

Isocyanate paint spraying

Safely managing spray booths and rooms



This guidance is aimed at vehicle body shop owners, managers and supervisors, their employees (particularly paint sprayers) and suppliers. It will also be useful to industries, other than motor vehicle repair (MVR), where there is spraying of isocyanate-containing paints and lacquers.

It replaces the previous HSE publication *Controlling isocyanate exposure in spray booths and spray rooms*.

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Introduction

Who is the guidance for?

This guidance is aimed at vehicle bodyshop owners, managers and supervisors, their employees (particularly paint sprayers) and suppliers. It will also be useful to industries, other than motor vehicle repair (MVR), where there is spraying of isocyanate-containing paints and lacquers.

It replaces the previous HSE publication *Controlling isocyanate exposure in spray booths and spray rooms* (WEB36).

What does the guidance cover?

This guidance focuses on the management of:

- spray booths (specially designed enclosing rooms, usually including a sophisticated ventilation and control system);
- spray rooms (not as sophisticated as booths and usually 'homemade', typically with simple extraction through a fan fitted in an outside wall).

It explains:

- health risks from isocyanate paint;
- what the law says;
- how people are exposed to isocyanate;
- important properties of spray guns and paint spray;
- how spray booths and rooms work;
- clearance indicators and other essential instrumentation;
- testing spray booths and rooms;
- advice on the design and maintenance of booths and rooms;
- advice on how to carry out smoke tests on spray booths and rooms;
- the sprayer's steps to safe working;
- a checklist of good practice, common errors and solutions.

What does the guidance not cover?

This guide **does not** cover in detail other health and safety issues relating to paint spraying such as:

- safe storage and mixing of paints;
- selection and use of appropriate respiratory protective equipment (RPE) for spraying isocyanate-based paints;
- health surveillance and biological monitoring requirements for workers involved in spraying isocyanate-based paints;
- small and medium area repair (SMART) techniques.

Information on these topics can be found at www.hse.gov.uk/mvr and in other HSE publications (see 'Further reading').

Isocyanate paint health risks

Almost all bodyshops use paints and lacquers containing isocyanate hardener. It is important to remember that 'water-based' paints can still contain isocyanates.

The bad news – occupational asthma

Materials containing isocyanate have, for many years, been the single biggest cause of occupational asthma in Great Britain. The workers at greatest risk are vehicle paint sprayers working in MVR bodyshops and in the commercial vehicle

and trailer manufacturing industry. Their risk is about 90 times greater than the industrial average for contracting occupational asthma.

Isocyanate paint mist is invisible and breathing it in can cause occupational asthma. It is not absorbed through the eyes or skin (although liquid paint on the skin can cause dermatitis).

Typical early signs of respiratory sensitisation to isocyanates include one or more of the following:

- chest tightness, often occurring outside working hours in the evening or early morning;
- persistent cough;
- recurring blocked or runny nose;
- recurring sore or watering eyes;
- wheezing;
- breathlessness;
- flu-like shivers.

If a person has early symptoms and continues to be exposed to isocyanates, they may suffer from permanent sensitisation to isocyanates and severe occupational asthma, for which there is no cure.

At this stage, asthma could be triggered by everyday smells or even cold air. This is a life-changing event and even a tiny amount of exposure to isocyanates could trigger an attack. It would almost certainly mean the person has to give up their current job. They may also have lungs that are affected by asthma over the long term, even when exposure to isocyanates has stopped.

The good news – there is a solution

The risk is completely preventable, but it will require:

- using properly designed and maintained spray booths and rooms;
- using suitable air-fed breathing apparatus (BA);
- following correct working procedures.

What the law says

Control exposure

The law, including the Control of Substances Hazardous to Health Regulations 2002 (COSHH), requires employers, and the self-employed, to control the risks from harmful substances used or produced at work, including isocyanate in paints – see www.hse.gov.uk/toolbox/harmful.

You need to take account of risks to yourself (if you run your own bodyshop), employees (if applicable) and other people who might be affected. Once the control measures are in place, and have been shown to work (commissioning), the law requires that the controls are checked and maintained, so have them examined and keep records. See 'Further reading' for other information on COSHH and controlling exposure to isocyanates.

The UK has a workplace exposure limit (WEL) for isocyanates of 20 micrograms per cubic metre ($\mu\text{g}/\text{m}^3$) of air. Exposure to isocyanate should not exceed this (see *Safety in isocyanate paint spraying*)¹ but it isn't a guaranteed safe level and exposure should be reduced as far below that level as is reasonably practicable. The publication *EH40/2005 Workplace exposure limits*² has more information.

Levels of isocyanates in the air during spraying and 'clearance' always substantially exceed the WEL. People going into the booth/room should always wear suitable RPE. The spray booth/room is there to capture all the isocyanate paint mist, which effectively protects all other workers nearby.

Monitor exposure

Currently, the only practical way to monitor the personal exposure from isocyanate spraying (from all routes of exposure) involves the worker providing a urine sample at the end of a shift. This checks whether the combination of all the protective measures is working (see *Safety in isocyanate paint spraying*).

Health surveillance

You should also provide health surveillance for paint sprayers – see *Safety in isocyanate paint spraying* and *Health surveillance for occupational asthma* (HSE's COSHH sheet G402).³

Urine testing only provides information about exposure and has no direct link with the person's health.

Report occupational asthma

The Reporting of Injuries, Diseases and Dangerous Occurrences Regulations 2013 (RIDDOR) require employers to report any medically confirmed cases of asthma or dermatitis caused by exposure to isocyanates at work (see www.hse.gov.uk/riddor).

What you need to know and do

The key messages about managing spray booths/rooms are summarised in Appendix 1. See also Appendices 2 and 3 for the key things sprayers and bodyshop owners/managers need to know and do.

Understand exposure

The main source of exposure to isocyanate is paint spraying.

All paint spraying, including spraying 2-pack isocyanate paint, produces 'over-spray', most of which you cannot see under normal lighting. The invisible mist will reach all parts of a workplace if not properly controlled. It fills the workplace soon after spraying has started and spreads like smoke.

It can be made visible with special lighting (see Figures 1 and 2).



Figure 1 Now you see it



Figure 2 Now you don't

Breathing in this invisible fine mist is what can cause occupational asthma.

After spraying, elevated levels of isocyanates may also be present during curing.

The only other potentially significant source in bodyshops is cleaning spray guns inappropriately. Mist from spray gun cleaning can contain high concentrations of isocyanate.

Controlling exposure

Enclosure

Most jobs should be done in an enclosed, ventilated spray booth or room. However, minor work may be carried out in an extracted enclosure specifically designed for the purpose (eg a spray cabinet).

