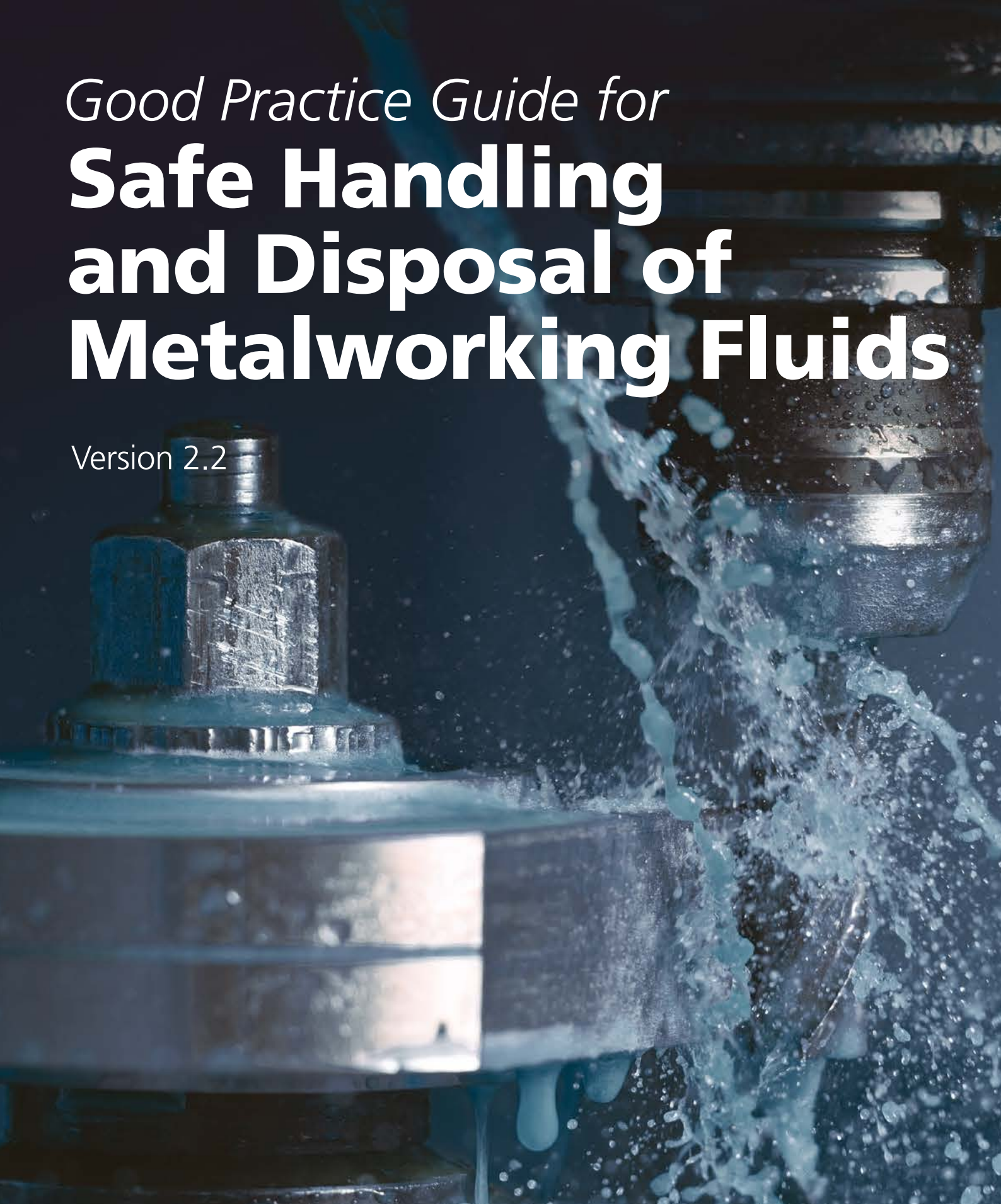




Good Practice Guide for **Safe Handling and Disposal of Metalworking Fluids**

Version 2.2

Table of Amendments

Page	Section	Amendment
7	Right hand column, paragraph 2	removed 0.4mm in brackets
30	Right hand column, paragraph 1	removed 0.4mm in brackets
42	Left hand column, 5th section in Table labelled 'Tramp Oil'	4th row headed 'Clear' has been changed to 'None'

Disclaimer: This guide has been developed by the United Kingdom Lubricants Association (UKLA) Metalworking Fluid Product Stewardship Group (MWFPSG) with support from the Health and Safety Executive (HSE) and other industry experts. The contents of the guide represent UKLA members' current knowledge about good practice with advice from the HSE. This guide contains advice which should be considered together with your knowledge and the advice of your lubricant supplier. No warranty either expressed or implied is provided to users of this guide by either both UKLA and/or HSE. This guide provides advice to dutyholders who ultimately have responsibility for protecting the health and safety of their employees. Future changes to this guide may be required to address changes to technology and working practices.

