

Controlling isocyanate exposure in spray booths and spray rooms



Contents

Introduction 2

Exposure to isocyanate 3

Where should people spray? 5

What are spray booths and spray rooms and how do they work? 5

How does the air move inside spray booths and spray rooms? 6

What users of spray booths and spray rooms need to know 8

Leaving a spray booth or room safely during the clearance time 9

Does your spray booth or room leak? 10

What are the essential features of a spray booth? 11

What are the essential features of a spray room? 12

What does the law say? 12

Commissioning 12

Checking and maintenance 13

Summaries for employers/managers and sprayers 14

Appendix 1 Spray booth/room clearance time and leakage test 19

Appendix 2 Example of a clearance time certificate 21

Appendix 3 Commissioning and thorough examination and test of spray booths and rooms 22

References 24

Further reading 24

Further information 24

Introduction

Who is this guidance for?

1 This guidance is aimed at owners and managers of bodyshops and will be of use to employees (particularly paint sprayers) as well as suppliers. It supplements other HSE guidance relating to protecting people's health from isocyanate exposure in spray booths and rooms, and the statutory 14-monthly thorough examination and test carried out on spray booths and rooms.

What does it cover?

2 The guidance covers:

- how people are exposed to isocyanate in 2-pack paints;
- the early symptoms of occupational asthma;
- important properties of paint spray and spray guns;
- how spray booths and rooms work;
- essential instrumentation and tests on spray booths and rooms;
- what the law says;
- the user manual;
- the sprayer's seven steps to safe working;
- other sources of isocyanate exposure;
- a checklist of good practice, common errors and solutions.

3 The advice will help you ensure people are not exposed to isocyanate paint mist. It does not cover details of the design and maintenance of booths and rooms or other safety-related issues (information on these can be found at www.hse.gov.uk/lev/index.htm and www.hse.gov.uk/mvr/index.htm).

4 Appendix 1 explains how to carry out smoke tests on spray booths and rooms (including clearance time measurement and leakage tests). Appendix 2 gives an example of a clearance time sign. Appendix 3 covers thorough examination and test.

The bad news

5 For many years, materials containing isocyanate have been the single biggest cause of occupational asthma in Great Britain. The workers at greatest risk are vehicle paint sprayers working in motor vehicle repair (MVR) bodyshops and in the commercial vehicle and trailer manufacturing industry. Their risk is over 80 times greater than the industrial average.

The good news

6 The risk is completely preventable. But it will require:

- proper design, application and use of spray booths and rooms;
- using air-fed breathing apparatus;
- following correct working procedures.

This guidance explains what is necessary.

Paints

7 Almost all motor vehicle repair bodyshops use 2-pack isocyanate or '2K' paint for spraying vehicles. There has been no change with the introduction of the EU Paints Directive. In fact the Directive is likely to increase the amount of isocyanate used in automotive paints.¹

Exposure to isocyanate

8 The main cause and source of exposure to isocyanate is paint spraying. The only other potentially significant source is if spray-gun cleaning is carried out inappropriately. This is because the mist from spray gun cleaning can contain high concentrations of isocyanate. Consider using an extracted gun cleaning machine.

9 The more effective the spray booth or room, the lower the isocyanate concentration in air. Spray booths are usually more effective than spray rooms. To illustrate this, the UK (8-hour) exposure limit is 20 micrograms per cubic metre ($\mu\text{g}/\text{m}^3$) of air. (Note: this isn't a safe exposure level and exposure can and should be much lower than this, but the number is useful for comparing exposures.)

10 Isocyanate exposures in spray rooms may exceed 6000 $\mu\text{g}/\text{m}^3$ (or 300 times the UK numerical limit of 20 micrograms per cubic metre of air ($\mu\text{g}/\text{m}^3$)). Isocyanate exposures in spray booths may exceed 600 $\mu\text{g}/\text{m}^3$ (or 30 times the UK numerical limit of 20 ($\mu\text{g}/\text{m}^3$)).

Fine paint mist is invisible

11 All paint spraying produces 'over-spray', most of which you cannot see under normal lighting. It is this invisible mist that sprayers and others inhale which causes occupational asthma. It fills the booth or room, 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

You can get asthma from breathing in paint mist

12 Isocyanate enters people's bodies when they breathe in the fine mist. In bodyshops, it is not absorbed through the skin (although liquid paint on the skin can cause dermatitis) or through the eyes.

Spray guns produce a fast-moving air jet

13 Spray guns are powered by compressed air, which leaves the air-cap at high speed (over 100 metres per second). The air jet has a 'throw' of over 12 metres. Most spray booth ventilation only generates air movement of around 0.5 metres per second. The spray gun air-jet overwhelms the air movement inside a booth or room and rapidly fills it with fine paint mist. Don't think that the booth ventilation will instantly sweep away the airborne paint over-spray. It can't and it doesn't.

14 Figures 3, 4 and 5 show the 'throw' of a typical compliant paint spray gun using smoke to make the air-jet visible. You can download a video supporting the advice from the HSE website at www.hse.gov.uk/mvr.