The spray booth/room is there to capture all the isocyanate paint mist, which effectively protects all other people working nearby. Booths/rooms should not leak airborne paint mist. To prevent fine airborne paint mist escaping into the workplace, all spray booths/rooms should be run at a slightly lower air pressure than the surroundings so that any air is drawn into the booth or room. This is commonly referred to as running at 'negative pressure'.

For spray gun cleaning, use an extracted gun-cleaning machine or spray wash guns in the spray booth/room with the extraction turned on.

Respiratory protective equipment

People going into the booth/room when spray mist is likely to be present should always wear suitable, air-fed RPE. See *Safety in isocyanate paint spraying* for more information on RPE.

Historically, sprayers have lifted their visors to check on the quality of a paint finish. This practice should be avoided at all costs. It is essential that the sprayer **must not flip up the visor** of the air-fed BA, either while spraying or once they have finished spraying and during the clearance time.

Enclosure design

The more effective the spray booth/room, the lower the isocyanate concentration in the air. Spray booths are usually more effective than spray rooms.

Spray booths

Spray booths are specially designed enclosing rooms (sometimes called 'cabins'), usually including a sophisticated ventilation and control system. The most common design of spray booth is the 'downdraft booth'. Air enters the booth through a large area of the ceiling and is extracted through a grated opening in the floor. There are other booth designs but they tend to have the following characteristics:

- an air inlet fan and an extract fan;
- the inlet and the outlet air is filtered;
- a control panel to program and operate the booth;
- manufactured specifically for the motor or commercial vehicle trade.

Spray booths are designed to dilute and displace airborne paint mist and reduce the sprayer's exposure. The extract fan removes slightly more air than the inlet fan supplies. This ensures that the booth is held at a slightly lower air pressure than the rest of the workplace and prevents paint mist leaking out of the booth.

Spray rooms

Spray rooms are not as sophisticated as booths and are usually 'homemade'. Typically, air is extracted from a spray room through a relatively small fan fitted in an outside wall. Inlet air is drawn into the room via openings in one or more walls or in an unplanned way through gaps in the structure. The design of spray rooms varies, but they tend to have the following characteristics:

- just an extract fan;
- the extract air is not filtered, though it should be;
- the inlet air is not always filtered (although it should be to assist with paint finish quality);
- smaller sized inlets and outlets than spray booths;
- operate at lower flow rates than spray booths.

Like booths, spray rooms are designed to dilute airborne concentrations and retain the invisible paint mist. But, as spray rooms tend to extract less air, the concentration of paint mist in the room is much higher, both during paint spraying and for a considerable time afterwards.

Spray booth or room leakage

The most practical way to check leakage is not happening is to combine the clearance smoke test with a leak test. When you or your contractor fills the spray booth/room with smoke, have someone outside check that there's no leakage of smoke. Sometimes the booth doesn't leak air but the associated ductwork does. The smoke test will show this up.

To check that spray booths/rooms are operating at negative pressure they should be fitted with a negative pressure indicator. This indicates that the booth/room is not leaking and should be checked prior to each spraying operation. A simple manometer should be adequate for booths.



Figure 3 Example of a manometer fitted to a spray booth



Figure 4 Example of a 'swinging vane' fitted to a spray room

How extract ventilation works

Don't think that the ventilation will instantly sweep away the airborne paint over-spray in the booth/room. It can't and it doesn't.

Spray guns are powered by compressed air. This leaves the gun's air-cap at over 100 metres per second and with a 'throw' of well over 5 metres from the gun. Most ventilation only generates air movement of around 0.5 metres per second, so the air jet from the spray gun overwhelms the air movement inside a booth/room and rapidly fills it with fine paint mist.

Figures 5, 6 and 7 show the 'throw' of a typical paint spray gun, using smoke to make the air jet visible.