(www.ukla.org.uk)

The Health and Safety Executive (HSE) was involved with the UKLA MWFPSG in producing this guidance. HSE endorses the guidance, as it follows a sensible and proportionate approach to managing health and safety.

Good Practice Guide for Safe Handling and Disposal of Metalworking Fluids



I am pleased to introduce the revised guide on good practice for safe handling and disposal of metalworking fluid (MWF). This booklet provides a guide on how to maintain MWF to prevent ill-health in machine workshops. It has been prepared by a panel of experts from the UK Lubricants Association (UKLA) Metalworking Fluid Product Stewardship Group (MWFPSG) and from the Health and Safety Executive (HSE) with additional advice from experienced workshop managers and medical experts.

The UKLA and HSE recognise the need for this guide to reflect current good practice in managing MWF to reduce the risks of ill-health in operators. The guide addresses the preparation, maintenance and eventual disposal of MWF and contributes towards a safe working environment. It sets out core good practices in managing the quality of MWF. The guide is aimed at those with the daily responsibilities for

managing MWF and also provides advice for the operators. It is available to download from the UKLA website (www.ukla.org.uk).

The second edition of the guide includes a revised layout for quick reference, further advice on health surveillance as well as specific advice for when a fluid can be treated, bringing the key properties back in line with its target ranges, or when a fluid should be written off, as “beyond repair”.

This guide has been peer reviewed by experts from the MWF producers and from the engineering industry. Users of the guide may identify improvements that could be made to the advice statements, and therefore comments from users are welcomed. The UKLA and HSE will continue to review the accuracy and relevance of this guide to ensure it is based on the best available evidence.

A stylized, handwritten signature in blue ink, appearing to read 'D. Wright'.

David Wright

UKLA Director General

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1.0 Introduction

This guide provides advice about maintaining water-mix MWF to prevent ill-health in machine workshops. Skin disease (dermatitis) and lung disease (occupational asthma and occupational hypersensitivity pneumonitis) can occur in operators, either because their skin is regularly in contact with MWF, or because they inhale MWF mist (Sections 2.1 and 2.2).

These risks to health increase as the composition of the MWF deteriorates in-use, becoming contaminated by tramp oil, soluble metals, metal fines, and microorganisms (bacteria, yeast and fungi). Overuse of biocides to inhibit microorganisms in MWF may also present health risks to operators.

A list of terms and abbreviations can be found in Section 9.0.

1.1 What does the law require?

The Control of Substances Hazardous to Health Regulations 2002 (COSHH) require employers to carry out a suitable and sufficient risk assessment for those exposed to MWF. The risk assessment should identify the measures required to ensure that exposure is either prevented or adequately controlled (i.e. kept to a minimum). A guide to COSHH and risk assessment (Figure 1) can be found by following the links summarised at the end of this section.

Adequate control of exposure can be achieved by:

- Reducing skin contact with MWF.
- Reducing inhalation of MWF mist to levels “as low as reasonably practicable” (ALARP).
- Applying COSHH principles of good control practice by:
 - Designing operating procedures and activities to minimise emissions and contact with MWF.
 - Choosing control measures that are proportionate to the risk and are the most reliable in minimising the escape and spread of MWF mist.
 - Checking and reviewing all control measures to ensure their continuing effectiveness e.g. the performance of Local Exhaust Ventilation (LEV) to minimise exposure to MWF mist.
 - If exposure to MWF (either by mist or contact with skin) cannot be adequately controlled, suitable Personal Protective Equipment (PPE) and Respiratory Protective Equipment (RPE) should be provided alongside other control measures.
 - Informing and training all employees about the hazards and risks to health, and the use of control measures required to minimise exposure to MWF.

1.2 Health Surveillance

COSHH requires that a suitable health surveillance programme is provided where there is a reasonable likelihood of disease occurring in the workplace. For work with MWF this programme should cover both skin and lung disease.