Figure 3 Less than one second after spraying started

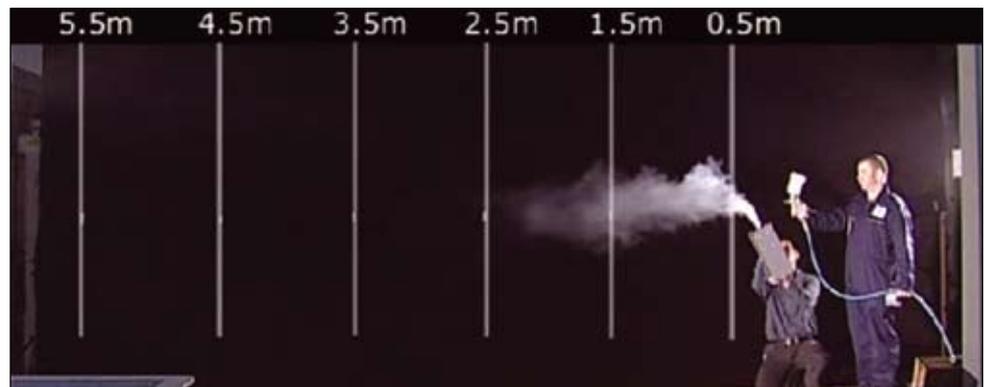


Figure 4 Two seconds after spraying started

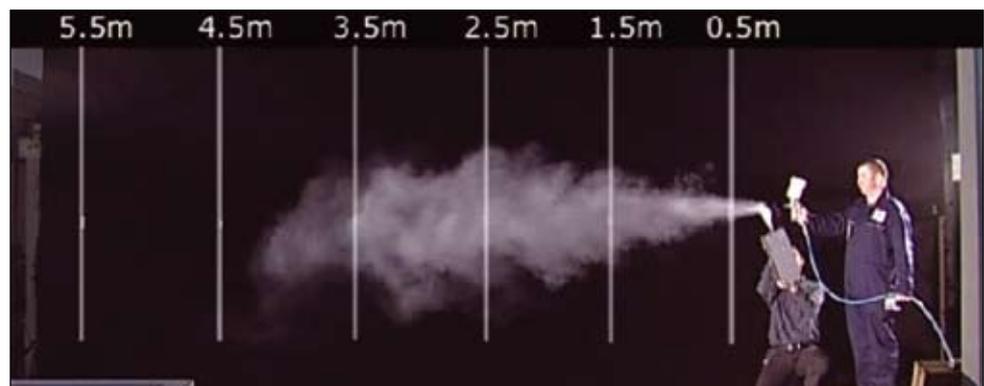
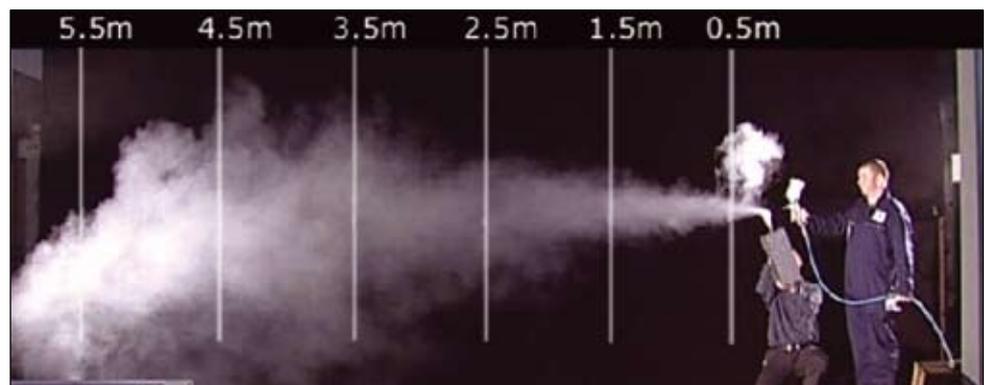


Figure 5 Four seconds after spraying started



What are the symptoms of occupational asthma?

15 Breathing in the fine isocyanate paint mist may cause occupational asthma. 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;
- persistent cold;
- wheezing;
- breathlessness; and
- flu-like shivers.

16 If a person has early symptoms and continues to expose themselves to isocyanates, they may suffer from permanent and severe asthma, for which there is no cure. At this stage, asthma could then be triggered by everyday smells or even cold air. Being this disabled 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.

Where should people spray?

17 Spraying of 2-pack isocyanate paint produces a 'smoke' of invisible mist, which will reach all parts of a workplace if not properly controlled. Most jobs should be done in an enclosed, ventilated spray booth or room. Minor work, however, may be carried out in an extracted enclosure specifically designed for the purpose.

What are spray booths and spray rooms and how do they work?

Spray booths

18 Spray booths are specially designed enclosing rooms (sometimes called 'cabins' or 'booths'), 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 all have the following characteristics:

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

19 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 bodyshop and prevents paint mist leaking out of the booth.

Spray rooms

20 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. As spray rooms are often purpose-built, their designs vary but they tend to have the following characteristics:

- they usually have just an extract fan;
- the extract air is not filtered, though it should be;
- the inlet air is not always filtered;
- they tend to have smaller sized inlets and outlets than spray booths;
- they tend to operate at lower flow rates than spray booths.

21 Like booths, spray rooms are designed to dilute airborne concentrations and retain the fine 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.

Key message 1 - What do spray booths and spray rooms do?

- Contain the paint mist
- Dilute the paint mist
- Reduce potential exposure of the sprayer, but air-fed breathing apparatus must also be used
- Prevent the exposure of others, in the bodyshop and outside
- Filter and discharge the extracted air to atmosphere

How does the air move inside spray booths and spray rooms?

