

# Metalworking Fluids (MWF): The right approach

Rosie McKay MSci LFOH  
Certified Occupational Hygienist

## Pragma and Associates

Engineers, scientists, chemists, occupational hygienists, health and safety practitioners and ex-factory inspectors

- Occupational hygiene
- Health and safety
- Expert witness
- Training



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## Pragma and Associates

Rosie McKay Msci LFOH

Certified Occupational Hygienist

- Pragma and Associates
  - Occupational hygiene lead
- Golder/WSP
  - Contaminated land and occupational hygiene consultant



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# Topics Covered

1. Why do we need to control MWFs?
2. How can we achieve / prove compliance?

- ✘ Air monitoring
- ✔ MWF management systems
- ✔ Qualitative testing
- ✔ Health surveillance
- ✔ Training



# MWFs: what are they?

Three main types:

- Neat cutting oils
- Water-miscible MWF
- Soluble oils



Functions: cooling, lubrication, fines removal

- Also improve machine tool life and the surface finish of parts

# Why control MWFs? – Health hazards



MWF, contaminants  
(tramp oil, metals,  
biocides and  
microorganisms)

During machining these  
become **aerosolised**



Inhalation of / contact  
with these droplets can  
cause irritation and  
sensitisation

These additional hazards  
(contaminants) are **not identified**  
**in the SDS.**

# Why control MWFs? – Diseases

## Respiratory disease

- Occupational asthma
- Occupational Hypersensitivity Pneumonitis (OHP)
- Decreased lung function
- Bronchitis
- Respiratory irritation

## Skin disease

- Irritant dermatitis
- Allergic dermatitis

# Why control MWFs? – Respiratory disease

## **Occupational Asthma:**

- Small quantities of the allergen can trigger severe reactions
- Cases have been reported in those exposed below the historical UK HSE guidance value of 1.0 mg/m<sup>3</sup>

## **Occupational Hypersensitivity Pneumonitis (OHP):**

- Exposure to water-miscible MWF has become the most common cause (UK)





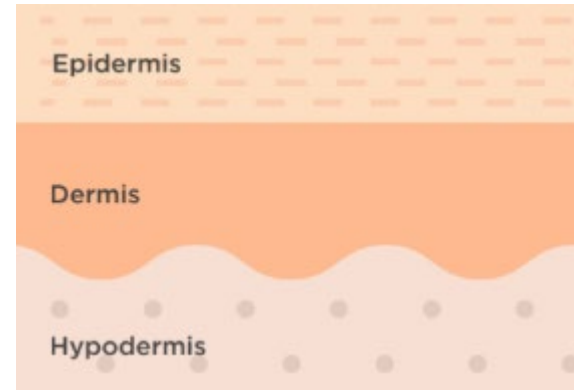
# Why control MWFs? – Skin disease

## Irritant dermatitis

- Increases the risk of developing allergic dermatitis

## Allergic dermatitis

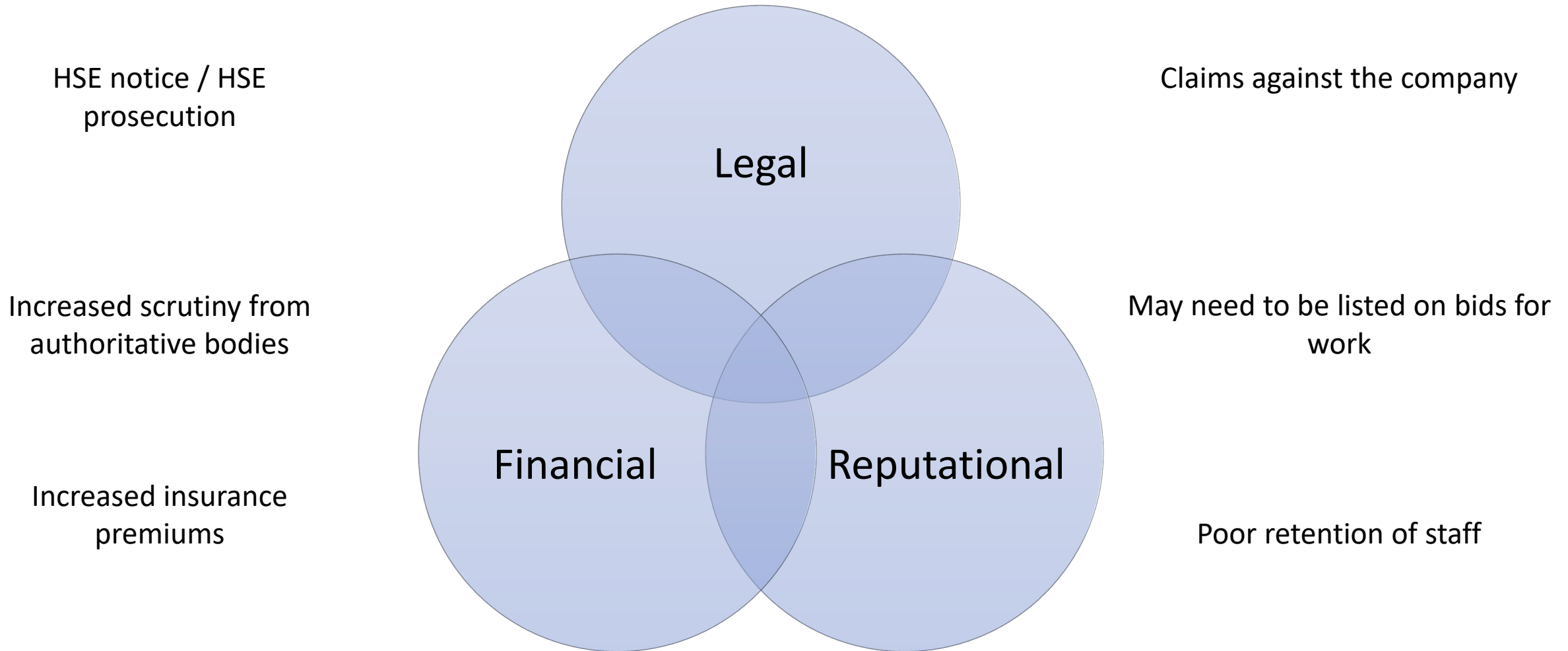
- In sensitised people, exposure to small quantities can trigger severe reactions



