



Monitoring requirements in the electroplating industry, including electrolytic chromium processes

Engineering Sheet No 3 (rev)

Introduction

This Information Sheet advises on the monitoring to be carried out at electroplating processes in order to comply with the Control of Substances Hazardous to Health Regulations 1994 (COSHH).

With respect to electrolytic chromium processes it replaces the guidance formerly given in *Chromic acid concentrations in air* EH6 (rev) HSE Books 1990.

Legal requirements

Regulation 10(1) of COSHH requires employers to monitor the exposure by a suitable procedure in any case where it is necessary for ensuring the maintenance of adequate control of exposure of employees to a hazardous substance, or where it is otherwise necessary for protecting the health of their employees.

Regulation 10(2) of COSHH further specifies, in Schedule 4, certain substances or processes where monitoring is necessary, and how often it should be carried out. Monitoring is required every 14 days for the spray given off from vessels at which an electrolytic chromium process is undertaken, except for trivalent chromium.

The need for routine monitoring should be established when the initial COSHH assessment is carried out, but in some circumstances monitoring may be necessary as part of the initial assessment.

Monitoring for the purpose of regulation 10(1) requires the use of valid and suitable occupational hygiene techniques to establish to what extent employees are exposed to substances hazardous to health. For airborne contaminants this measurement will normally involve sampling of the breathing zone of operators using personal sampling equipment but may, where appropriate, involve the periodic or continuous sampling of the atmosphere of the workplace.

If monitoring a specified substance or process in Schedule 4 for the purposes of regulation 10(2), it may be adequate to carry out inspection and test of the control measures alone. This should normally be supported by some initial sampling of the atmosphere and further sampling if appropriate to provide the baseline data for deriving suitable and adequate settings for the control measures concerned.

Monitoring is required:

- when failure or deterioration of control could create a serious risk to health;

- when necessary, to ensure that maximum exposure limits, occupational exposure standards or any in-house working standards are not exceeded;
- where it is necessary to have an additional check on the effectiveness of controls provided under regulation 7 of COSHH; and
- where the employer's work involves substances or processes specified in Schedule 4 of COSHH.

Procedures

Monitoring procedures should establish:

- when, where and how the monitoring is to be done;
- how sampling is to be carried out and the results interpreted; and
- how frequently samples should be taken.

Records

Employers should always keep a suitable record or summary of any monitoring carried out under COSHH.

Monitoring records can be kept in any format so long as they are:

- readily retrievable;
- easy to understand; and
- comparable with the health records required by regulation 11 of COSHH.

Monitoring records should be kept for at least 40 years if they record the personal exposure of identifiable employees. They should be kept for at least 5 years in all other cases.

Monitoring records should provide sufficient information to determine:

- when, where and under what conditions monitoring took place;
- what monitoring procedures were used, and how long they took;
- whose exposure was monitored; and
- what the results were.

Monitoring records should be made available to:

- employees and their representatives;
- enforcing inspectors; and
- Employment medical advisors or appointed doctors.

It should be noted that any *biological monitoring* carried out under regulation 11 cannot be accepted as monitoring of exposure under regulation 10.

Some commonly used hazardous substances for which monitoring is or may be required

Hazardous substance/process	Exposure limit	Hazard route
Chromium VI compounds including chromic acid - solution, fume, mist	MEL	Inhalation, skin
Nickel salts or compounds - solution, mist (water soluble and insoluble)	MELs	Inhalation, skin
Degreasing solvents - trichloroethylene (trike)	MEL	Inhalation, skin
Halogeno-platinum compounds	MEL	Inhalation, skin
Cyanide - solids, solutions	OES	Ingestion, skin
Hydrogen cyanide	MEL	Inhalation (if hydrogen cyanide gas)
Cadmium and cadmium compounds - dust, solution	MEL	Inhalation, ingestion
Acids - solutions, mists	OES	Inhalation, skin
Alkalis - solutions, mists	OES	Inhalation, skin

Note: Monitoring of spray given off from vessels at which an electrolytic chromium process is carried on (except trivalent chromium) is MANDATORY and must be repeated at least once every 14 days.

Other substances hazardous to health will be present in plating shops but cannot be covered in this brief guide. Also, inadvertent mixing of incompatible chemicals may lead to hazardous products: eg acid with bisulphite gives sulphur dioxide, acid with hypochlorite gives chlorine, acid with cyanide gives hydrogen cyanide.

As a general rule any substance with a MEL may require regular monitoring in conjunction with other methods of assessing control measures, such as examination of exhaust ventilation.