Health surveillance should be set up in consultation with a competent occupational health provider. Workers and their representatives should also be consulted. The aims of the health surveillance programme and the processes involved should be clearly defined at the outset (see sections 2.1.2 and 2.2.1).

1.3 Keeping records of checks

- COSHH requires that records of any inspections or checks etc., that relate to control measures (e.g., LEV, tramp oil, bacteria, MWF concentration and pH) are kept (paper or electronically) and retained for 5 years.
- It also requires that employee health records, and records of personal exposure are retained for 40 years.



Figure 1: HSE guidance for COSHH and risk assessment

Links to relevant HSE website advice and guidance documents:

HSE Working with Hazardous Substances: A Brief Guide

HSE Risk Assessment: A Brief Guide

HSE COSHH Essentials for Machining with Metalworking Fluids

HSE Working Safely with MWF: A Guide for Employees

www.hse.gov.uk/pubns/indg136.pdf

www.hse.gov.uk/pubns/indg163.pdf

www.hse.gov.uk/metalworking/ecoshh.htm

www.hse.gov.uk/pubns/indg365.pdf

2.0 Health

2.1 Skin disease

Operators may develop dermatitis, particularly on their hands, arms, and face caused by contact with water-mix MWFs or neat oils. These fluids can cause the skin to lose its natural oils and protective layer. Early symptoms of dermatitis include itching and the appearance of red patches on the skin. Other symptoms which may develop include dry and cracking skin, swellings, pain, and in some cases blisters and open sores. You may see one or all of these symptoms (Figure 2). Chemicals such as biocides and certain soluble metals in MWF can cause an allergic form of dermatitis. Dermatitis symptoms can be painful and debilitating and in the worst case may prevent an operator undertaking certain tasks.

The earlier that dermatitis is diagnosed and treated, the greater the likelihood that it will not become a chronic illness. When an employee is experiencing problems with their skin, the employer should refer them to their occupational health provider. If the individual is also talking about their condition to their GP, or other health professional, it is appropriate for them to highlight that their job involves working with MWFs which can cause skin disease.

- Any soaking of the skin with water-mix MWF, i.e. wet working, should be minimised as far as possible.
- Refer to the MWF supplier's safety data sheet (SDS) to check for substances classified as causing irritation or allergic skin reactions. There may be a MWF with less hazardous components, take advice from your fluid supplier.

- Use control measures to minimise skin contact, for example automatic mixing devices, enclosing machines, providing splash-guards and using suitable tools such as brushes, magnetic wands and swarf hooks.
- Close-fitting disposable gloves may be required to prevent MWF and chemicals from contaminating the skin. If disposable gloves (e.g. nitrile) are required, they must easily tear to minimise risk of entanglement in moving machinery.
- Wash hands, arms and any other exposed skin before taking a break and at the end of a shift. It is essential to dry the skin well e.g. between the fingers where moisture and soap can be retained.
- Employers should provide soap and a means for drying hands e.g. paper towels or a hot air dryer. You can encourage good practice by providing hand cleaning charts.
- Use a good skin care regime which includes regular use of moisturising cream.

For more information regarding advice and guidance on skin disease follow the links at the end of this section.

2.1.2 Health surveillance for skin disease

- Regular skin checks should be part of an overall health surveillance programme undertaken by a competent person or occupational health provider.
- Where a competent person is used, they must be adequately trained and supported by a competent occupational health provider.
- Employees should be trained to recognise the common symptoms of dermatitis.
- For employees with skin symptoms it is essential that the occupational health provider assesses their condition.
- Where allergic contact dermatitis is suspected by the occupational health provider, the expert opinion of an appropriate skin specialist should be sought.
- If a case of dermatitis has been diagnosed, the employer, with support from the occupational health provider, should carry out an investigation of all exposed employees to identify if other operators are at risk of (or have also developed) skin disease.



Figure 2a: Photograph of hands affected by dermatitis showing dry, flaking and cracked skin



Figure 2b: HSE poster explaining how to check for signs of dermatitis

Links to relevant HSE website advice and guidance documents:

HSE Skin Checks for Dermatitis

www.hse.gov.uk/skin/posters/skindermatitis.pdf

HSE COSHH Essentials: Control of Skin Risks During Machining

www.hse.gov.uk/pubns/guidance/mw2.pdf

HSE Choosing the Right Gloves to Protect Skin: A Guide for Employers

www.hse.gov.uk/skin/employ/gloves.htm

HHSE COSHH Essentials: Health Surveillance for Occupational Dermatitis

www.hse.gov.uk/pubns/guidance/g403.pdf

2.2 Lung disease

For operators inhaling MWF mist there is a greater risk of developing lung disease. Occupational hypersensitivity pneumonitis (OHP) and occupational asthma (OA) are the most commonly reported types of lung diseases in operators.