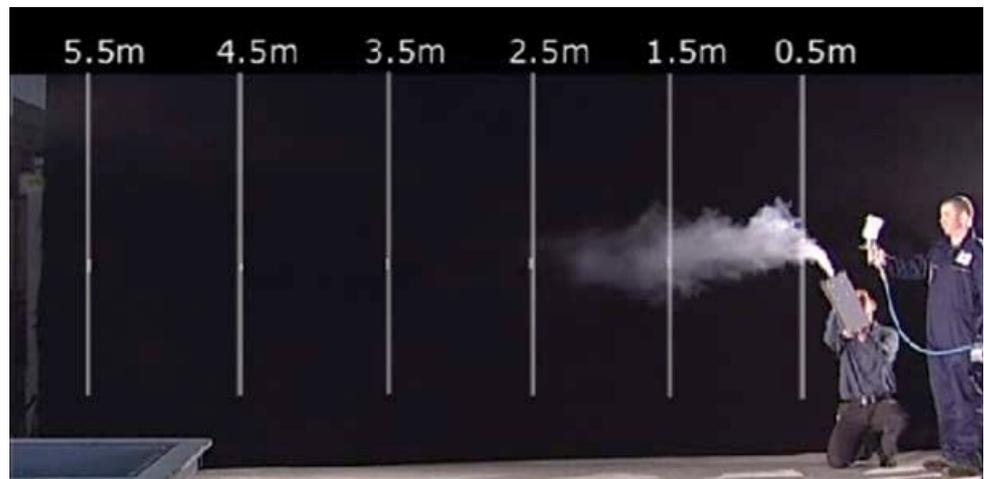


Figure 5 Less than one second after spraying started

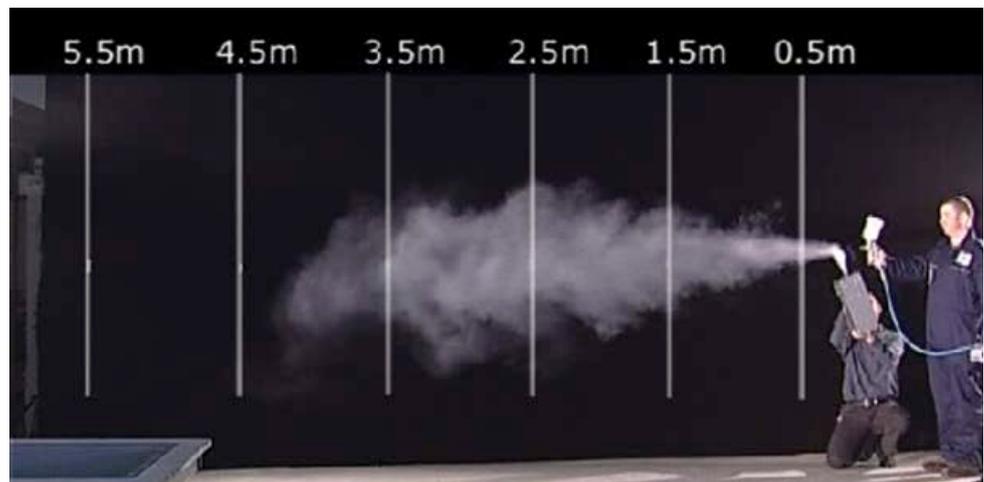


Figure 6 Two seconds after spraying started

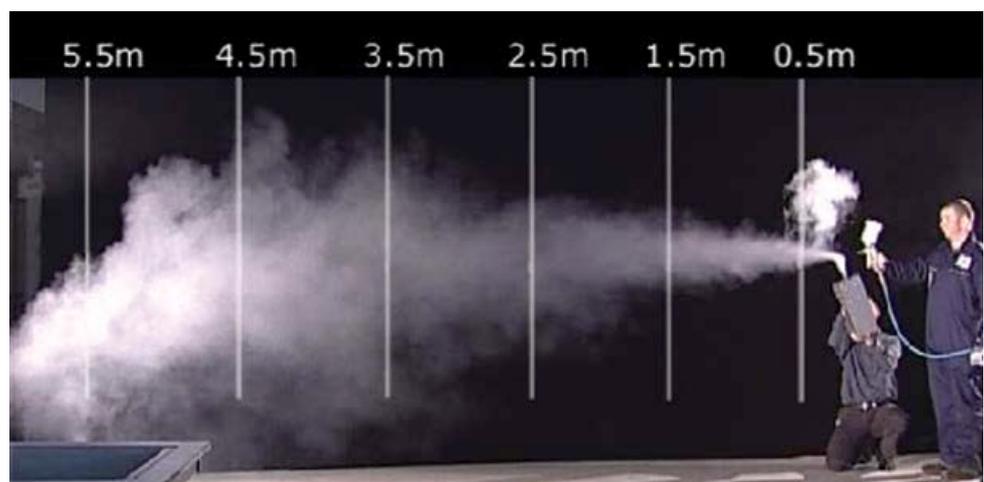


Figure 7 Four seconds after spraying started

To see spraying in practice (including the gun 'throw' shown above) and related isocyanate exposures, watch the videos at www.hse.gov.uk/mvr/resources/videos.htm.

How the air moves in a spray room

It is often believed that air moves through a spray room smoothly from the inlet(s) in one wall to the extract in another wall, carrying any paint mist with it. Unfortunately, this is not the case and air movement in spray rooms tends to be quite random and reasonably well mixed.

The only areas where the air movement has any noticeable direction is close to the room air inlet(s) and very close to the extract fan. However, spraying close to the fan, in the belief that the over-spray will be easily 'captured', is misguided. This doesn't happen because the flow of air from the spray gun easily overcomes the 'pull' of the extract fan, and the paint mist spreads throughout the room (see Figures 8 and 9).

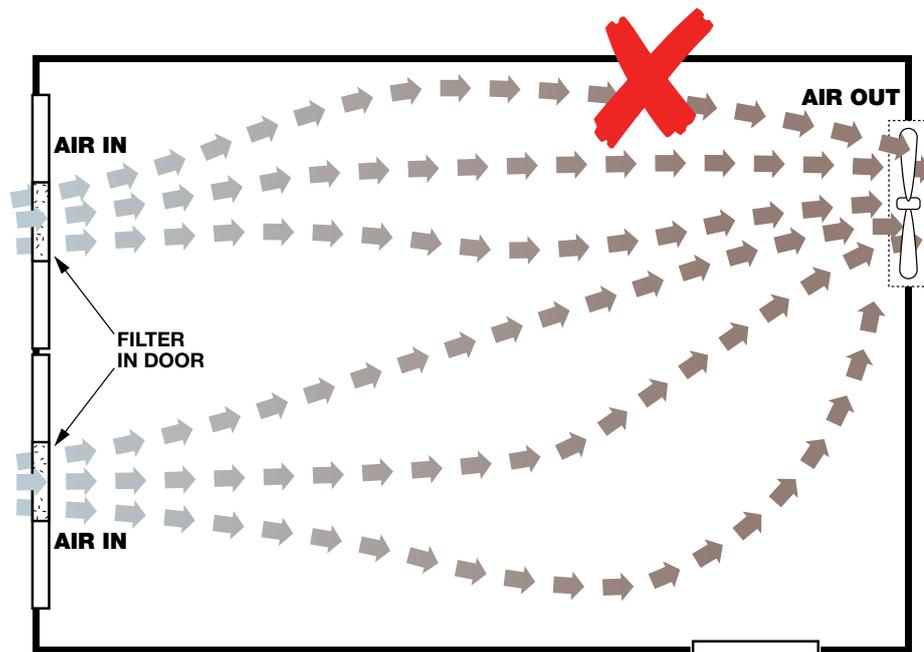


Figure 8 Imagined air movement in a spray room

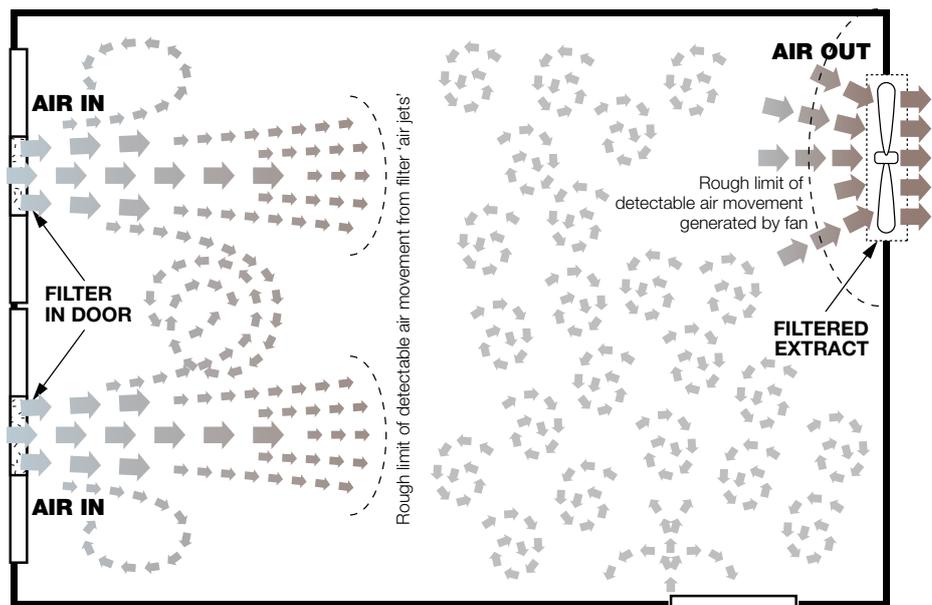


Figure 9 What really happens

Air movement in 'downdraft' spray booths

Although spray booths do generally provide better control than spray rooms, they still do not perform as effectively as people think.