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# Why control MWFs? – Other



# Why control MWFs? – Other

## Morally

- It's the right thing to do

## Legally

- In accordance with COSHH etc.

## Financially

- No fines for non-compliance with legislation
- No loss of revenue due to reputational damage
- Stand out amongst competitors as a leader
- Healthy staff are more productive
- Staff that feel looked after will be more loyal

# Compliance with legislation?

ALARP: as low as reasonably practicable

- Considering all routes of exposure

Previously we might have used air monitoring, however:

- Lack of relevant measurement method
- No exposure values

**What is recommended instead?**

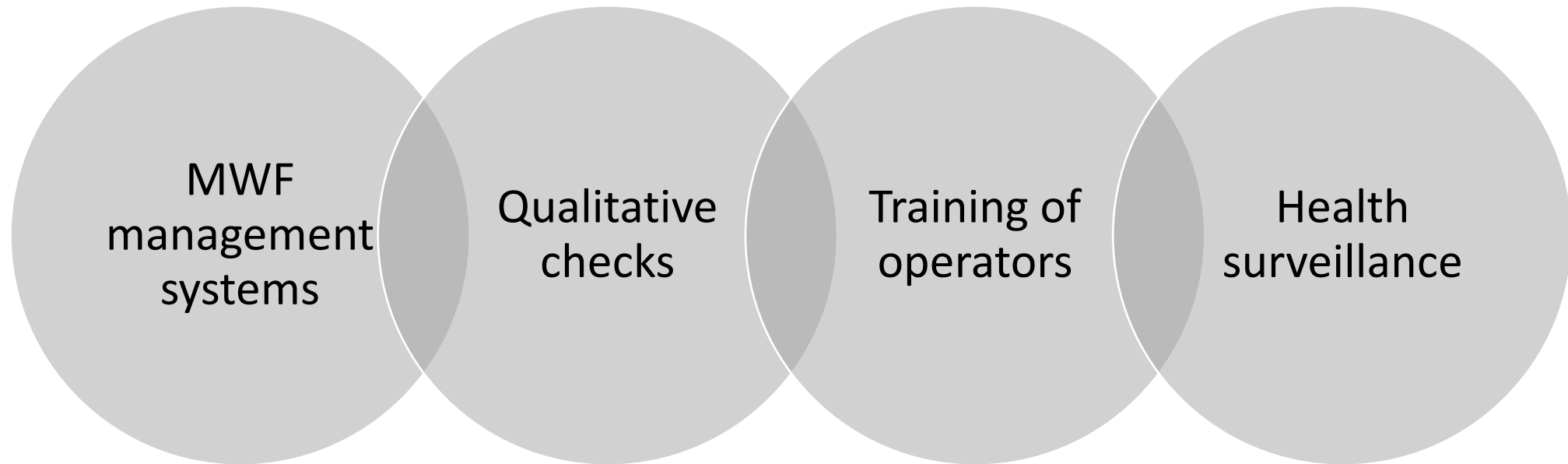


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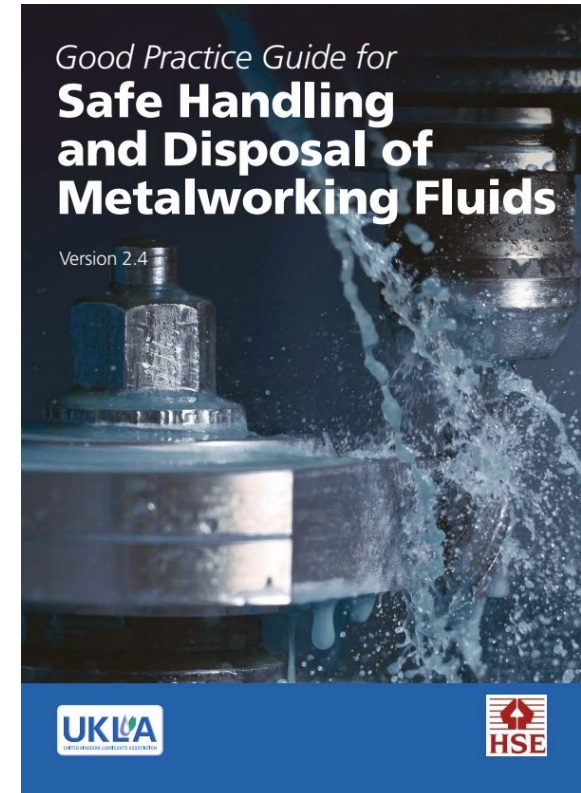
# Compliance with legislation?