Unexplained coughing, recurrent chest infections, breathing difficulty, and weight loss in an operator may be an early indication they are developing serious lung disease. Employees who have developed asthma before they started working with MWFs may also be at risk of aggravating this condition should they inhale MWF mist.

OA and OHP are debilitating conditions that can impair the quality of life and the capacity for work. The sooner the signs of these conditions are recognised and the operator removed from where they may be exposed, the less likely it is that they will suffer permanent lung damage. If an employee is experiencing breathing problems, the employer should refer them to their occupational health provider. If the individual is also talking about their condition to their GP, or other health professional, it is appropriate for them to highlight that their job involves working with MWFs which can cause lung disease.

The SDS may not have the hazard statement H334 “May cause allergy or asthma symptoms or breathing difficulties if inhaled”, because the MWF as formulated may not contain sensitising substances but when in use it becomes contaminated (by metals, biocides and microorganisms) and can cause lung disease.

Exposure to MWF mist should be minimised by enclosing the work processes where reasonably practicable and by using LEV and mist filtration units. These engineering controls need to be maintained and checked on a regular basis. Section 6 contains more information on control measures.

2.2.1 Health Surveillance for lung disease

- Employers should put in place a suitable health surveillance programme for OA and OHP, which are linked to workplace exposure to MWF mist (see links on page 10). Adequate health surveillance includes a questionnaire looking for relevant symptoms and a periodic lung function test (Figure 3a).
- It is important that employees are trained to recognise the symptoms that may indicate lung disease and to report them to an appropriate supervisor who can then arrange a referral to the occupational health provider.
- If an employee has persistent or recurring respiratory symptoms or chest infections, it is essential that the occupational health provider is informed.
- Where the occupational health provider suspects an employee of having OA or OHP, an early referral to a respiratory physician with expertise in these conditions should be made.
- If a case of OA or OHP has been diagnosed, the employer, with support from the occupational health provider, should carry out an investigation of all exposed employees to identify if other operators are at risk of (or have already developed) lung disease.



Figure 3a: A picture of a patient using a spirometer, which is the equipment used to test lung function



Figure 3b: Illustrates the fine airway structures of the human lung. This is where small MWF mist particles may penetrate and deposit into the lung when inhaled

Links to relevant HSE website advice and guidance documents:

HSE COSHH Essentials: Health Surveillance for Occupational Asthma www.hse.gov.uk/pubns/guidance/g402.pdf

HSE: Set Up and Design Health Surveillance
According to Need

www.hse.gov.uk/health-surveillance/setup/index.htm

3.0 Storage of MWF

3.1 Environmental conditions

It is important to manage the environmental storage conditions for MWF to maintain quality and performance. For specific storage advice refer to the SDS.

- MWF concentrate should be stored indoors (between 5 °C and 40 °C) in drums or using an Intermediate Bulk Container (IBC).
- If stored outside, these containers should be placed under covers as a minimal precaution to avoid extremes of temperature.
- If there is a risk of exposure to rain or condensation, either store upright with the lids covered, or on their side to prevent water collecting around the outlets.
- Rotating the stock ensures that concentrates are not stored longer than recommended by the supplier.
- Do not use MWF concentrate beyond the expiry date set by the supplier.
- Ensure that hazard warning labels are visible on all storage containers.

3.2 Storing diluted MWF

- Refer to the supplier's instructions for storing diluted MWF.
- Do not exceed any storage life or temperature recommendations.
- If in doubt, consult the MWF supplier for advice about the conditions of storage and durability of diluted stocks.

Links to government guidance documents:

Storing oil at your home or business:

www.gov.uk/guidance/storing-oil-at-a-home-or-business#exempt-oil-storage-containers

4.0 Preparing working dilutions from MWF concentrate

4.1 Mixing the MWF

It is important to mix the MWF correctly to ensure optimum quality and performance. Ensure that the supplier's advice is followed for each specific MWF. The preferred method is to use a mixing (dosing) unit to prepare emulsions; always seek advice from the supplier.