22 Historically, many spray booth 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 (or spray room). For the sprayer the most important issue is how the air flows within a spray booth or room and how long it takes to clear of fine, invisible, airborne paint mist. When smoke tests are done, you and your staff will see how air moves in your spray booth or room and how long it takes to clear. You will be surprised. The most common spray booth and room designs are described below.

Typical 'downdraft' spray booth

23 It is often mistakenly believed 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.

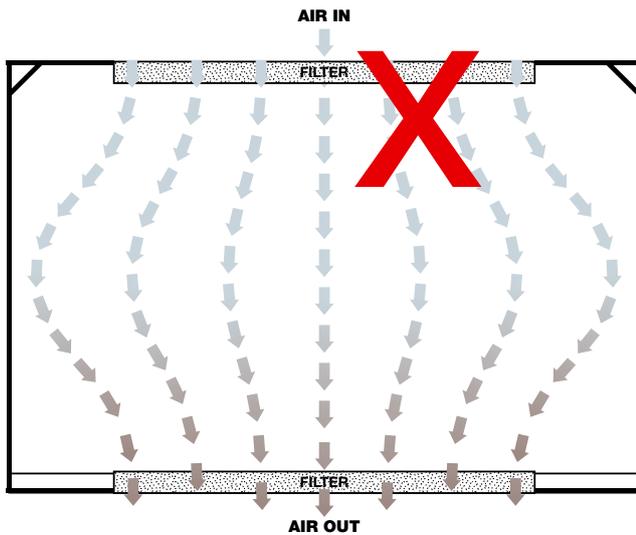


Figure 6 Imagined movement of air in a downdraft booth

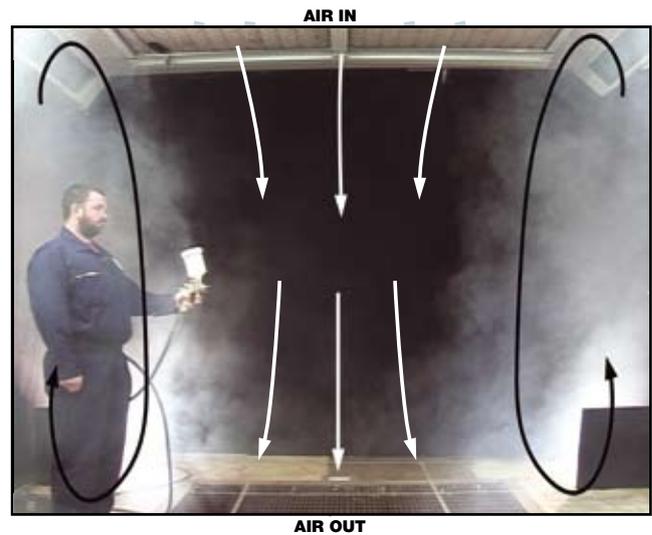


Figure 7 What really happens

Typical crossflow or tunnel booth

24 Crossflow and tunnel booths also have a haphazard air movement and display similar vortices to downdraft booths.

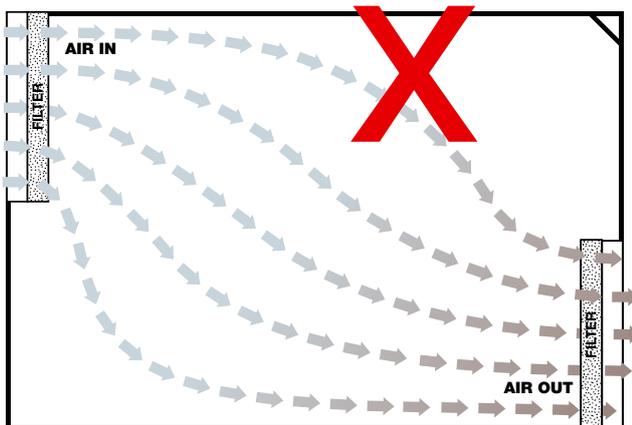


Figure 8 Imagined air movement in a crossflow or tunnel booth

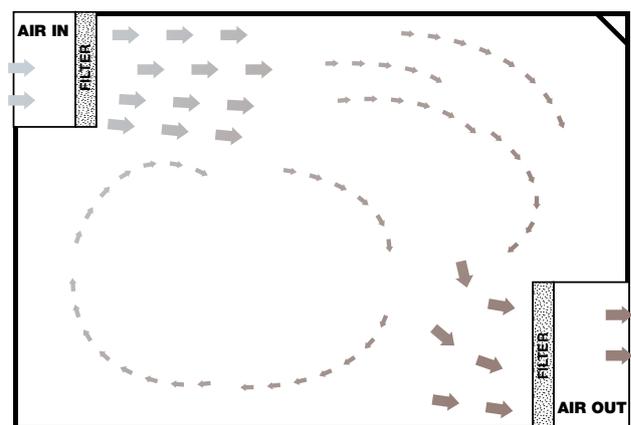


Figure 9 What really happens

Airflow in a typical spray room

25 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.

26 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.