What is recommended instead of air monitoring?



# Control – MWF management systems

- Safety data sheet
- COSHH risk assessment
- Written MWF management policy
- Sump clean RAMS and schedule
- LEV TExT
- List of checks that are completed daily / weekly etc.

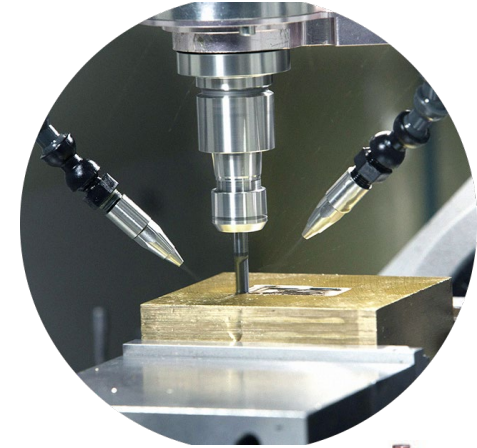


# Control – MWF checks

Daily	<ul style="list-style-type: none"><li>• Visually check the appearance of MWF: changes in colour / clarity, biofilm formation, tramp oil, fines and swarf, foaming and other foreign materials</li><li>• Olfactory / odour changes</li></ul>
Weekly	<ul style="list-style-type: none"><li>• Check the temperature is not above 30°C</li></ul>
<u>At least weekly</u>	<ul style="list-style-type: none"><li>• Visually check for tramp oil and record the consumption of oil</li><li>• Check the pH and analyse records to identify changes</li><li>• Measure the concentration of the MWF using a refractometer and analyse records to identify changes</li><li>• Check circulation and flow, if there are accumulations of metal fines swarf, deposits and biofilms in the sump and supply systems, and 'dead-ends'</li><li>• Use dip slides to monitor microbial growth to determine the number of colony forming bacteria (if you can demonstrate that the controls in place are keeping bacteria growth consistently below 10,000 CFU/ml (<math>10^4</math> CFU/ml) the frequency of these tests may be reduced to monthly)</li></ul>

# Control – Site observations

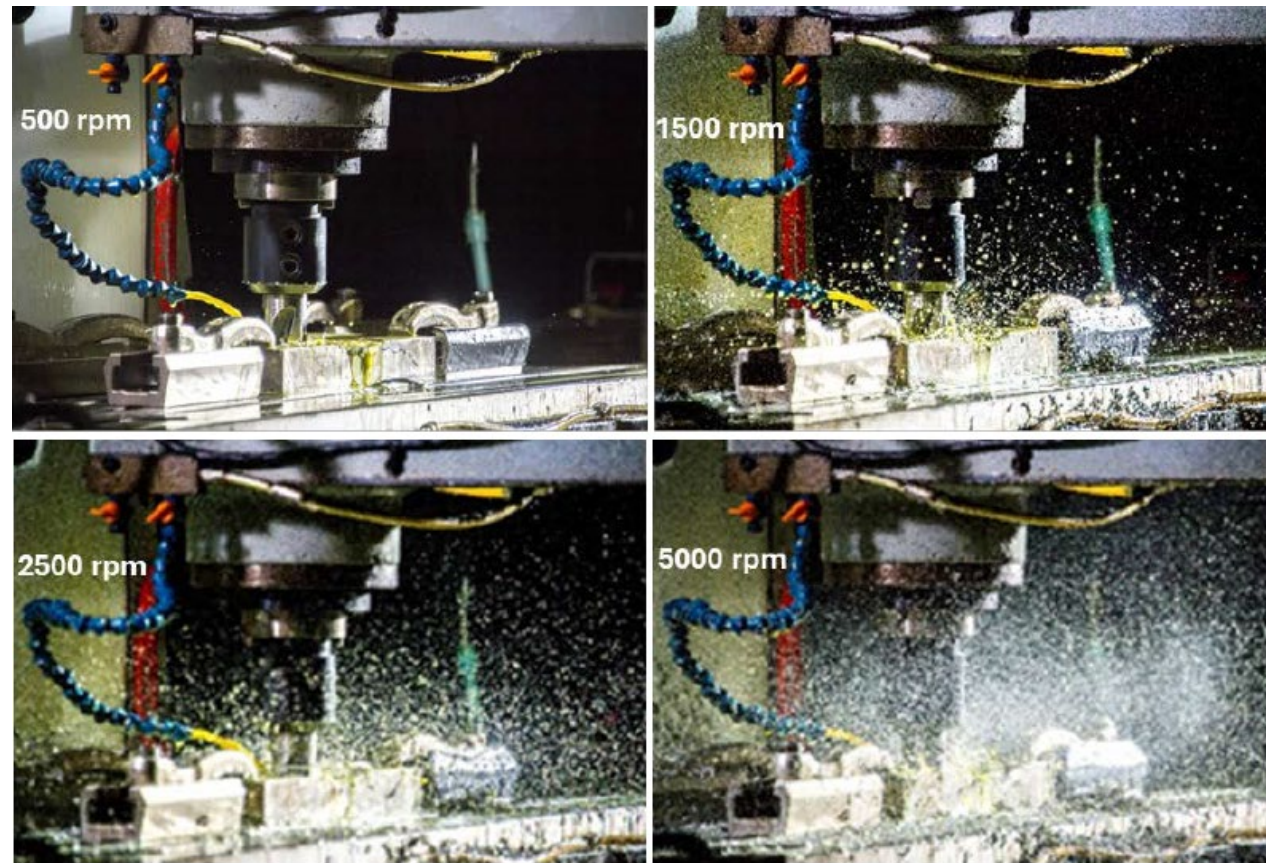
- Usage, cycle lengths, materials
- Machine speeds as low as possible
- Fluid delivery
- Compressed air use
- Time delays on enclosure doors opening
- Placement of LEV inlets
- Where breaks are taken / house-keeping
- What PPE is worn and how well