- Ensure that PPE^A is available and used (e.g. protective overalls, gloves and glasses) (Figure 4a and 4b)
- Please refer to the supplier's SDS. This contains information about the hazards of the MWF concentrate, including precautions for safe handling.
- Always add the concentrate to water to ensure that the emulsion is formed correctly.
- Before using the MWF check that the pH and concentration are within the recommended limits.
- Where possible, prepare MWF in a designated and well-ventilated area to avoid inhalation of volatile respiratory irritants. These can accumulate at the top of sealed drums containing the concentrate.

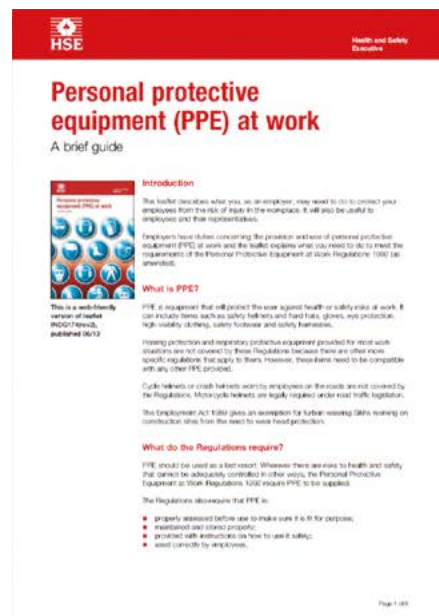


Figure 4a: HSE guide to the selection and use of personal protective equipment



Figure 4b: Examples of basic PPE that should be used by a machine operator

^A PPE (and RPE) has to comply with the PPE Directive (89/686/EEC) and UK PPE Regulations 2002 (SI 2002/1144) and be kite marked to the relevant EN Standards.

4.2 Water quality

The quality of the water used to prepare the working emulsion is important to ensure stability and performance.

- It is recommended to consult the MWF supplier about suitable water quality requirements (e.g. hardness and pH).
- It is advisable to check the water source for the levels of bacteria, yeast or fungi. For example, use a dipslide to test the water supply.
- The use of stored water (rather than direct mains) may increase the risk for bacterial contamination of the MWF. Weekly inspections of water storage tanks and water filtration apparatus should be undertaken to ensure they are kept clean to prevent the formation of biofilm.
- If it is necessary to store water it is best practice to keep records of regular weekly checks on the water microbial quality.

Technical advice about water hardness and electrical conductance

Water hardness: This is most commonly measured using water hardness test strips and kits that can be obtained from a variety of manufacturers with instructions on how to use them. Water hardness test kits provide a reading as parts per million (ppm) which can also be expressed as a degree of water hardness related to calcium carbonate (CaCO_3) content.

The ideal hardness of water to use with MWF ranges from 80 to 200 ppm. This can vary

dependent on formulation and fluid use. If the water hardness is too soft this can cause an increase in foaming and if too hard this could cause insoluble soaps to form which could block pipes and/or filters.

Conductivity tests: Conductivity is a measure of the electrical conductance (expressed in microsiemens) of a MWF and is influenced by the amount of dissolved materials and salts. Conductivity of a MWF generally increases over time and thus may lead to insoluble residues, an unstable emulsion, and loss of operating performance.

Links to relevant HSE website advice and guidance documents:

HSE Personal Protective Equipment at Work: A Brief Guide

HSE Selecting Protective Gloves

HSE Single Use, Splash-resistant Gloves

www.hse.gov.uk/pubns/indg174.pdf

www.hse.gov.uk/pubns/indg330.pdf

www.hse.gov.uk/skin/posters/singleusegloves.pdf

5.0 Maintaining MWF

It is important to maintain the MWF quality according to the supplier’s recommendations to minimise risks to health (skin and lung disease) and to ensure good fluid performance. Indications of microbial contamination in MWF include changes in appearance and odour (e.g. a rotten eggs smell). Over a longer period, a visible biofilm can form on the inner surfaces of sumps

and supply pipes (Figure 5). Fungal growth can be found on the inner and outer surfaces of machines and pipes and the surface of the MWF sumps. The following factors influence MWF quality and are summarised in Table 1.