For downdraft spray booths it is often thought that the air moves smoothly downwards from the ceiling to the floor of the booth. In most, if not all, downdraft spray booths this does not happen. In reality, large, slow-moving vortices are created along all four walls of the booth that typically stretch from floor to ceiling. It is in these areas that the fine, invisible mist becomes trapped during spraying and for some time afterwards. Unfortunately, the sprayer normally works in these areas (see Figures 10 and 11).

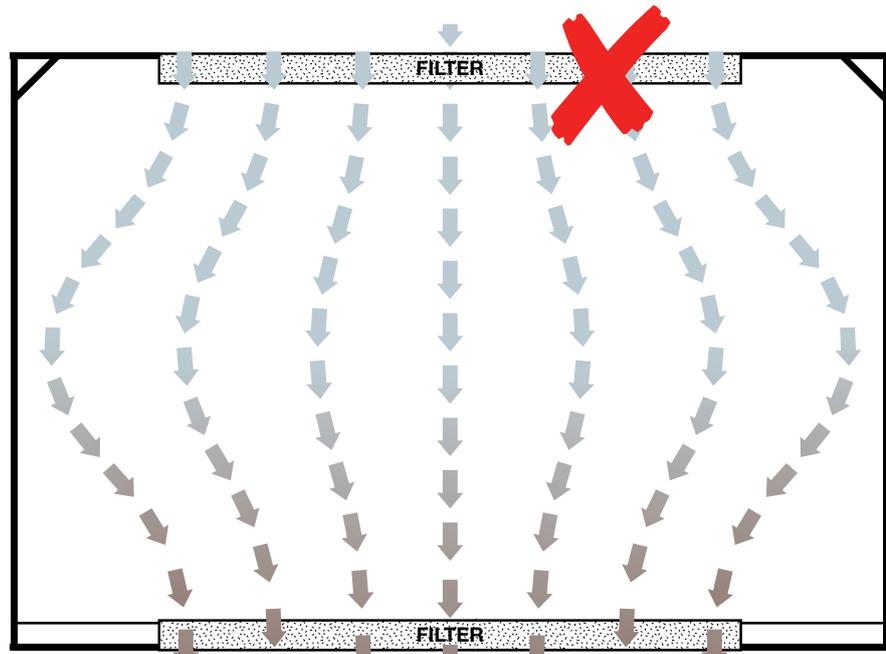


Figure 10 Imagined movement of air in a downdraft booth

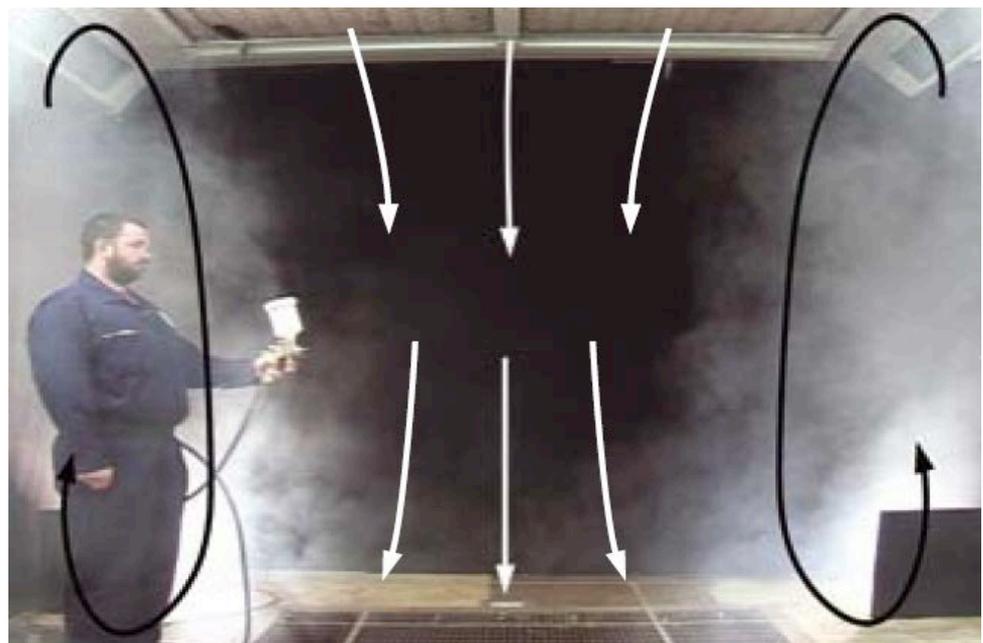


Figure 11 What really happens (as demonstrated with smoke and special lighting)

Air movement in cross-flow or tunnel booths

Cross-flow and tunnel booths also have a haphazard air movement and display similar vortices to downdraft booths (see Figures 12 and 13).