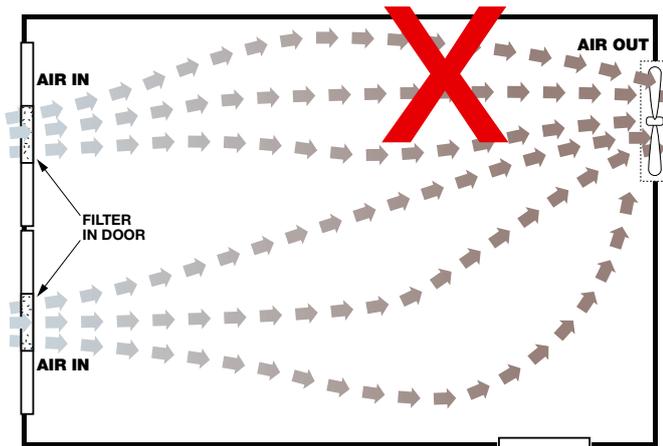


Figure 12 Imagined air movement in a spray room

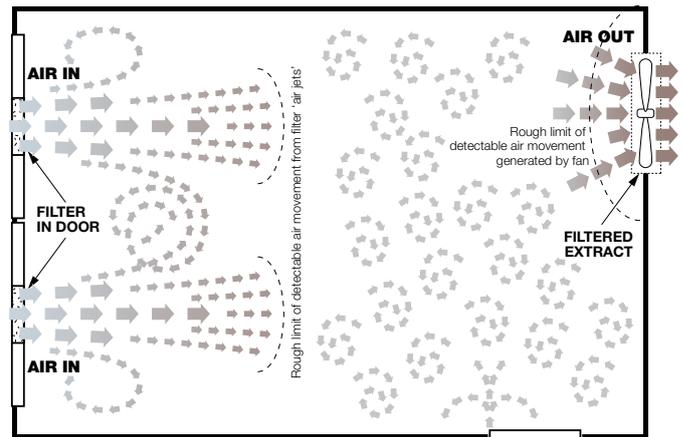


Figure 13 What really happens

What users of spray booths and spray rooms need to know

Measure and know the clearance time of your booth or room

27 Once spraying stops, the air passing through the booth/room will dilute and displace the fine, 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 or room will depend upon the design and the volume of air moving through it. Typically, a booth will clear in less than 5 minutes, but a room could take 20 minutes or longer.

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

28 The only practical way to measure the clearance time is to carry out a smoke test. If you buy a smoke machine, you can do this yourself. Smoke 'party fog' machines are relatively inexpensive and many are suitable for determining clearance times of standard size booths. A review of suitable fog machines can be found at: www.hse.gov.uk/research/hsl_pdf/2006/hsl0643.pdf2 and guidance on how to perform this test is given in Appendix 1.

29 If you have a large commercial booth a professional smoke generator will probably be required. These are more expensive (over £600) and it is therefore probably worth asking the company who carry out the annual thorough examination and test to do this for you.

30 Clearance tests are not exact (see Appendix 1) 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 statutory 14-monthly thorough examination and test.

31 If there is some reason why a smoke test cannot be carried out, an equally effective method of determining the clearance time should be used.

Key message 2 - How long does your spray booth or room take to clear?

- They all take time to clear of the fine mist - you must know the clearance time of your booth or 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 booth or room and tell everyone who needs to know.

Clearance time sign and indicator

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

- the clearance time (in large letters);
- when the test was carried out;
- who carried out the test;
- when the test will be repeated.

33 An example of a clearance time sign is given in Appendix 2.

34 The preferred method of informing workers when a booth or room is safe to enter is installation of 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.

35 Details of the design of one type of clearance time indicator are available in an HSL report.²

Leaving a spray booth or room safely during the clearance time

36 Sprayers, and other users, must know the clearance time of their booth or room. The sprayer must not flip up the visor of the air-fed breathing apparatus (BA) during the clearance time. We are not suggesting that the sprayer stands in the booth or room waiting for it to clear. But he or she must know how to leave the booth or room safely during the clearance time.

Leaving a spray booth or room safely

37 You should be able to reach the door of the booth or room while still wearing your breathing apparatus (it may mean the airline plug-in point needs to be moved to allow this). Open the door. Unplug yourself from the airline, step out and shut the door and remove your air-fed breathing apparatus.

Negative pressure indicators

38 To prevent fine airborne paint mist escaping into the workplace, all spray booths and rooms should be run at a slightly lower air pressure than the surroundings so that any air leakage is inwards. This is known as running at 'negative pressure'. It is required by law³ and has been since 1991.

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

40 For spray rooms something less exact will do.



Figure 14 Example of a manometer fitted to a spray booth



Figure 15 Example of a 'swinging vane' fitted to a spray room

Does your spray booth or room leak?

41 Booths and rooms should not leak airborne paint mist and should run under negative pressure. 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 booth or 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.

Key message 3 - Spray booth and rooms indicators

- As a minimum, all booths and rooms should have the clearance time displayed on the doors of the enclosure.
- Clearance time indicators are the preferred method of letting others know when a booth or room is safe to enter.
- The booth/room must operate under a negative pressure – all leaks must be inwards.
- You must have a negative pressure indicator fitted.
- Check that the sprayers know how to behave in the booth/room and how to leave safely.

What are the essential features of a spray booth?