Table 1: Factors to consider that affect the quality of water-mix MWF

MWF concentration: During use MWF may increase in concentration and foam due to evaporative loss of water. There may be an increased risk of misting. Diluting the MWFs below recommended concentrations may increase the risk of bacterial contamination and corrosion, resulting in poor cutting performance, shorter sump life and increased cost.
MWF pH: The pH should be maintained within the supplier’s recommended range. Corrosion and microbial growth can occur when the pH of a MWF drops below the recommended operating range (i.e. becomes more acidic). If the MWF pH increases too much there is an increased risk of skin irritation.
Tramp oil: Contamination of the MWF with tramp oil above a 2% concentration may reduce surrounding air quality, increase the risk for dermatitis in operators and encourage microbial growth in the MWF. It will cause the emulsion to become discoloured and to separate and foam which may increase the release of mist. An increase in the suspension of solids may also occur which reduces filtration efficiency and tool life.
Metal contamination: Allowing the concentration of metal contaminants to increase causes poor cutting performance, reduces sump volume, promotes microbial growth and also increases disposal costs. Metal fines and swarf increase skin abrasion, cuts and the risk of dermatitis.
Circulation of the MWF: Maintain circulation of the MWF to prevent stagnation. This discourages the growth of anaerobic microorganisms and the formation of noxious gases and volatile compounds.
Biocides: In some circumstances biocides are needed to prevent microbial growth. The incorrect use of biocides may lead to the development of biocide resistant organisms and may be harmful to the operator.
Operating temperature • Water-mix MWF: Operating MWF at a temperature above 30 °C creates optimal conditions for microbial growth and increases MWF concentration through evaporation. • Neat oil: The operating temperature can affect the viscosity and cooling properties. Consult the MWF supplier about the appropriate temperature range for their product.

5.1 Actions to maintain MWFs

Specific actions and checks are required to maintain the MWF. Tables 2 to 10 summarise actions and checks that need to be undertaken to maintain the quality of MWF.

The recommended frequency of the checks in Tables 2 to 10 are considered good practice. A different frequency of checks may be relevant taking into account the type of MWF, machining and other circumstances. The frequency of checks adopted needs	therefore to be supported by historical records demonstrating that the MWF quality has been maintained consistently. This also needs to be explained in your risk assessment.
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Table 2: MWF odour and appearance

Actions • Ensure that the MWF is effectively maintained, failure to do so might lead to changes in its appearance, odour and the stability of the MWF emulsion.	
Checks • That the MWF has not dramatically changed in colour or clarity. • For signs of foaming and for levels of fines and swarf, tramp oil and separation of the emulsion. • For unusual odours which can indicate growth of bacteria and stagnation of the MWF. • For obvious signs of biofilm on the visible surfaces of the sump tanks and filters (Figure 5).	
Explanation • Stagnant MWF may smell rancid or sulphurous.	
Frequency	Daily



Figure 5: Biofilm deposits on the inside of MWF supply tank

Table 3: MWF operating temperature

Actions • Ensure that the MWF operating temperature is within the supplier’s specification to maintain optimal product and machining performance. • It is recommended that the MWF operating temperature does not rise above 30 °C unless required for the performance of the MWF. • For larger sumps, a heat exchanger may be used to manage the fluid temperature.	
Checks • It is recommended to check the temperature of the MWF in the sump regularly. • Leave temperature probes in the sump for several minutes to obtain a stable reading.	
Explanation • Warm conditions promote the growth of microorganisms and water evaporation can increase the MWF concentration.	
Frequency	Weekly

Table 4: *Tramp oil*

Actions • Maintain machines and other equipment to minimise tramp oil leakage. • Tramp oil contamination should always be kept to a minimum level (recommended below 2%). • When tramp oil leaks occur these should be removed using mechanical skimmers, mobile oil coalescers, or vacuum systems. • For advice about dealing with tramp oil in neat oils refer to the MWF supplier.	
Checks • Frequently check tramp oil contamination (Figure 6a). • Tramp oil contamination may appear as discoloured patches of oil on the sump surface or discolouration of the MWF (Figure 6b). • Record the checks on tramp oil leaks and the consumption of the machine oil supply. • Ensure that operators are trained to promptly report any leaks to the work supervisor.	
Explanation • Tramp oil is likely to promote microbial growth, affect air quality and MWF performance.	
Frequency	At least weekly