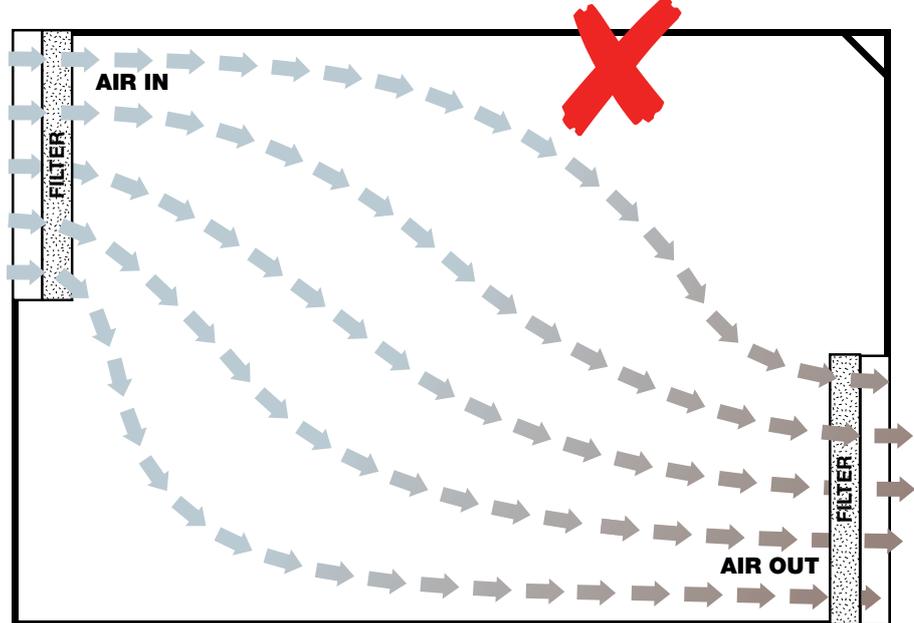


Figure 12 Imagined air movement in a cross-flow or tunnel booth

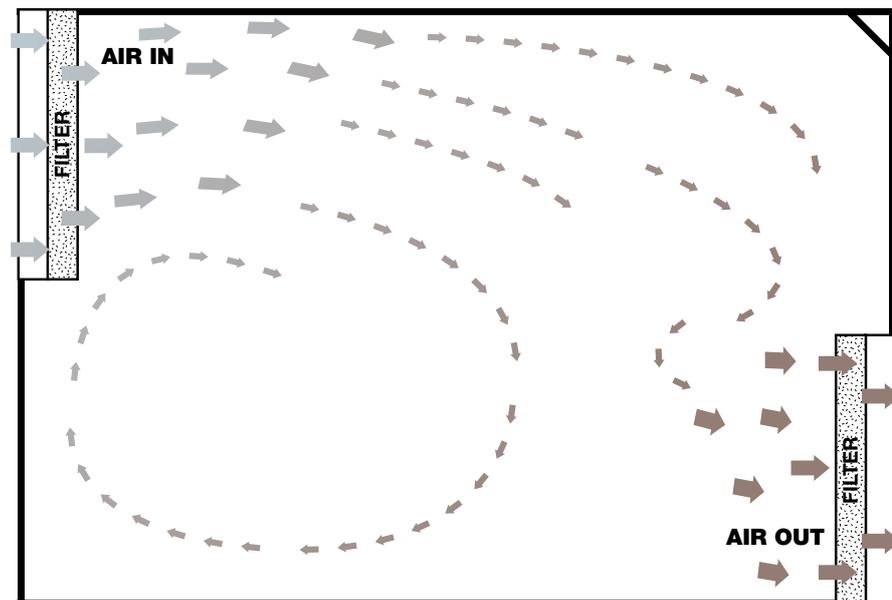


Figure 13 What really happens

Clearance time

How long the spray booth or room takes to clear

Many spray booth/room designers have focused on factors such as the number of air changes per minute that occur; the implication being that the more air changes the better for the booth/room.

For the sprayer, the most important issue is how the air flows within a booth/room and how long it takes to clear the invisible airborne paint mist. Carrying out a smoke test on a booth/room will allow you and your staff to see how air moves and how long it takes to clear.

Once spraying stops, the air passing through the booth/room will dilute and displace the invisible airborne paint mist and eventually remove it. The time taken for the fine paint mist to be removed is known as the 'clearance time'. The time for your booth/room will depend on the design and the volume of air moving through it. Typically, a booth will clear in less than five minutes, but a room could take 20 minutes or longer.

Everyone involved must know how long their spray booth/room takes to clear.

A practical way to measure the clearance time is to carry out a smoke test. You can do this yourself. Smoke 'party fog' machines are relatively inexpensive and many are suitable for determining clearance times of standard-sized booths. Guidance on how to perform this test is given at www.hse.gov.uk/mvr/bodyshop/cleartime.htm.

If you have a large commercial spray booth/room then a professional smoke generator will probably be required. These are more expensive, therefore it might be more cost-effective to ask the company who carry out the thorough examination and test to do this for you (see the section 'Thorough examination and test').

Smoke clearance tests are not exact and times measured are approximate. The initial test should be done under 'worst-case' circumstances, for instance just before the extract filters need replacing. Measuring the clearance time should also form part of the thorough examination and test.

Clearance time sign and indicator

Once you have determined the clearance time, you should place a plain and simple sign at all entrances to the spray booth/room that states:

- the clearance time;
- when the test was carried out;
- who carried out the test;
- when the test will be repeated.

An example of a clearance time certificate is given in Appendix 4.

The preferred method of informing workers when a spray booth/room is safe to enter is by installing an automatic clearance time indicator. For instance:

- This could consist of a sensor installed in the compressed airline that detects when the spray gun is being used.
- During spraying, a light could be illuminated on the outside of the booth or room indicating that people must not enter.
- If practical, the light should be also visible from the inside of the booth/room.
- When spraying stops, a timer ensures the light stays on for the clearance time period.⁴

Leaving a spray booth or room safely

Sprayers, and other users, must know the clearance time of their booth or room. The sprayer does not need to stand in the booth/room while waiting for it to clear, but must know how to leave the booth/room safely during the clearance time.

To leave a booth/room safely during the clearance time:

- walk to the pedestrian door wearing air-fed BA. The air hose must be long enough, and the connection point by the door;
- open the door, unplug the airline and hang it next to the door;
- step out, shut the door and remove the air-fed BA.

Local exhaust ventilation (LEV) efficiency

Commissioning

HSE guidance *Controlling airborne contaminants at work. A guide to local exhaust ventilation (LEV)*⁵ gives advice on commissioning systems, including:

- diagrams and a description of the system, including test points;
- details of the LEV performance specification;
- results such as pressures and velocities at stated points;
- a written description of the commissioning, the tests undertaken, and the outcome.

See Appendix 6 for further details.

Checking and maintenance

Engineering controls such as booths, rooms and extracted enclosures must be regularly checked and maintained. Details of what an employer should arrange to be done should be provided in the user manual.

Booth or room user manual

Equipment suppliers are legally obliged to provide adequate information about how it should be used, how it has been designed and tested, and any conditions necessary to ensure it is safe and without risks to health throughout its operating life. HSE's guidance *Controlling airborne contaminants at work. A guide to local exhaust ventilation (LEV)* recommends that, just like a car, spray booths/rooms should be supplied with a user manual.

The level of detail will depend on the complexity of the spray booth/room. Typically, the user manual should cover the following, and include a 'log book' or equivalent so that you can record your findings:

- a description of the spraying enclosure, including a drawing;
- a regular maintenance schedule and description of the checks needed to ensure the enclosure is operating as designed and commissioned, (for example daily, weekly and monthly checks with example sheets for recording the checks and any actions taken);
- air quality tests for BA supply (to be performed at least once every three months unless you have evidence to demonstrate that air quantity and quality are stable);
- maintenance:
 - filter replacement schedule;
 - lights (eg replace failed bulbs, keep covers clean, consider fitting protective film to the lights which can be replaced on a regular basis);
 - air supply (filters and compressor);
 - list of replacement parts (and part numbers);
- smoke tests:
 - clearance time test;
 - leakage test (see 'Further reading');
- instruction on how to use the enclosure safely;
- details of thorough examination and testing.