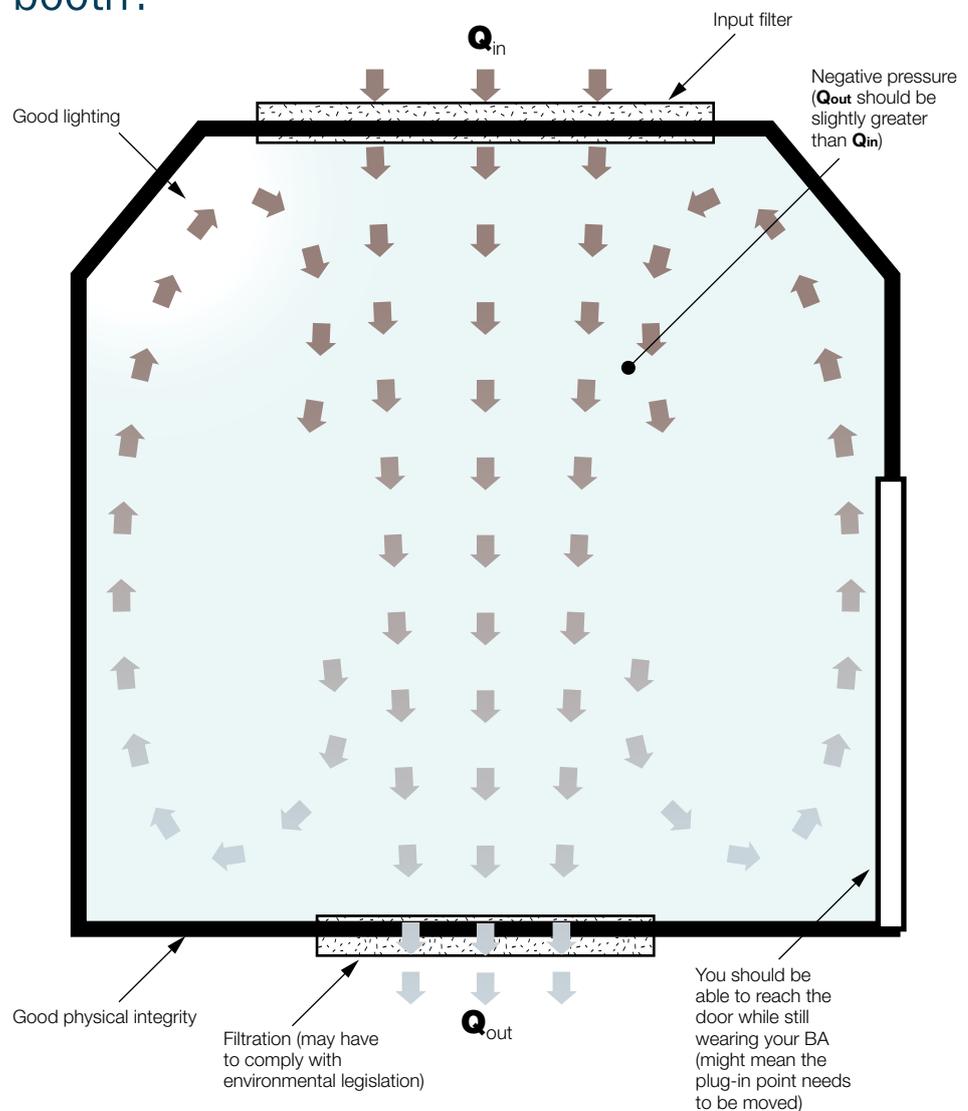


Figure 16 Essential features of a spray booth

What are the essential features of a spray room?

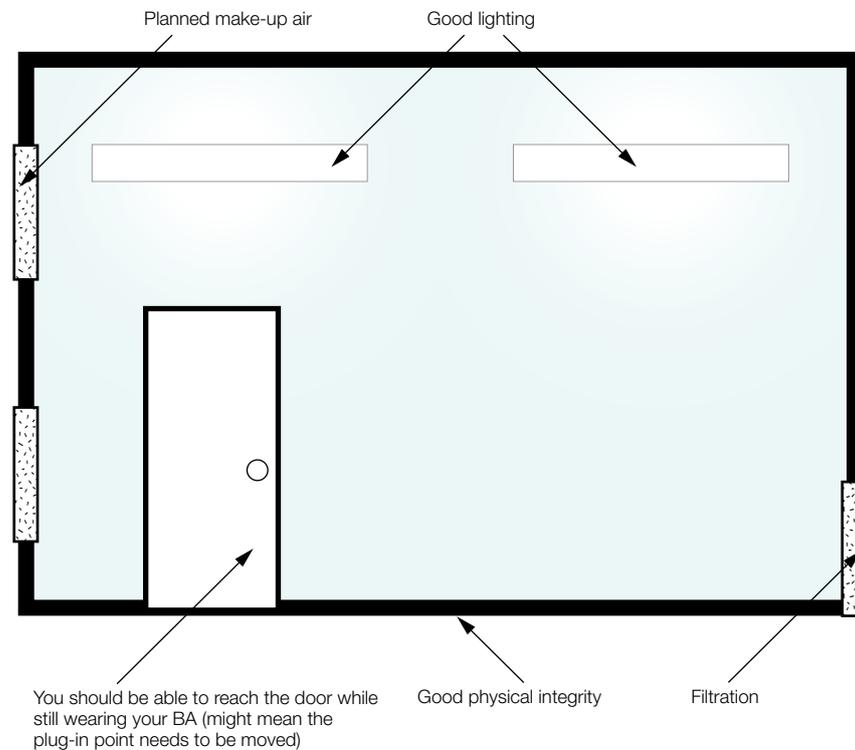


Figure 16 Essential features of a spray room

What does the law say?