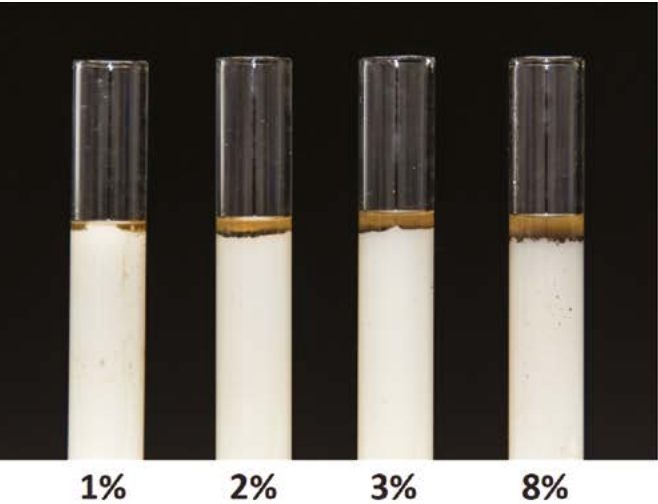


Figure 6a: Represents the different concentrations (1%, 2%, 3%, and 8%) of tramp oil estimated by leaving a small volume of the MWF to settle overnight in clear test tubes. The darker lines at the top of the MWF are where the tramp oil has settled and can be estimated.



Figure 6b: Tramp oil (light brown) floating on the MWF surface.

Table 5: MWF pH

Actions • Ensure that the pH of the MWF stays within the supplier’s recommended range. • Adjust to the required operating pH by adding higher strength pre-mixed MWF, or a suitable additive, recommended by your MWF supplier.	
Checks • Check the pH using test strips (Figure 7a) or a calibrated pH meter. • Keep a record of pH readings to identify changes and trends in the MWF (Section 9.1).	
Explanation • pH measurements give an indication of fluid quality, a sharp drop in pH may indicate high bacteria levels, and a sharp increase in pH may indicate possible chemical contamination (e.g. alkaline cleaning solutions). • An explanation of how to undertake a pH test using a calibrated meter is given on the next page.	
Frequency	At least weekly



Figure 7a

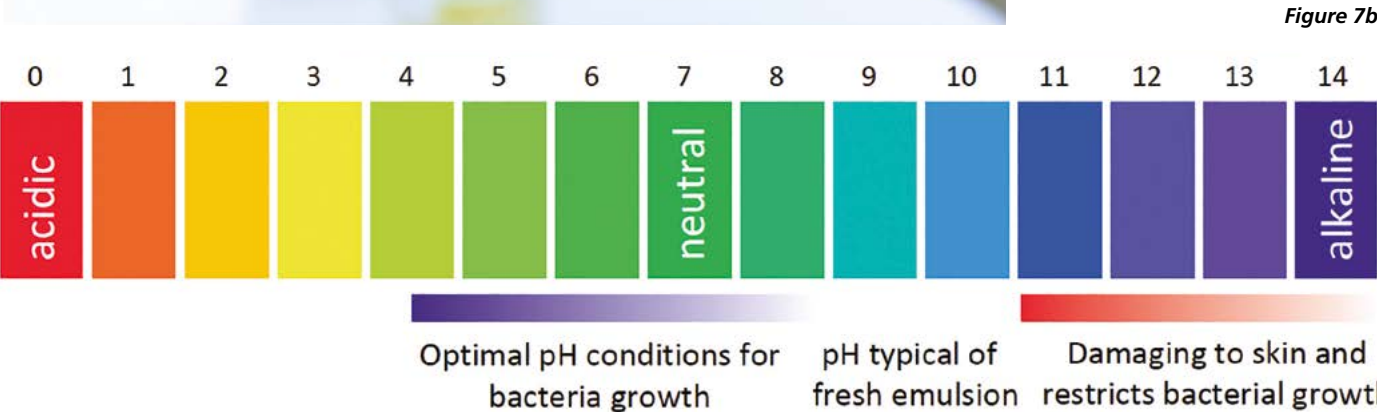


Figure 7b

Figure 7a: pH test paper strips are commonly used to determine the pH of a MWF. Dip the indicator strip into the MWF for a few seconds and then remove it to compare the strip colour to the pH indicator guide (**Figure 7b**) provided by the supplier of your pH paper.

Technical advice about measuring pH using an electronic meter

Electronic pH probes: There are different types of electronic pH probes and meters. Therefore, always read the manufacturer's instructions as to their proper use. The following is a generalised account of how to use this equipment.

Equipment: You will require a pH probe; pH buffer standard solutions (pH 4.0, 7.0 and 10.0); distilled water and 0.1M hydrochloric acid. Keep buffers in sealed containers to minimise contamination.