# Control of Worker Exposure to MWF

Spindle speed has the largest influence on the volume of mist formed and droplet size



# Control – Qualitative checks

Use a **smoke generator** to:

- Visualise air flow
- Determine efficacy of enclosures
- Identify any leaks or dead spots
- Use **smoke** (Drager tube) to determine if enclosure is under negative pressure
- Demonstrate clearance time for enclosure = **time delay**

Use a **dust lamp** (MDHS82/2) to visualise fine airborne particles and check for escape around the edges of the enclosure

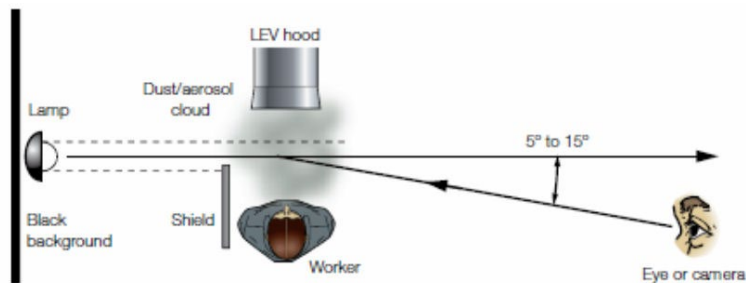


Figure 44 How to use a dust lamp



# Control – DRAMs

## Direct Reading Aerosol Monitors (DRAMs)

- They provide a semi-quantitative estimate of the mass concentration of particles of a certain size range
- Limitations: reduced accuracy in environments with high humidity and high background particle levels
- DRAMs can be used to determine *relative changes* in MWF mist but are **not suitable** for quantitative measurements



# Control – LEV checks

- Pre-use checks, recorded in the logbook



- Velocities

- Duct entry >10 m/s (not always reachable)
- Duct velocities of >15 m/s
- Inlet velocities at the door of the enclosures >0.75 m/s



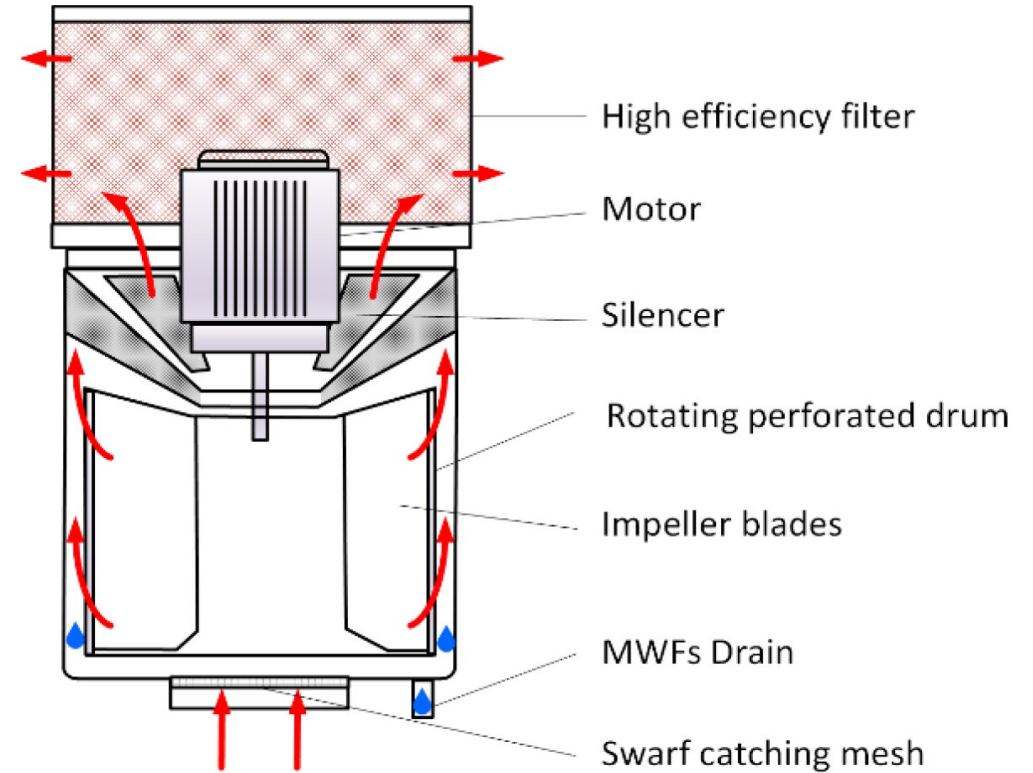
- Consider the use of air flow gauges for LEV systems
- Programme equipment so that machines cannot be on without LEV