42 The law, including the Control of Substances Hazardous to Health (COSHH) Regulations 2002⁴ and the Health and Safety at Work etc Act 1974, require employers, and the self-employed, to control the risks from substances used or created at work including isocyanate in 2-pack paints.

43 They need to consider risks to themselves, employees (if applicable) and other people who might be affected. Once the control measures are in place, and have been shown to work (commissioning), there is a legal duty to check and maintain them, have them examined and keep records.

Commissioning

44 HSE guidance on local exhaust ventilation (LEV) outlines the approaches to commissioning systems. The following will need to be covered (see Appendix 3 for further details):

- 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 qualitative and quantitative tests undertaken, and the outcome.

Checking and maintenance

45 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 in the user manual.

Booth or room user manual

46 Equipment suppliers are legally obliged to provide adequate information about the use for which the article has been designed and tested and any conditions necessary to ensure the equipment is safe and without risks to health at all times thorough its operating life. HSE guidance on local exhaust ventilation⁵ recommends that, just like a car, all booths and rooms should be supplied with a user manual. If an employer doesn't have a user manual he or she should ask the supplier for one.

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

- a description of the spraying enclosure, including a drawing;
- a regular maintenance schedule and description of checks. These are carried out to ensure the enclosure is operating as designed and commissioned. For example:
 - daily checks – record problems;
 - weekly checks – record problems;
 - monthly checks – record problems and actions;
- air quality tests for breathing apparatus supply – these should be performed at least once every three months unless you have evidence to demonstrate that air quantity and quality are stable;
- maintenance:
 - run time;
 - 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;
- instruction on how to use the enclosure safely;
- details of thorough examination and testing.

48 If you do not have a user manual for your spray booth/room, you need to obtain or develop one. You may need help from the supplier or other industry advisers.

Thorough examination and test

49 Apart from regular checks and maintenance, all engineering controls (eg the spray booth or room or extracted enclosure) should be 'thoroughly examined and tested' by a competent person, typically once a year. Air-fed breathing apparatus should be examined, typically every month, in line with the manufacturer's instructions.

50 Follow the recommendations in the report, and look critically at your own checking and maintenance if it's clear that booth or room operation or fabric has deteriorated. The thorough examination and test is, in effect, an audit of your own checking and maintenance over the year. Records need to be kept for at least five years. (See Appendix 3 for further details.)

51 COSHH regulation 9⁴ provides a list of some of what should be included in a thorough examination and test report, see Appendix 3 for details. This should include smoke tests for clearance and leakage. Velocity measurements within the booth or room may also be made as a check on the amount of air entering and on the evenness of air velocity. If you choose to do this we recommend you do so with no vehicle present (as for smoke tests) because the aim of the measurements is to compare booth performance from one year to the next (consistency). Measurements should be made at standardised positions, for instance at fixed points and heights, in a downdraught booth. This is easier and quicker to do with no vehicle present, and will give more reproducible results.

52 Following a thorough examination and test, the spray booth or room should have a label attached stating when it was tested and examined, who did it, and when it will be re-tested. If the booth or room fails the annual thorough examination and test, the examiner should attach an additional red label indicating this. The spray booth or room should not be used until the fault is rectified and it is shown to be operating as intended. An example of failure would be if the booth or room were operating at a positive pressure.

Summaries for employers/managers and sprayers

The sprayer's seven steps to safe working

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

The employer/manager's checklist

55 Use it to check on your performance and take the action needed to better control exposure to isocyanates in your bodyshop more effectively.

Aim	Common errors	Common causes	Effects	Have I achieved aim and avoided common errors? Yes No ??	Some things you can do	What you are going to do? (Use examples from adjacent column or equally effective actions.)
Know the clearance time	Don't know that a booth or room has a clearance time. Guess at the clearance time	Can't see paint mist Think that air flows straight out taking the 'over-spray' with it	Regular isocyanate exposure to the sprayer Isocyanate exposure to those using the workplace and possibly nearby, including the public		Measure the clearance time using a smoke test	
Show the clearance time	Clearance time is known but not shown and nobody knows what to do	Poor management and communication	Regular, high, short-term isocyanate exposure to the sprayer Isocyanate exposure to those using the workplace and possibly nearby, including the public		Put up large, clear signs Explain to all who need to know Install a simple clearance time indicator	
Contain all paint mist in booth or room	Booth or room leaks or discharges fine paint mist, causing exposure to others in bodyshop and next door units	Extract filter blocked and needs changing – booth becomes pressurised Air in/out imbalance Poor booth integrity, eg damaged or missing door seals Failure of automatic over-pressurisation shutdown system	High isocyanate exposure to all using workplace		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	

Aim	Common errors	Common causes	Effects	Have I achieved aim and avoided common errors? Yes No ??			Some things you can do	What you are going to do? (Use examples from adjacent column or equally effective actions.)
Filter and discharge extracted air safely	Spray booth or room exhaust recirculates back into the workplace	Spray room extract air not filtered Poor discharge position	Isocyanate exposure to those using the workplace and possibly others nearby, including the public				Adequate exhaust filters (two-stage) plus discharge in a safe position	
Brief, train and supervise sprayers	Operator raises visor or removes BA during clearance time	Little understanding of the risks Poor lighting levels No knowledge of clearance time and procedures Poor visibility through visor Poor supervision	Very high, short-term isocyanate exposure				Briefing on risks Awareness of clearance time – training Lighting suitable and maintained Agree safe methods of working Check and maintain air-fed breathing apparatus including visor and tear-off strips	
Check and maintain your booth/room	Checks/maintenance not done or only when booth or room ventilation fails	No management system or appreciation of risks No user manual and/or inadequate guidance from supplier	Particularly high isocyanate exposure sprayers The sprayer should be protected by BA others in your workplace Loss of production				Manage checks, maintenance and use of spray booth/room Get or develop a user manual Brief and explain procedures for all concerned including sprayers and bodyshop manager	

