by a single limit known as the Workplace Exposure Limit (WEL). WELs are concentrations of hazardous substances in the air, averaged over a specified period of time, referred to as time-weighted average (TWA). Two time periods are used: long term (8hours) and short term (15 minutes). Current limits are set out in HSE guidance note EH40 *Workplace Exposure Limits* – which is normally updated annually. Exposure below the limits should cause no ill effects in most people, although asthmatics and small children may be at greater risk.

A COSHH risk assessment must be undertaken before using any substance hazardous to health. The substance used to create such effects should be checked against EH40 to see if any WEL has been assigned to it. It should also be checked against the Material Safety Data Sheet (MSDS) that should accompany any hazardous substance on purchase. The MSDS is not a COSHH assessment.

Assessments should take into consideration ingestion, inhalation, skin or eye contact with the substance. If you are uncertain of what to do, you should seek advice from a qualified health and safety practitioner who will have the necessary expertise to undertake the assessment.

The main substances used to generate smoke and vapour effects, their methods of use and types of effects, are briefly outlined below.

Dry ice

When dry ice, solid carbon dioxide (CO₂) is immersed in water or steam, the resultant gas causes a mist which is heavier than air and covers the stage floor. The same effect can be caused by changing liquid nitrogen or liquid synthetic air to gas. (It is worth noting that Carbon Dioxide (CO₂) has an entry in EH40.)

Oil mists/Glycol/Smoke guns

Oil mists, usually called haze, 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. Wherever possible, these should be substituted by a less hazardous effect, (many mineral oils are carcinogenic and the particular type used will need to be checked in EH40).

Smoke guns all work on the same principle although their size, precise method of operation and the chemicals used vary. The basic principle is that a mineral oil or glycol based substance is heated, atomizing it. This is then forced out of the machine under pressure.

Pyrotechnic smoke effects

When pyrotechnic smoke effects are used they may give off a range of harmful by-products. The storage and use of pyrotechnics is a specialist matter and may be subject to specific legislation concerning explosives. Details of more specific guidance is contained in Further reading.

Hazards

Smoke and vapour effects can give rise to a variety of hazards depending on the substances and how they are used. Manufacturers and suppliers must provide a MSDS concerning the hazards which may arise from their products in a variety of use situations. This information must be obtained and should be used when carrying out both COSHH and risk assessments.

Though not an inclusive list, 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 smokes or vapours.
- Smoke or vapour may obscure visibility and so increase the possibility of slips, trips or falls.
- Slips due to spilt oil or condensation from dry ice.
- Incorrect storage of any substances being used.

Risk assessment

However the smoke or vapour effect is produced, certain requirements remain constant. Work with smoke effects will be subject to 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 constitution of which may have changed during heating. The risks identified in these assessments must be eliminated or controlled so far as is reasonably practicable. Any person creating or working with 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 (as amended) 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 artistes, 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 carrying out 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 make sure 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 control and direct the smoke. Where possible, the use of Local Exhaust Ventilation (extraction) should be used to remove smoke after use.

Since CO₂ is heavier than air, particular attention should be paid to low-lying areas, such as the front of the stalls in a theatre, basements, orchestra pits and under-stage areas. It may be necessary to arrange for a competent person to monitor the CO₂ and oxygen levels in these areas if they are to be occupied by any person. Wherever possible, this monitoring should be done remotely and incorporated with an alarm alert. If the areas are not to be occupied, access to them should be denied.

Controlling exposure

On-site monitoring has indicated that it is very easy to exceed the WELs laid down in guidance note EH40. 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

Personal protective equipment (PPE) must 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. This must be appropriate to the hazards and indicated in the risk assessment. Those using dry ice or liquid nitrogen should always wear well-insulated, impervious gloves to protect against freeze burns. Such gloves are PPE and may be used in conjunction with other precautions but must always be worn if the risk has not been sufficiently removed by other means. The use of tongs or scoops 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 be avoided altogether. The person in charge of the production should know if it is possible for smoke 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 toward 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.

Animals

Consideration must be given when animals are to be used in any production where there will be smoke and vapour effects. Certain animals, eg cats can be more susceptible to airborne toxins in smoke etc. More information can be found in HSE Entertainment Information Sheet 4 *Working with animals in entertainment*.

For all productions using animals where there will be such special effects, the advice of a Veterinary Surgeon should be sought.

Further reading

Management of health and safety at work. Management of Health and Safety at Work Regulations 1999. Approved Code of Practice and guidance L21 (Second edition) HSE Books 2000 ISBN 978 0 7176 2488 1 www.hse.gov.uk/pubns/books/l21.htm

Control of substances hazardous to health (Fifth edition). The Control of Substances Hazardous to Health Regulations 2002 (as amended). Approved Code of Practice and guidance L5 (Fifth edition) HSE Books 2005 ISBN 978 0 7176 2981 7 www.hse.gov.uk/pubns/books/l5.htm

EH40/2005 Workplace exposure limits: Containing the list of workplace exposure limits for use with the Control of Substances Hazardous to Health Regulations 2002 (as amended) Environmental Hygiene Guidance Note EH40 HSE Books 2005 ISBN 978 0 7176 2977 0

The fire safety risk assessments Department for Communities and Local Government (DCLG) 2006 ISBN 978 1 85112 8228 www.firesafetyguides.co.uk Code of practice for pyrotechnics and smoke effects Association of British Theatre Technicians 1999 www.abtt.org.uk

The event safety guide: A guide to health, safety and welfare at music and similar events HSG195 (Second edition) HSE Books 1999 ISBN 978 0 7176 2453 9 www.hse.gov.uk/pubns/books/hsg195.htm

Guidelines for the use of animals in entertainment PAWSI www.pawsi.org

Further information

For information about health and safety, or to report inconsistencies or inaccuracies in this guidance, visit www.hse.gov.uk/. You can view HSE guidance online and order priced publications from the website. HSE priced publications are also available from bookshops

This document 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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