# Control – LEV checks

## Air Cleaners

- Multi-stage devices designed to remove airborne contaminants
- 'Filter mist' are most common



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# Control – Compressed air

- Used for cleaning components and tooling heads
- Generates a spray that contaminates clothing and skin, and can be inhaled
  - Also noisy
- Compressed air use should be avoided, if this is not reasonably practicable then implement further controls
  - 2 bar or lower at exit
  - Vacuum guns or low-pressure coolant guns
  - Spindle mounted fans
  - Automated compressed air
  - Absorbent material



# Control – Work procedure

Use of tools for handling and fluid preparations:

- Tongs or clamps
- Swarf hooks or magnetic wands
- Conveyor systems for tools, parts and swarf (difficult to retrofit)
- Automated mixing devices



# Control – PPE

- Long sleeves / coveralls
- Laundry service / storage etc.
- Gloves
- Glasses





# Control – RPE

If exposure cannot be adequately controlled by other means

- Powered RPE preferable
- APF of at least 20
- Tight-fitting RPE needs a face fit test



# Control – Training

- Essential to enable control measures to be used and maintained effectively
- Training should cover:
  - The health hazards associated with MWFs
  - The control measures to reduce exposure to MWF
    - E.g. LEV, SOP, PPE etc.
  - The significant findings of any risk assessments undertaken
  - The collective results of any health surveillance
  - How to report any health and safety concerns
  - How to spot signs of ill health



# Control – Health surveillance

- Employers should engage a competent occupational health provider
- Following a questionnaire, possible:
  - Lung function tests
  - Visual checks on skin appearance



# Control – Audit and Review

- Reducing exposure to MWF requires the management of a wide range of controls
- Regular audits and reviews to check the efficacy of controls and ensure that exposures are adequately controlled
- Audits should also check that record keeping is adequate

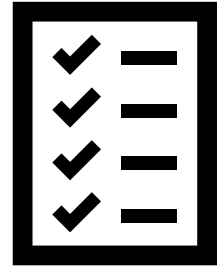


# How can we ensure compliance?

Step 1	Identify the standards you should be complying with
Step 2	Make a plan to reach the required level
Step 3	Implement the plan
Step 4	Demonstrate compliance
Step 5	Audit compliance periodically
Step 6	Continuously improve

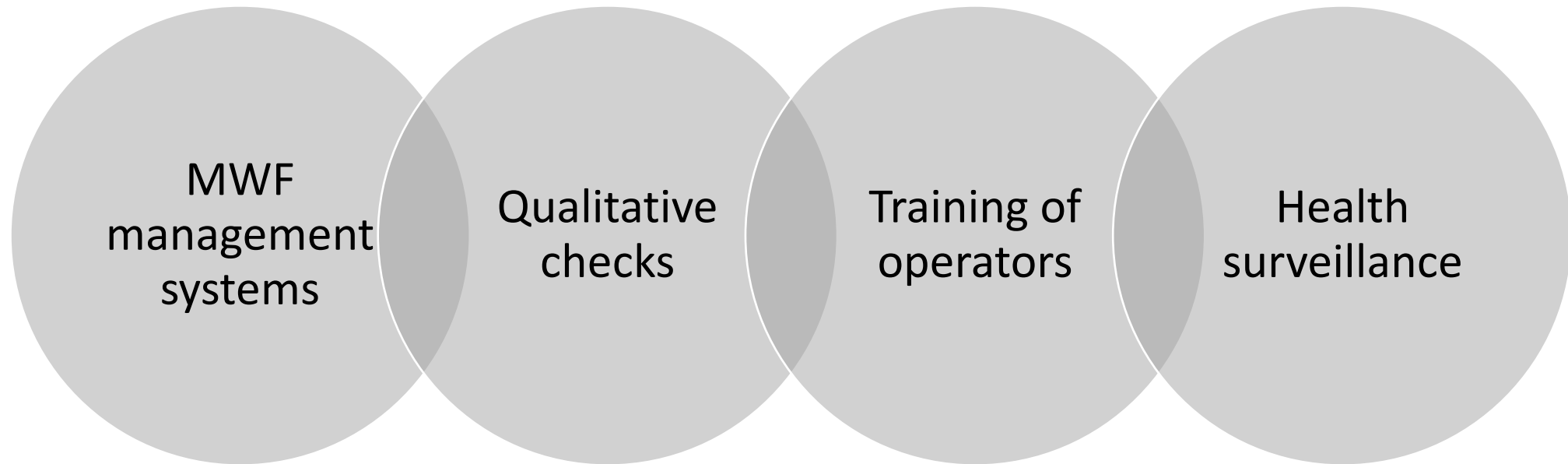
# Actions

- Lower the spindle speed and pressure of the fluid
- Enclose and extract
- Time delays on doors of enclosures
- Remove / reduce compressed air
- Get paperwork sorted
  - Policy, training, health surveillance



# Summary

- Exposure to MWF = known health risks
- Compliance:



# Further information

- BOHS (British Occupational Hygiene Society) published a guidance document aimed at Occupational Hygienists in November 2024
- Provides info on assessing/preventing/controlling exposure to MWF following COSHH principles of good control practice



Guidance for Occupational Hygienists on  
the Assessment and Control of the Health  
Risks from Metalworking Fluid (MWF)





# Further information

- Other essential reading are the HSE “Machining with metalworking fluids COSHH essentials advice sheets”.