Aim	Common errors	Common causes	Effects	Have I achieved aim and avoided common errors? Yes No ??			Some things you can do	What you are going to do? (Use examples from adjacent column or equally effective actions.)
Check and maintain air-fed breathing apparatus (BA)	No checks are made and air flow and/or quality falls BA equipment is not checked and maintained and protection deteriorates	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	Deterioration in protection Poor visibility means sprayer flips-up visor Sprayer isocyanate exposure rises Risk of occupational asthma increases				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 Always carry enough spare parts on site Manage checking and maintenance by inspecting records and examining equipment	

Aim	Common errors	Common causes	Effects	Have I achieved aim and avoided common errors? Yes No ??	Some things you can do	What you are going to do? (Use examples from adjacent column or equally effective actions.)
Check your exposure control measures are working	People don't follow safe working procedures and expose themselves to isocyanate during the clearance time	Controls are assumed to work and no checks are done 'I've told them to wear it but what can you do?'	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		Measure isocyanate exposure of sprayers (and others who need to enter the booth/room) using biological monitoring Do this soon after employing a new-starter and annually If exposure is consistently well controlled reduce the frequency of test Health and safety duties are not optional – this includes duties placed on employees. If an employee refuses to comply, they are in breach of the law and normal disciplinary procedures can be enforced. You may wish to involve your local HSE inspector	

Appendix 1 Spray booth/room clearance time and leakage test

- You need to know the clearance time of your spray booth or room.
- Check this just before changing the extract filters to give a 'worst-case' time.
- Include the clearance time test in the 14-monthly 'thorough examination and test', as required by COSHH regulation 9 (see Appendix 3). Note that you may need to test more often than this.

Equipment: Fog or smoke machine; an extension lead (for mains-powered machines); stopwatch or similar; high 'candle-power' torch on a stand or tripod.

Clearance time measurement procedure

(A video clip of the clearance procedure can be downloaded from the MVR website at www.hse.gov.uk/mvr/.)

- Measure the clearance time with the spray booth or room empty. You won't want greasy deposits on vehicles or body parts.
- Do the test with the burners/heaters off. Turn the lights on maximum to help show up the smoke.
- During smoke tests, arrange for someone else to check for any smoke leaks outside the booth/room, or from the ductwork.
- **Pre-test:** Turn the extraction off. Fill the booth/room with smoke. Turn the extraction on, and watch how the smoke clears. Some areas will take longer to clear. Then turn the extraction off again.
- **Test:** Position the torch to shine through the area that clears slowest. Fill the booth/room evenly with smoke. You may need the extension lead to do this properly.
- When you cannot see across the width of the booth/room, it is full of smoke. If the fog machine cuts out, give it time to reheat once or twice to get the right smoke density.
- Turn on the extraction and start the timer. Stand facing the torch. You need to look 'up' the light beam towards the torch at a slight angle.
- The room is clear when you can see no smoke anywhere in the booth/room, especially those areas identified in the pre-test.
- Round up the measured time to the next quarter minute.
- Display this time on a large, clear notice on the entrances to the booth or room. Tell everyone who needs to know.

Leakage test procedure

- During the clearance time smoke test, position someone outside of the booth or room and get them to check for smoke leakage.

- Likely leakage points include door seals and hinges, ductwork joints, duct inspection panels, filter housings and explosion relief panels.
- If smoke leakage is spotted, repeat the test, observe, work out why leakage is occurring and arrange repairs.

Note 1: Warn your employees, and possibly your neighbours, about the smoke test so that they are not alarmed. It may also be necessary to warn the local fire service to avoid unnecessary call outs.

Note 2: The clearance time test is imprecise, relying on individual perception of when the booth/room is 'full' of smoke, and when all the smoke has gone. The method is fairly crude but it is good enough to give users the information they need to work safely. Using a high-powered torch to help estimate clearance can increase the measured time by about half a minute. If the booth fans take an appreciable time to run up to normal speed, you may need to make some allowance for clearance time during normal booth working.

Note 3: The smoke has low toxicity but if you have a pre-existing lung condition and/or do tests regularly (eg every day) and/or experience discomfort using smoke, wear appropriate respiratory protection equipment (RPE). A well-fitting respirator with a combination A/P3 filter will be adequate. More information can be found in HSL report *Review of commercially available party fog machines suitable for determining the clearance time of paint spray booths and rooms.*²

The details of what you need to do and how to record your findings should be in your spray booth or room user manual.

Appendix 2 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 3 Commissioning and thorough examination and test of spray booths and rooms

Commissioning

1 COSHH regulations 6 and 7 require employers to develop and apply effective exposure control measures and make sure that they work, ie controls require commissioning. The main issues to be covered in commissioning any local exhaust ventilation (LEV) system are identified in HSE publication *Controlling airborne contaminants at work: A guide to local exhaust ventilation*⁵ and 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;
- a written description of the commissioning, the qualitative and quantitative tests undertaken, and the outcome.