Electrolytic chromium processes

The monitoring requirements of Schedule 4 of COSHH apply to all electrolytic chromium processes except trivalent chromium. These include:

- hard chrome plating;
- decorative chrome plating - bright and black chrome;
- anodising - even though this is not a plating process; and
- some passivation processes.

Chromic acid and chromate solutions are often used in passivation processes, but in most cases passivation is not carried out as an electrolytic process. Where this is the case, it will not attract the requirements of Schedule 4 of the COSHH Regulations, although the remainder of the Regulations will still apply.

Prevention of exposure and control of chromic acid mist

When chromic acid is electrolysed chromic acid mist is formed. The amount of chromic acid mist emission will depend on a number of process variables, particularly: the concentration of chromic acid in solution; the surface area of the articles treated; the current density; and the length of time current is passed through the solution.

Measures for preventing exposure to chromic acid mist under regulation 7 of COSHH might include substitution by a less hazardous substance or process. In particular, it is possible to use a trivalent chromium process for decorative chrome finishes instead of solutions containing chromic acid, in which case monitoring under Schedule 4 of the COSHH Regulations will not apply.

With tightening environmental and health requirements and improved technology such substitution is now a very viable alternative. *Safer chromium finishing* published by the Metal Finishing Association provides further information.

Where changes to the process are not possible it is necessary to achieve adequate control of chromic acid mist by other means. At some operations emission of chromic acid mist can be controlled by total enclosure of the process. Where this is not reasonably practicable it is necessary to achieve adequate control by providing efficient exhaust ventilation, and/or by treating the electrolyte (plating solution) with a spray suppressant to limit the emission of spray or mist into the workplace atmosphere.

Exhaust ventilation is usually provided in the form of lip extraction along each side of the bath to avoid impeding the process operation. Where mist suppressants are used, the modern fluorinated surfactants are much to be preferred.

Even when the process can be completely enclosed, extract ventilation should still be provided at the enclosure. The extraction should be sufficient to ensure that there is movement of air into the enclosure when any access points in the enclosure are opened for purposes of process control, so preventing emission of chromic acid mist into the workroom atmosphere.

Maintenance of equipment and solutions

Chromic acid solutions are extremely corrosive to most metals. Ventilation plant and equipment should therefore be constructed of corrosion resistant materials. Because of the corrosive nature of acid mists the

extraction system should be visually checked at least weekly and, as required by regulation 9(2) of COSHH, thoroughly examined and tested by a competent person at least once every 14 months.

Where spray suppressants are used to control chromic acid mist emissions the electrolyte solution must be properly checked and maintained in accordance with the spray suppressant supplier's instructions.

Occupational exposure limit

Chromium VI compounds have a maximum exposure limit (MEL) of 0.05 mg/m³ (8 hour time weighted average (TWA)), measured as chromium (Cr). To comply with the requirements of COSHH exposure to these substances should be reduced as far below the MEL as is reasonably practicable and should never exceed the MEL when averaged over the reference period.

Provided the control measures are properly applied, used and maintained they should be capable of keeping the concentration of chromic acid in air well below 0.05mg/m³ (as Cr) 8 hr TWA.

Monitoring procedures for chromic acid mist

The purpose of the monitoring is to tell employers, and their employees, whether the measures that are being used to control emission of chromic acid mist are working satisfactorily and if adequate control of exposure to chromium VI is being maintained. The results of routine sampling at least every 14 days are used to monitor the performance of the process over a longer period.

A new validated sampling and analytical procedure for chromic acid mist has been published in HSE's Methods for the Determination of Hazardous Substances series. *Hexavalent chromium in chromium plating mists* MDHS 52/3 has now replaced MDHS 52/2 and should be used to monitor and analyse chromic acid mist concentrations as required by regulation 10(2) and Schedule 4 of COSHH. Indicator tubes are not suitable for carrying out the routine statutory test procedure.

Some key points of MDHS 52/3 are summarised below, but for full details of the equipment to be used and appropriate procedures to be followed a copy of the MDHS document should be obtained.

- A continuous air sample should be taken from a fixed/static position above, or in some cases adjacent to, the bath in normal operating conditions for at least 15 minutes (but if using a comparator, for at least one hour).
- At manual baths with local extract ventilation the sampler should be positioned with the filter vertical, 300mm above the exhaust plane of the extract system, directly over the bath and always within its edges.
- At manual baths where a spray suppressant is

used without extract ventilation the same applies except that the sampler should be placed 300mm above the upper surface of the electrolyte.