If you **do not** have a user manual for your spray booth/room, you should obtain or develop one with help from the supplier/installer, manufacturer or other industry advisers.

Thorough examination and test

In addition to regular checks and maintenance, the spray booth, room or extracted enclosure should be 'thoroughly examined and tested' by a competent person at least once every 14 months. This is a requirement of COSHH (regulation 9).

The thorough examination and test is, in effect, an audit of your own checking and maintenance over the year. Follow the recommendations in the report of thorough examination and test and, if it's clear that the spray booth/room operation or fabric has deteriorated, look critically at your own checking and maintenance. Records need to be kept for at least five years. (See Appendix 6 for further details.)

A thorough examination and test report should include smoke tests for clearance and leakage. Velocity measurements within the booth/room may also be made as a check on the amount of air entering and on the evenness of air velocity. The measurements allow you to compare performance from one year to the next (consistency) so measurements should be made at standardised positions, for instance at fixed points and heights. This is easier and quicker to do with no vehicle present, and will give results that are easier to compare.

After a thorough examination and test, it is now industry accepted practice that the spray booth/room should have a label attached to it, stating when it was tested and examined, who did it, and when it will be re-tested. If the booth/room fails the annual thorough examination and test (eg because it was operating at a positive pressure), the examiner should also attach an additional (usually red) label indicating this. The spray booth/room should not be used until the fault is rectified and it is shown to be operating as intended.

Appendix 1 Key messages

Key message 1

What spray booths and spray rooms do

- Contain the paint mist.
- Dilute the paint mist.
- Reduce potential exposure of the sprayer (but air-fed BA must also be used).
- Prevent the exposure of other people who are outside the spray booth/room.
- Filter and discharge the extracted air to the atmosphere.

Key message 2

Spray booth/room operation and sprayer behaviour

- The booth/room should operate under a negative pressure – all leaks must be inwards.
- You should have a negative pressure indicator fitted.
- Check the sprayers know how to behave in the booth/room and how to leave safely (particularly not to lift the RPE visor during spraying activities, eg to check paint quality).

Key message 3

How long your spray booth/room takes to clear

- All booths/rooms take time to clear of the invisible mist.
- You must know the clearance time of your booth/room.
- Measure the clearance time using smoke and, at the same time, check that the booth/room and ductwork is not leaking.
- Put the clearance time on the outside of the booth/room and tell everyone who needs to know.
- Clearance time indicators are the preferred method of letting others know when a booth/room is safe to enter.

Appendix 2 Sprayer's steps to safe working

- Remember that most airborne paint mist is invisible.
- Always spray paint in a spray booth/room and not in the open workshop.
- Always make sure your spray booth/room runs under negative pressure (so any air leakage is inward).
- Always wear air-fed BA during paint spraying.
- All spray booths/rooms have a 'clearance time'; you need to know what it is.
- Keep your mask on during the clearance time (or leave the spray booth/room safely).
- Don't raise your visor while in the spray booth/room.
- Regularly check and maintain your spray booth/room and air-fed BA.

Appendix 3 The employer's/manager's checklist

Use this checklist to check on your performance and take the action needed to better control exposure to isocyanates.

Aim	Common problems	Common causes	Effects	What you should do	What you are going to do
Know the clearance time	<ul style="list-style-type: none"> ■ Don't know that a spray booth/room has a clearance time ■ Guess at the clearance time 	<ul style="list-style-type: none"> ■ Can't see the paint mist ■ Think that air flows straight out taking the 'over-spray' with it 	<ul style="list-style-type: none"> ■ Regular isocyanate exposure to the sprayer ■ Isocyanate exposure to those using the workplace and possibly those nearby, including the public 	<ul style="list-style-type: none"> ■ Measure the clearance time using a smoke test 	
Show the clearance time	<ul style="list-style-type: none"> ■ Clearance time is known but not shown and nobody knows what to do 	<ul style="list-style-type: none"> ■ Poor management and communication 	<ul style="list-style-type: none"> ■ Regular, high, short-term isocyanate exposure for the sprayer ■ Isocyanate exposure to those using the workplace and possibly nearby, including the public 	<ul style="list-style-type: none"> ■ Put up a clear sign on all entrances to the spray booth/room ■ Explain to all who need to know ■ Install a simple clearance time indicator 	

Aim	Common problems	Common causes	Effects	What you should do	What you are going to do
<p>Contain all paint mist in spray booth/room</p>	<ul style="list-style-type: none"> ■ Booth/room leaks or discharges fine paint mist, causing exposure to other workers within the premises as well as in neighbouring premises 	<ul style="list-style-type: none"> ■ Extract filter blocked and needs changing – booth/room becomes pressurised ■ Air in/out imbalance ■ Poor booth integrity, eg damaged or missing door seals ■ Failure of automatic over-pressurisation shutdown system 	<ul style="list-style-type: none"> ■ High isocyanate exposure to all using workplace 	<ul style="list-style-type: none"> ■ Manage filter-changing procedure (keep spares, agree run-time or similar, appoint a responsible person) ■ Daily checks on physical state ■ Prior to use, check pressure readings and records kept 	
<p>Filter and discharge extracted air safely</p>	<ul style="list-style-type: none"> ■ Spray booth/room exhaust recirculates into the workplace 	<ul style="list-style-type: none"> ■ Booth/room extract air not filtered ■ Poor discharge position 	<ul style="list-style-type: none"> ■ Isocyanate exposure for those using the workplace and possibly those nearby, including the public 	<ul style="list-style-type: none"> ■ Provide adequate exhaust filters (two-stage) that discharge to a safe position 	
<p>Brief, train and supervise sprayers</p>	<ul style="list-style-type: none"> ■ Operator raises visor or removes BA during clearance time 	<ul style="list-style-type: none"> ■ Little understanding of the risks ■ Poor lighting levels (so can't see the quality of the paint finish) ■ No knowledge of clearance time and procedures ■ Poor visibility through visor ■ Poor supervision 	<ul style="list-style-type: none"> ■ Very high, short-term isocyanate exposure 	<ul style="list-style-type: none"> ■ Explain the risks ■ Ensure awareness of clearance time – provide training ■ Provide and maintain suitable lighting ■ Agree and explain safe methods of working ■ Check and maintain the air-fed BA, including visor and tear-off strips 	