**MW1**  
COSHH essentials for machining with metalworking fluids

**CNC machining**

Control approach 2 Engineering control

**The Control of Substances Hazardous to Health Regulations 2002 (COSHH)** require employers to ensure that exposure is prevented or, where this is not reasonably practicable, adequately controlled. This guidance gives practical advice on how this can be achieved by applying the principles of good practice for the control of exposure to substances hazardous to health, as required by COSHH.

It is aimed at people whose responsibilities include the management of substances hazardous to health at work (eg occupational health specialists, anyone undertaking COSHH assessments and supervisors).

It is also useful for trade union and employee safety representatives. It will help you carry out COSHH assessments, review existing assessments, deliver training and supervise activities involving substances hazardous to health.

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.

See Essential information near the end of the sheet.

**Control approach 2 Engineering control**

**What this sheet covers**  
This sheet describes good control practice using engineering controls to reduce exposure to metalworking fluid (MWF) mists during computer numerically controlled (CNC) machining.

It is important to follow all the points, or use equally effective measures.

**Hazards**

- ✓ MWF mist is produced inside the CNC enclosure during machining. This can escape through gaps in the enclosure and when the enclosure doors are opened shortly after machining stops.
- ✓ The use of hand-held compressed air guns to clean components and machine surfaces generates mist.
- ✓ Inhalation of MWF mist can cause lung diseases, such as occupational asthma and occupational hypersensitivity pneumonitis.
- ✓ Skin exposure to MWF can cause dermatitis. For guidance on skin risks see MW2 Control of skin risks during machining.


**Access to work areas**

- ✓ Allow access to authorised and appropriately trained persons only.

**Equipment and procedures**

**MWF Delivery**

- ✓ Apply MWF at the lowest possible pressure and flow volume consistent with adequate lubrication, cooling and wear removal.
- ✓ Apply MWF at the point where the tool and workpiece make contact to minimise mist generation from other rotating parts.
- ✓ Stop MWF delivery when not machining. You will still need to maintain fluid circulation to prevent stagnation (see MWF Management (L104)).
- ✓ LEV Design and Use
- ✓ Enclose machines as much as possible eg retrofitting net panels.



CNC machine with a standstone LEV fitted

**MW2**  
COSHH essentials for machining with metalworking fluids

**Control of skin risks during machining**

Control approach S Harm via skin or eye contact

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See Essential information near the end of the sheet.

**Control approach S Harm via skin or eye contact**

**What this sheet covers**  
This sheet describes good control practice to reduce skin exposure to metalworking fluid (MWF). For guidance on inhalation risks during CNC machining see MW1 CNC Machining.

It is important to follow all the points, or use equally effective measures.

**Hazards**

- ✓ MWF can cause skin diseases such as dermatitis (contact and allergic). Particularly on the hands, arms, face and torso, through contact with: - substances in MWF concentrates, neat oils and other chemicals eg biocides and additives; - contaminants present in the fluid eg metal fines, dissolved metals, tramp oil.
- ✓ Prolonged or frequent contact with water-mix fluids, called 'wet work', can cause dermatitis.

**Access to work area**

- ✓ Allow access to authorised and appropriately trained people only.

**Equipment and procedures**

**Fluid Management**

- ✓ Consider your MWF selection. There may be a fluid with less hazardous components. Take advice from your fluid supplier.
- ✓ Minimise leaks of tramp oil (hydraulic, lubricating or gearbox oil) into the sump. Remove tramp oil by mechanical skimmers, mobile oil collectors or vacuum systems.
- ✓ Remove fines using centrifuges, filtration systems or magnetic separators (for ferrous materials).
- ✓ Mix fresh water-mix fluids to the supplier's recommended concentration. In use, water-mix fluids evaporate and become more concentrated. Therefore top up only with fluid below recommended concentration.
- ✓ Do not add biocides until all good practice measures to maintain the fluid have been followed. If you need to add biocides, add the right amount directly to the sump.
- ✓ Higher than recommended fluid or biocide concentration increases the risk of skin diseases.

**Limiting Skin Contact**

- ✓ If possible, prevent skin contact. If you cannot prevent skin contact, can you limit it?
- ✓ Use automatic mixing devices instead of manual mixing.
- ✓ Enclose machines as much as possible.

**MW3**  
COSHH essentials for machining with metalworking fluids

**Sump cleaning: water-mix fluids**

Control approach S Respiratory protective equipment (RPE) and Harm via skin or eye contact

**The Control of Substances Hazardous to Health Regulations 2002 (COSHH)** require employers to ensure that exposure is prevented or, where this is not reasonably practicable, adequately controlled. This guidance gives practical advice on how this can be achieved by applying the principles of good practice for the control of exposure to substances hazardous to health, as required by COSHH.