- A dummy cathode of similar surface area to the average batch process operated at the same current density may be used where the sampler impedes transfer of jigs or is at risk of contamination by splashing.
- For automatic or semi-automatic processes where the sampler is liable to impede work, it may be placed half way along the bath and 300mm above the edge. The filter should be kept vertical, facing towards the bath centre and set as near as possible to the source of fume emission.
- Enclosed systems usually have access points to the bath for process control purposes. In this case the sampling point should be as close as possible to the access point and no further than 300mm from it with the filter vertical and facing the opening.
- An alternative filter to the one used in MDHS 52/2 may now be used. See MDHS 52/3 for details.
- The correction factor applied to measurements in MDHS 52/2 is no longer necessary.

Sampling results

Each sampling position should be clearly identified for record purposes and the analytical results recorded for each sample taken. Any result higher than normal for that position should be investigated to assess the operating conditions and continued effectiveness of controls. Where spray suppressants are used checks should be done on whether appropriate additions have been made and maintained.

All records should be kept so that long-term trends and the efficiency of any control measures can be properly determined. Monitoring records for each sampling position must be retained for at least five years as required by regulation 10(3) of COSHH.

An alternative monitoring approach

Although monitoring should not automatically be equated with air sampling, most chromium electroplaters and anodisers have chosen air sampling as the means of measurement to meet requirements under regulation 10(2) and Schedule 4 of COSHH.

The monitoring method outlined in MDHS 52/3 may, however, create some practical problems in its application which could lead to the aims of regulation 10 not being met. In particular, the use of a dummy cathode may not be properly representative of the real emissions above a bath.

An alternative monitoring approach has been developed which relies on measuring the variables such as the face

velocity of the extract ventilation, ullage (freeboard), and the surfactant level which are controlling exposure. This is set out in *Safer chromium finishing* published by the Metal Finishing Association.

It is important that initial air sampling is carried out under worst case conditions ie highest current, longest plating time etc. Sufficient samples should be taken to establish a proper benchmark of exposure under these conditions. This benchmark should be set up with optimum control measures in place so that the levels recorded will be well below the MEL and as low as is reasonably practicable.

At the same time as the air sampling is carried out, measurement of the critical controls should be taken. Provided that these levels are subsequently maintained at the same or a better level than when initially established, the employer can be confident that emissions from the bath are being adequately controlled.

It is HSE's considered opinion that this approach to monitoring under regulation 10(2) and Schedule 4 of COSHH fulfils the legal requirements.

The main advantages of this approach are that measurement of ullage level, extract ventilation velocity and surface tension can be carried out more easily, more quickly and probably more cheaply than air sampling. This should allow monitoring on a more frequent basis, producing a clearer picture of what is happening in terms of control and giving early indications of any fall-off in performance. Air sampling above the bath could then be reduced in frequency as appropriate, for example to once every 3-6 months.

Useful information

COSHH: The new brief guide for employers INDG136
HSE Books (single copies free; ISBN 0 7176 1189 2 for priced packs of ten copies)

A step by step guide to COSHH assessment HSG97
HSE Books 1993 ISBN 0 11 886379 7

Health risk management: a practical guide for managers in small and medium sized enterprises HSG137
HSE Books 1995 ISBN 0 7176 0905 7

General COSHH ACOP (Approved Code of Practice) and Carcinogens ACOP and Biological Agents ACOP Control of Substances Hazardous to Health Regulations 1994 L5 HSE Books 1997
ISBN 0 7176 1308 9

Occupational exposure limits EH40/98 (Updated annually) HSE Books 1998 ISBN 0 7176 1474 3

Monitoring strategies for toxic substances HSG173
HSE Books 1997 ISBN 0 7176 1411 5

Hexavalent chromium in chromium plating mists MDHS 52/3
HSE Books 1998 (due mid 1998)

Chromium and its inorganic compounds: health and safety precautions EH2 (Rev) HSE Books 1998
ISBN 0 7176 1502 2

Nickel and its inorganic compounds: health and safety precautions EH60
HSE Books 1991 ISBN 0 7176 1341 0

Cadmium: health and safety precautions EH1 (Rev)
HSE Books 1995 ISBN 0 7176 0825 5

Health and safety in engineering workshops HSG129
HSE Books ISBN 0 7176 0880 8

Other publications

Safer chromium finishing - Metal Finishing Association
Tel: 0121 237 1122/3 Fax: 0121 237 1124

The future availability and accuracy of the publications listed in this Information Sheet cannot be guaranteed.

HSE priced and free publications are available by mail order from HSE Books, PO Box 1999, Sudbury, Suffolk CO10 6FS Tel: 01787 881165 Fax: 01787 313995

HSE priced publications are also available from good booksellers.

For other enquiries ring HSE's InfoLine Tel: 0541 545500, or write to HSE's Information Centre, Broad Lane, Sheffield S3 7HQ

HSE home page on the World Wide Web:
<http://www.open.gov.uk/hse/hsehome.htm>

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