Aim	Common problems	Common causes	Effects	What you should do	What you are going to do
<p>Check and maintain your spray booth/room</p>	<ul style="list-style-type: none"> ■ Checks/maintenance not done or only when ventilation fails 	<ul style="list-style-type: none"> ■ No management system or appreciation of risks ■ No user manual and/or inadequate guidance from supplier 	<ul style="list-style-type: none"> ■ Particularly high isocyanate exposure for sprayers but the sprayer should be protected by BA ■ Others in your workplace may also be exposed (without protection) ■ Loss of production 	<ul style="list-style-type: none"> ■ Manage spray booth/room checks, maintenance and use ■ Get, or develop, a user manual ■ Brief and explain procedures for all concerned including the sprayers and bodyshop manager 	
<p>Check and maintain air-fed BA</p>	<ul style="list-style-type: none"> ■ No checks are made and air flow and/or quality falls ■ BA equipment is not checked and maintained and protection deteriorates 	<ul style="list-style-type: none"> ■ Air-fed BA is assumed to 'work' without any need for checks and maintenance ■ Air-fed BA is not seen as equipment like the booth or room ■ No-one is made responsible or given time to check and maintain equipment ■ No spare parts are kept in store 	<ul style="list-style-type: none"> ■ Deterioration in protection ■ Poor visibility means sprayer flips up (raises) visor ■ Sprayer isocyanate exposure rises ■ Risk of occupational asthma increases 	<ul style="list-style-type: none"> ■ Train sprayers to check equipment before each use and report defects ■ Appoint a responsible person to check and maintain equipment monthly (could be the sprayers themselves) ■ Agree simple, practical checks and maintenance ■ Carry enough spare parts on site ■ Keep suitable inspection and maintenance records and audit them 	

Aim	Common problems	Common causes	Effects	What you should do	What you are going to do
<p>Check your exposure control measures are working</p>	<ul style="list-style-type: none"> ■ People don't follow safe working procedures and expose themselves to isocyanate during the clearance time 	<ul style="list-style-type: none"> ■ Controls are assumed to work and no checks are done ■ 'I've told them to wear it but what can you do?' 	<ul style="list-style-type: none"> ■ Some people follow procedures and safe working methods and others don't ■ Control of isocyanate exposure is erratic ■ Risk of occupational asthma rises for some people 	<ul style="list-style-type: none"> ■ Measure isocyanate exposure of sprayers (and others who need to enter the booth/room) using urine sampling ■ Do this soon after employing a new starter and annually ■ If exposure is consistently well controlled reduce the frequency of test ■ Provide health surveillance (lung function tests and questionnaire) to measure lung deterioration and identify early symptoms of ill health that may have been caused by exposure to isocyanate paints 	

Appendix 4 Example of a clearance time certificate

THE CLEARANCE TIME OF THIS SPRAY BOOTH IS:

..... **Minutes** **Seconds**

DO NOT raise visor whilst spraying or during the clearance time
DO NOT enter without air-fed breathing apparatus during the clearance time

ISOCYANATES IN PAINT CAN CAUSE ASTHMA

Test date Spray booth model

Test carried out by Spray booth number

Date of next test

Appendix 5 Essential design features of spray booths and rooms

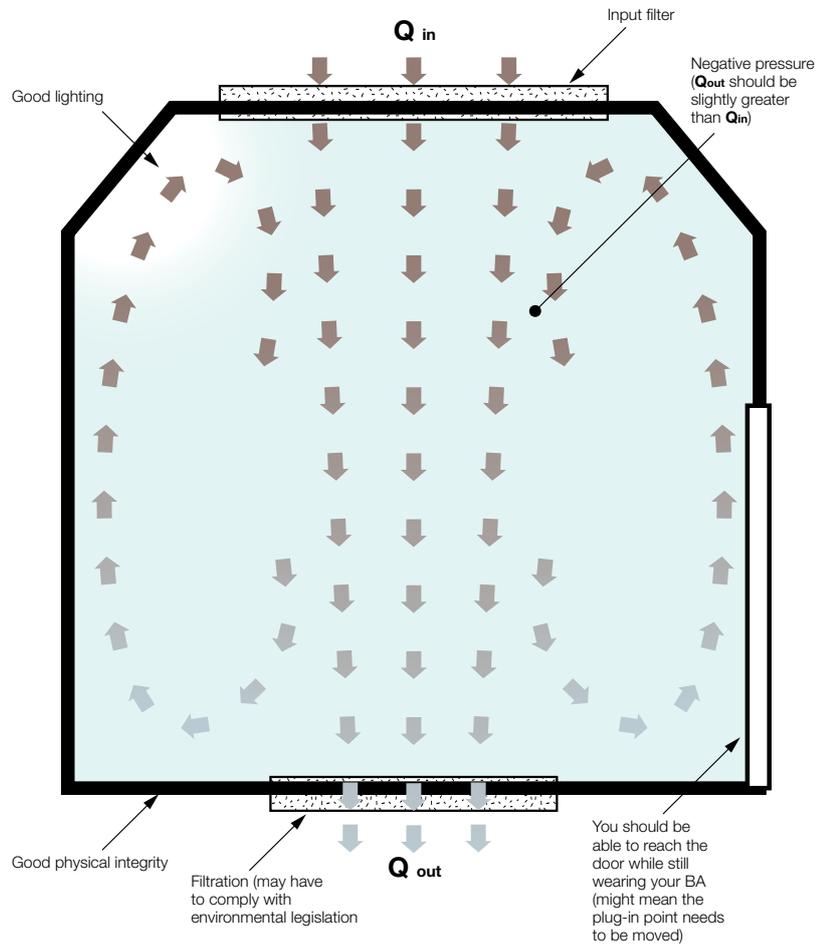


Figure 14 Essential features of a spray booth

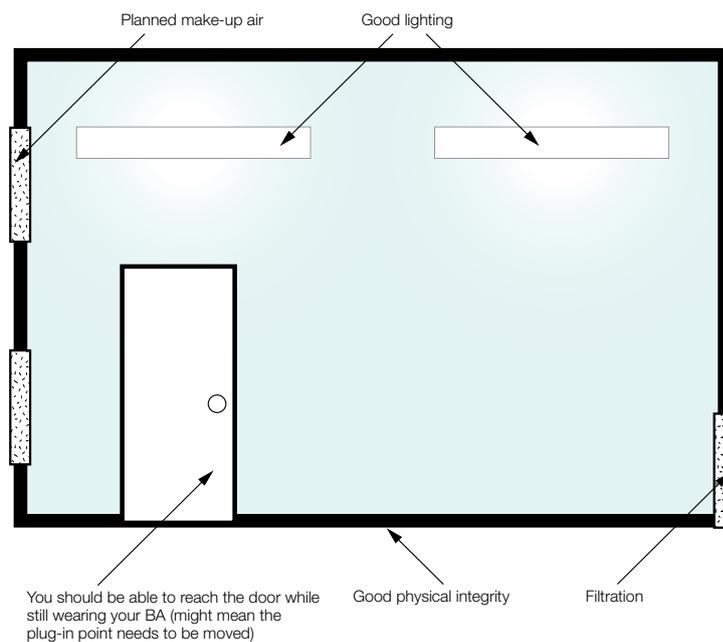


Figure 15 Essential features of a spray room

Appendix 6 Commissioning, thorough examination and testing

Commissioning

Spray booths/rooms require commissioning. The main issues to be covered in commissioning any local exhaust ventilation (LEV) system are identified in *Controlling airborne contaminants at work: A guide to local exhaust ventilation*. These include:

- diagrams and a description of the system, including test points;
- details of the LEV performance specification;
- results such as pressures and velocities of stated points;
- calculations;
- a written description of the commissioning, the qualitative and quantitative tests undertaken (including air sampling results where necessary), and the outcome;
- a description of operator behaviour for optimum LEV effectiveness.

Table 17 of *Controlling airborne contaminants at work: A guide to local exhaust ventilation* contains further useful information on the principles of commissioning LEV plant.

Our understanding of booths and rooms, and the most important factors that control exposure, has improved. The emphasis during commissioning has previously been mainly on the booth/room air-change rate and, in the case of booths, the velocity of air at fixed points around a vehicle inside it. Now the emphasis is on measuring the clearance time and ensuring that the booth/room runs at slightly negative pressure so it doesn't leak during spraying. The smoke test is important in achieving that.

Air velocities and pressures measurement will also be important to establish the technical performance of a spray booth/room. Measurement procedures should be written down and done in a standard way so that they can be repeated during thorough examination and test work. For instance, in a down-draught booth, the supply and extract volume flows should be measured.

For booths it is also useful to measure internal air velocities at fixed points, for instance in front of the supply filter panels and above the extract grilles. Then these results can be compared with later measurements as a measure of booth/room air-flow performance.

Thorough examination and test

Spray booths/rooms and extracted enclosures should be examined by a competent person at least every 14 months. The examination and test should compare the performance of the booth/room, extracted enclosure etc with the commissioning test findings.

(Air-fed BA should also be examined, typically every month, in line with the manufacturer's instructions. Additionally, the air supply quality should be tested every three months.)

Test report

The thorough examination and test report should contain at least the following details:

- name and address of the employer responsible for the plant;
- identification and location of the LEV plant and the process and hazardous substance concerned;
- date of the last thorough examination and test;

- date of the current examination and test;
- name, job title and employer of the person carrying out the examination and test;
- signature or other acceptable means of identifying the person carrying out the examination and test;
- plant condition at the time of the test and whether this was normal production or special conditions;
- intended operating performance of the plant for adequately controlling the hazardous substance;
- whether the plant is still achieving the same performance;
- the methods used to judge performance, eg visual, pressure measurements, airflow measurements, dust lamp, air sampling, tests to check the condition and effectiveness of the filter;
- if not achieving the same performance, the adjustments and repairs needed to achieve that performance;
- details of the adjustments and repairs actually carried out, including proving the effectiveness of repairs by re-test (these details should be completed by employers responsible for the LEV plant).

Further advice is contained in *Control of substances hazardous to health. Approved Code of Practice and guidance*⁶ and in *Controlling airborne contaminants at work: A guide to local exhaust ventilation*.

References

- 1 *Safety in isocyanate paint spraying* Leaflet INDG388(rev2) HSE 2013
www.hse.gov.uk/pubns/indg388.htm
- 2 *EH40/2005 Workplace exposure limits: Containing the list of workplace exposure limits for use with the Control of Substances Hazardous to Health Regulations (as amended)* Environmental Hygiene Guidance Note EH40 (Second edition) HSE Books 2011 ISBN 978 0 7176 6446 7
www.hse.gov.uk/pubns/books/eh40.htm
- 3 *Health surveillance for occupational asthma* COSHH essentials sheet G402 HSE 2006 www.hse.gov.uk/pubns/guidance/g402.pdf
- 4 *An automated system for indicating spray clearance times of MVR spray booths and rooms* Health and Safety Laboratory research report
www.hse.gov.uk/research/rrpdf/rr742.pdf
- 5 *Controlling airborne contaminants at work. A guide to local exhaust ventilation (LEV)* HSG258 (Second edition) HSE Books 2011 ISBN 978 0 7176 6415 3
www.hse.gov.uk/pubns/books/hsg258.htm
- 6 *Control of substances hazardous to health. The Control of Substances Hazardous to Health Regulations 2002 (as amended). Approved Code of Practice and guidance* L5 (Sixth edition) HSE Books 2013 ISBN 978 0 7176 6582 2
www.hse.gov.uk/pubns/books/l5.htm

Further reading

General MVR advice, including paint spraying

- www.hse.gov.uk/mvr/index.htm
- *Health and safety in motor vehicle repair and associated industries* HSG261
HSE Books 2009 ISBN 978 0 7176 6308 8
www.hse.gov.uk/pubns/books/hsg261.htm

Paint spraying

- *Safety in isocyanate paint spraying* Leaflet INDG388(rev2) HSE 2013
www.hse.gov.uk/pubns/indg388.htm
- *SMART paint spraying: How to control health and safety risks* Leaflet INDG473
HSE Books 2013 www.hse.gov.uk/pubns/indg473.htm
- MVR COSHH essentials summary sheet www.hse.gov.uk/mvr/resources/summary.pdf
- Individual COSHH sheets for MVR www.hse.gov.uk/mvr/topics/general-coshh.htm

Clearance testing

- *Party fog machines suitable for measuring clearance time: Review and clearance time method* HSL/2006/43
www.hse.gov.uk/research/hsl_pdf/2006/hsl0643.pdf

Extraction systems

- Local exhaust ventilation www.hse.gov.uk/lev/index.htm

Biological monitoring and health surveillance

- *Biological monitoring in the workplace: A guide to its practical application to chemical exposure* HSG167 HSE Books 1997 ISBN 978 0 7176 1279 6
www.hse.gov.uk/pubns/books/hsg167.htm
- *Urine sampling for isocyanate exposure measurement* COSHH essentials sheet G408 HSE 2006 www.hse.gov.uk/pubns/guidance/g408.pdf
- *Health surveillance for occupational asthma* COSHH essentials sheet G402 HSE 2006 www.hse.gov.uk/pubns/guidance/g402.pdf

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 leaflet is available at: www.hse.gov.uk/pubns/hsg276.htm.

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