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See Essential information near the end of the sheet.

**Control approach S Respiratory protective equipment (RPE) and Harm via skin or eye contact**

**What this sheet covers**  
This sheet describes good control practice to reduce inhalation of metalworking fluid mist and contact with the skin during sump cleaning where water-mix fluids have been used.

It is important to follow all the points, or use equally effective measures.

**Hazards**

- ✓ Inhalation of metalworking fluid mist can cause lung diseases, such as occupational asthma and occupational hypersensitivity pneumonitis.
- ✓ Skin contact with metalworking fluids can cause dermatitis.

**Access to work area**

- ✓ Allow access to authorised and appropriately trained people only.

**Equipment and procedures**

- ✓ Decide how often you need to clean your system. The frequency will depend on a number of factors including visual inspection and monitoring results. Discuss this with your fluid supplier.
- ✓ If possible, prevent skin contact. If you cannot prevent skin contact, can you limit it?
- ✓ Provide equipment to remove and replace sump fluids with minimum spillage eg wet vacuum. Ensure that the sump is cleaned before adding from MWFs.
- ✓ Avoid the use of high pressure water hoses for sump cleaning where practicable.
- ✓ Keep absorbent material to hand in case of spillages.
- ✓ Follow your supplier's guidelines for sump cleaning as well as this sheet.

**Caution: Don't remove sump and fines from the sump by hand. Use suitable tools eg brushes and shovels, and wear suitable out resistant protective gloves to prevent injury.**

- ✓ Cleaning a large enclosed sump or underfloor tank may create a confined space risk. Ensure you have assessed the risk and put in place measures such as a permit to work system.

**Caution: Before carrying out work in confined spaces refer to the guidance - Safe Work in Confined Spaces (L101).**

**MW4**  
COSHH essentials for machining with metalworking fluids

**Sump cleaning: neat oils**

Control approach S Harm via skin or eye contact

**The Control of Substances Hazardous to Health Regulations 2002 (COSHH)** require employers to ensure that exposure is prevented or, where this is not reasonably practicable, adequately controlled. This guidance gives practical advice on how this can be achieved by applying the principles of good practice for the control of exposure to substances hazardous to health, as required by COSHH.

It is aimed at people whose responsibilities include the management of substances hazardous to health at work (eg occupational health specialists, anyone undertaking COSHH assessments and supervisors).

It is also useful for trade union and employee safety representatives. It will help you carry out COSHH assessments, review existing assessments, deliver training and supervise activities involving substances hazardous to health.

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See Essential information near the end of the sheet.

**Control approach S Harm via skin or eye contact**

**What this sheet covers**  
This sheet describes good control practice to reduce skin exposure to neat oil metalworking fluids (MWF) during sump cleaning.

It is important to follow all the points, or use equally effective measures.

**Hazards**

- ✓ Neat oils can cause skin diseases such as dermatitis. Particularly on the hands, arms, face and torso, through contact with: - Substances in neat oil and other chemicals eg additives; - Contaminants present in the neat oil eg metal fines.

**Access to work area**

- ✓ Allow access to authorised and appropriately trained people only.

**Equipment and procedures**

- ✓ Decide how often you need to clean your system. Discuss this with your fluid supplier.
- ✓ If possible, prevent skin contact. If you cannot prevent skin contact, can you limit it?
- ✓ Provide equipment to remove and replace sump fluids with minimum spillage eg wet vacuum. Ensure that the sump is cleaned before adding fresh oil.
- ✓ If you follow the guidance in this series of sheets, the removal of resins, solid aggregates, carbon deposits etc from sumps will not be required.
- ✓ Keep absorbent material to hand in case of spillages.
- ✓ Follow your supplier's guidelines for sump cleaning as well as this sheet.

**Caution: Don't remove sump and fines from the sump by hand. Use suitable tools eg brushes and shovels, and wear suitable out resistant protective gloves to prevent injury.**

- ✓ Clearing a large enclosed sump or underfloor tank may create a confined space risk. Ensure you have assessed the risk and put in place measures such as a permit to work system.

**Caution: Before carrying out work in confined spaces refer to the guidance - Safe Work in Confined Spaces (L101).**

**MW5**  
COSHH essentials for machining with metalworking fluids

**Managing fluid quality**

Control approach 4 Special

**The Control of Substances Hazardous to Health Regulations 2002 (COSHH)** require employers to ensure that exposure is prevented or, where this is not reasonably practicable, adequately controlled. This guidance gives practical advice on how this can be achieved by applying the principles of good practice for the control of exposure to substances hazardous to health, as required by COSHH.

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See Essential information near the end of the sheet.

**Control approach 4 Special**

**What this sheet covers**  
This sheet describes good practice to manage fluid quality of water-mix metalworking fluids (MWF).

It is important to follow all the points, or use equally effective measures.

**Hazards**

- ✓ MWF stays in the machine and deteriorates over time.
- ✓ Systems that contain water-mix MWF can become contaminated with harmful bacteria.
- ✓ The maintenance of fluid quality is key to controlling risk.
- ✓ Inhalation of MWF mist can cause lung diseases, such as occupational asthma and occupational hypersensitivity pneumonitis.
- ✓ Skin exposure to MWF can cause dermatitis.

