# Liquid dye penetrants containing CI Solvent Red 164: Safe use in detecting flaws or cracks in metal

## HSE information sheet

Engineering Information Sheet No EIS46

### Introduction

Some liquid penetrants used in non-destructive testing (NDT) contain CI Solvent Red 164. This guidance is to help engineering and foundry employers, whose workers use such liquid penetrants, assess the health risks. There is a short checklist at the end that may be helpful for workers.

HSE has reviewed the information available on CI Solvent Red 164 through the Advisory Committee on Toxic Substances (ACTS) and advises that users should implement controls as though it is a suspect (Category 3) carcinogen.

### Background

Aromatic azo compounds are synthetic organic chemicals which have strong colours. This makes them suitable for use as dyes. CI Solvent Red 164 is a compound used in such dyes because of its particularly strong colour, which makes it easily visible.

Use of liquid dye penetrants is a simple, reliable and low-cost technique to check for flaws or cracks in the surface of castings, forgings and welds.

The object for checking is coated with the liquid containing the dye and any surface flaws or cracks draw the dye into them by capillary action. Excess dye is then cleaned away and the surface is coated with a developer which acts like blotting paper to draw the remaining dye away from the flaw or crack to reveal the defect.

The liquid can be applied by spray (aerosol can or air gun), brush, or by immersing the test piece in a tank of liquid dye.

### Toxicology

Concern has been raised about health risks from the use of liquid dye penetrants containing CI Solvent Red for NDT purposes.

It is known that some azo dyes can be metabolised in the body producing ortho-toluidine, a substance classified as a Category 2 carcinogen in the European Union (EU). There is typically about 3.5% CI Solvent Red 164 in the relevant liquid dye penetrants, the highest-volume constituent of the penetrant liquid being kerosene (70–75%).

### Supply of liquid dye penetrant containing CI Solvent Red 164 dye

CI Solvent Red 164 concentrate is delivered to formulators in intermediate bulk containers (IBCs). The concentrate is transferred to a dye penetrant mixing tank either by pumped transfer or by gravity drain.

The red azo dye penetrant solution is then transferred by pumped delivery to a filling point located in a ventilated cabinet in which 440 ml aerosol spray cans are filled remotely. Alternatively, the solution can be transferred to a manual filling point for 25 litre or 5 litre tins for application by immersion, air gun or paint brush.

### Exposure

The two groups most likely to be exposed to CI Solvent Red 164 are workers in industries using liquid dye penetrants containing CI Solvent Red 164 for NDT (eg foundries, steel works, fabrication shops), and surveyors and assessors employed by specialist subcontractors and insurance companies.

HSE visited formulators and users to build up a profile of exposure data for these two potentially exposed groups. Usage was found to vary greatly from as little as two or three brief (less than ten seconds) aerosol spray applications per year to using at least two aerosol spray cans per week.

The British Institute of Non-Destructive Testing (BINDT) and The Welding Institute (TWI) estimate that about 60% of liquid dye penetrant testing is carried out using red azo dyes.

BINDT estimate there are 17 000 registered testers in Britain, most of whom will have worked with red azo dyes at some point. BINDT and the insurance industry Safety Assessors Federation (SAFed) indicate that liquid penetrant is used by many welders. The ONS Labour Force Survey estimates there to be around 200 000 of these in Great Britain, but there is no reliable estimate of the potential number of workers exposed.

The nature of the dye (brightness and permeability) makes any contact with the skin or clothing obvious and should encourage the worker to take immediate action to clean away any residue and seek to avoid further exposure.

## Substitution

There are red non-azo dye-containing substitutes available. However, due to the limited hazard and exposure information for both red azo dye penetrants and potential alternatives, it is impossible to say whether these would be safer alternatives. Whatever penetrants are to be used, employers should obtain comprehensive information about the precise chemical identity from the supplier to fully inform their risk assessment.

Other NDT methods are available and should be considered as part of the risk assessment. These comprise:

- visual examination;
- fluorescent dye penetrants;
- magnetic particle inspection;
- radiography;
- ultrasonics;
- eddy current.

## Control measures

Based on the data available, it is appropriate to consider that CI Solvent Red 164 may have carcinogenic potential; it should therefore be subject to the same exposure control approach as for other suspect (Category 3) carcinogens.

There is little exposure data to inform users and suppliers.

Safety data sheets for liquid penetrants containing any variant of red azo dye should recommend that users follow a precautionary approach and wear suitable respiratory, skin and body protection. This should include the advice summarised in the following checklist for workers.

## Workers' checklist

- Avoid all skin contact (this may mean changing the way the azo dye is used).
- Wear gloves classed as suitable for use with organic chemicals (frequent changes and good maintenance of gloves is essential – HSE recommends consulting a specialist safety equipment provider).
- Avoid spray application.
- Use effective extraction systems where vapours or spray may be released.
- Take extreme care when carrying out tasks where there may be exposure to those working with dye penetrants, including during:
  – disposing of contaminated material;
  – cleaning the dye off the test piece;
  – maintaining the extraction system.
- Inform other workers that carry out these tasks, or work nearby, of the need to take particular care.

## 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 guidance is issued by the Health and Safety Executive. Following the guidance is not compulsory, unless specifically stated, and you are free to take other action. But if you do follow the guidance you will normally be doing enough to comply with the law. Health and safety inspectors seek to secure compliance with the law and may refer to this guidance.

This publication is available at:
www.hse.gov.uk/pubns/eis46.htm.