2 In the past, when commissioning spray booths and rooms, the emphasis has mainly been on the booth/room air-change rate and, in the case of booths, the velocity of air at fixed points around a vehicle in a booth/room.

3 Understanding of booths and rooms, and the most important factors that control exposure, has improved and now the emphasis is on measuring and knowing the booth/room clearance time and ensuring that it runs at slightly negative pressure so that it doesn't leak during spraying. An important test during commissioning is the smoke test to measure clearance time and ensure that the booth/room doesn't leak.

4 To characterise the technical performance of a booth or room measurement of air velocities and pressures will also be important. 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.

5 It would also be useful to measure booth internal air velocities at fixed points, for instance in front of the supply filter panels and above the extract grills. These results can then be compared with later measurements and will serve as a measure of booth air-flow performance.

Thorough examination and test

6 COSHH regulation 9 requires a thorough examination and test of all engineering controls. Spray booths, rooms and extracted enclosures should be examined by a competent person, typically once a year. Air-fed breathing apparatus should be examined, typically every month, in line with the manufacturer's instructions.

7 In practice, most employers arrange for this to be done annually. The examination and test should compare the performance of the booth, room, extracted enclosure etc with the commissioning test findings. Only booths and rooms will be covered here.

Test report

8 The areas and sort of things that should be covered in a thorough examination and test report are identified in paragraph 176 of the guidance that accompanies regulation 9:

'A suitable record in respect of each thorough examination and test of LEV should contain at least the following details:

- (a) the name and address of the employer responsible for the plant;
- (b) the identification and location of the LEV plant and the process and hazardous substance concerned;
- (c) the date of the last thorough examination and test;
- (d) the condition at the time of the test and whether this was normal production or special conditions;
- (e) information about the plant which shows:
 - (i) its intended operating performance for adequately controlling the hazardous substance...
 - (ii) whether the plant is still achieving the same performance
 - (iii) if not, the adjustments and repairs needed to achieve that performance
- (f) the methods used to make the judgement ... eg visual, pressure measurements, air flow measurements, dust lamp, air sampling, tests to check the condition and effectiveness of the filter;
- (g) the date of the examination and test;
- (h) the name, job title ... and employer of the person carrying out the examination and test;
- (i) the signature or other acceptable means of identifying the person carrying out the examination and test;
- (j) the details of repairs carried out. The details should be completed by employers responsible for the LEV plant. The effectiveness of repairs should be proved by re-test.'

9 This advice is complemented by recent guidance on local exhaust ventilation systems⁵ and recommends that test reports should contain:

- diagrams and a description of the LEV, including test points;
- details of the LEV performance specification;
- results, such as pressures and velocities at stated points;
- calculations;
- a written description of the commissioning, qualitative and quantitative tests undertaken, and the outcome. Where necessary, this could include air sampling results or, for sprayers, biological monitoring of isocyanate exposure;
- a description of operator behaviour which minimises exposure;
- a new requirement in the LEV guidance is that, where an LEV hood has 'failed', the examiner should issue a red label and immediately tell the employer. In the case of spray booths/rooms failure would be, for instance, where a booth/room was not operating under negative pressure and was badly leaking.

References

- 1 *Motor vehicle repair: Spraying isocyanate-containing paints. Developing issues: Consequences of the Paints Directive – isocyanates are not being banned* HSE Sector Information Minute (SIM 03/2006/12) www.hse.gov.uk/foi/internalops/sectors/manuf/3_06_12.pdf
- 2 HSL report *Review of commercially available party fog machines suitable for determining the clearance time of paint spray booths and rooms* HSL/2006/43 www.hse.gov.uk/research/hsl_pdf/2006/hsl0643.pdf
- 3 Environmental Protection Act 1991 The Stationery Office: www.opsi.gov.uk/acts/acts1990/Ukpga_19900043_en_1.htm
- 4 HSE COSHH essentials: www.hse.gov.uk/mvr/coshh/paintspraying.htm
- 5 *Controlling airborne contaminants at work: A guide to local exhaust ventilation (LEV)* HSG258 HSE Books 2008 ISBN 978 0 7176 6298 2

Further reading

Safety in motor vehicle repair: Working with 2-pack isocyanate paints Leaflet INDG388 HSE Books 2003 (single copy free or priced packs of 10 ISBN 978 0 7176 2756 1) www.hse.gov.uk/pubns/indg388.pdf

Web-based advice on the motor vehicle repair (MVR) industry:
www.hse.gov.uk/mvr/index.htm

Web-based advice on local exhaust ventilation: www.hse.gov.uk/lev/index.htm

Further information

HSE priced and free publications are available by mail order from HSE Books, PO Box 1999, Sudbury, Suffolk CO10 2WA Tel: 01787 881165 Fax: 01787 313995 Website: www.hsebooks.co.uk (HSE priced publications are also available from bookshops and free leaflets can be downloaded from HSE's website: www.hse.gov.uk.)

For information about health and safety ring HSE's Infoline Tel: 0845 345 0055 Fax: 0845 408 9566 Textphone: 0845 408 9577 e-mail: hse.infoline@natbrit.com or write to HSE Information Services, Caerphilly Business Park, Caerphilly CF83 3GG.

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

This document is available at: www.hse.gov.uk/pubns/web36.pdf.

© *Crown copyright* This publication may be freely reproduced, except for advertising, endorsement or commercial purposes. First published 12/08. Please acknowledge the source as HSE.