**Access to work area**

- ✓ Allow access to authorised and appropriately trained people only.

**Equipment and procedures**

- ✓ Cover sumps to keep them free from contamination eg food, bags and urns.
- ✓ Minimise leaks of tramp oil (hydraulic, lubricating or gearbox oil) into the sump. Remove tramp oil by mechanical skimmers, mobile oil collectors or vacuum systems.
- ✓ Remove fines using centrifuges, filtration systems or magnetic separators (for ferrous materials).
- ✓ Remove sump from the sump with suitable tools eg brushes and shovels. Wear gloves which provide protection from chemical and mechanical hazards, but only when machinery is switched off.
- ✓ Mix fresh water-mix fluids to the supplier's recommended concentration. In use, water-mix fluids evaporate and become more concentrated. Therefore top up the machine with fluid below recommended concentration.
- ✓ Maintain and clean the machine and MWF system in accordance with the supplier's instructions.
- ✓ When commissioning or modifying a MWF supply system, avoid points of low or no flow (agitation). For example, these include bottlenecks, dead-ends (a length of pipe sealed at one end preventing continuous flow) and dead-legs (fittings through which MWF only passes infrequently).
- ✓ Prevent fluid stagnation in sumps and pipes, which allows biofilm (microbial growth by keeping the fluid circulating with pumps).
- ✓ Remove dead-ends, and where reasonably practicable dead-legs. Otherwise minimise risk by regular (eg weekly) flushing.
- ✓ Check all strainers/filters regularly for blockages.

- These set out basic advice for both employers and employees as straightforward factsheets

# Further information

- Also G402 & G403; guidance on health surveillance for occupational asthma and dermatitis



Health and Safety Executive

## G402

COSHH Essentials:  
General guidance

### Health surveillance for occupational asthma

**Control approach 4: Special**

**Introduction**

- Occupational asthma (OA) is asthma caused by a substance in the work environment.
- Where a worker is sensitised (allergic) to a particular substance, further exposure (even at low levels) may trigger an asthma attack.
- If you detect symptoms early and modify a sensitised worker's exposure, the risk of developing long-term asthma is reduced.

**Main causes**

- Isocyanates (eg two-pack spray paints), flour dust, grain dust, wood dust, latex, rosin-based solder flux fume, laboratory animals, cleaning products, enzymes, stainless-steel welding, aldehydes, glues and resins.

**High risk occupational groups**

These include bakeries, food manufacturing, beauty industry, cleaning services, healthcare workers, spray painters, repairers (including electronics), welders, woodworkers (including forestry), workers exposed to metal working fluids, seafood processing, laboratory work and detergent manufacturing.

**What is health surveillance?**

- Health surveillance is a risk-based scheme of repeated health checks for the early identification of ill-health caused by work (eg OA).
- You should not use health surveillance instead of doing a risk assessment or using effective exposure controls.
- You should feed results from health surveillance into your risk management system.

**This information will help employers (including the self-employed) comply with the Control of Substances Hazardous to Health Regulations 2002 (COSHH), as amended, to control exposure and protect workers' health. It is also useful for trade union safety representatives.**

**The sheet describes specialist advice on health surveillance for occupational asthma.**

**It sets out what you should expect from a health surveillance provider.**

**Health surveillance should identify if your workers have any of the following symptoms:**

- recurring sore or watering eyes;
- recurring blocked or running nose;
- bouts of coughing;
- chest tightness;
- shortness of breath;



Health and Safety Executive

## G403

COSHH Essentials:  
General guidance

### Health surveillance for occupational dermatitis

**Control approach 4: Special**

**Introduction**

- Exposure to skin sensitisers or repeated exposure to skin irritants can lead to occupational dermatitis (OD). It is an important and common type of work-related ill-health.
- If skin becomes sensitised, exposure to a small amount of the relevant substance can trigger a severe reaction.
- If you detect the signs of OD early and modify a worker's exposure, the risk of developing long-term (irreversible) skin problems is reduced.

**Main causes**

- Epoxy resins, latex, solvents, chemicals used in rubber manufacture, soaps and cleaning products, metalworking fluids, cement, enzymes, wood and irritating chemicals.
- Hand immersion ('wet work'), particularly multiple washing of hands using soap or detergent.
- Prolonged glove use.

**High risk occupational groups**

These include construction work, health service work, rubber processing, printing, paint spraying, agriculture, horticulture, electroplating, cleaning, catering, hairdressing and floristry.

**What is health surveillance?**

- Health surveillance is a risk-based scheme of repeated health checks for the early identification of ill-health caused by work (eg OD).
- You should not use health surveillance instead of doing a risk assessment or using effective exposure controls.

**This information will help employers (including the self-employed) comply with the Control of Substances Hazardous to Health Regulations 2002 (COSHH), as amended, to control exposure and protect workers' health. It is also useful for trade union safety representatives.**

**The sheet describes specialist advice on health surveillance for occupational dermatitis.**

**It sets out what you should expect from a health surveillance provider.**

**Health surveillance should identify if your workers have any of the following skin symptoms:**

- Itching
- Scaling/flaking
- Dry or cracking skin
- Skin colour changes
- Blistering
- Weeping