Calibration:

1. Allow the pH meter, probe and sample buffers time to reach room temperature.
2. If the MWF operating pH is expected to range between pH 8.0 to 10.0, select the pH 7.0 and pH 10.0 buffer standards to calibrate the equipment.
3. Place the probe in the pH 7.0 standard and after a minute when the reading stabilises, if required, adjust the meter to read pH 7.0. Wash the pH probe in distilled water and using a clean tissue wipe the probe to remove the surface water.
4. Repeat this adjustment for the pH 10.0 standard.
5. After calibration the probe is cleaned as in step 3 and the sample pH determined.

How to measure pH: After calibration, place the probe in the MWF fluid and allow the reading to stabilise before recording the pH value.

Maintaining electronic pH probes: pH probes should be cleaned to remove MWF contaminants and stored in pH 7.0 buffer.

To remove tramp oil from the pH probe:

1. Soak the probe in 0.1M hydrochloric acid for ~3 minutes (5 minutes for heavy contamination), rinse thoroughly with distilled water and dry the sensor using lint-free tissue. Return the probe to a pH 7.0 buffer solution.
2. Calibrate before use.
3. pH probes should be cleaned at least every two weeks and when the probe head appears dirty.

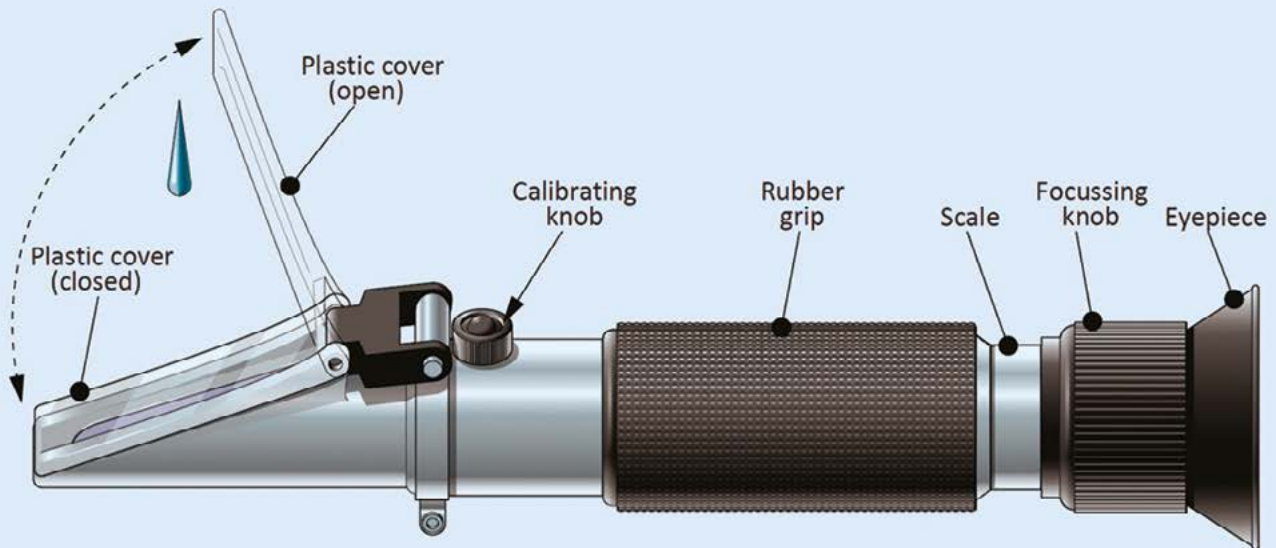
Safety: Wear suitable eye protection and disposable gloves to protect skin and eyes from hazardous chemicals when using and cleaning the pH meter.

Table 6: *MWF concentration*

Actions • Use the correct MWF concentration recommended by the supplier. • Adjust MWF concentration using a higher or weaker strength pre-mixed MWF. In most circumstances it is advisable not to use water or the concentrate stock directly.	
Checks • Check the concentration of the MWF. This can be carried out with a refractometer (Figures 8 and 9). • For quality purposes it is good practice to perform these checks as frequently as possible. • For some MWFs it may be necessary to carry out these checks more frequently than stated. • Record refractometer readings (e.g. using the chart in section 9.1) to identify changes and trends in the MWF concentration. Retain copies of these checks.	
Explanation • Refractometers are an effective shop floor tool to monitor the concentration of the MWF. There are other methods to measure MWF concentration, seek advice from your supplier as to the most suitable equipment. • A refractometer reading is not a direct measure of concentration. Product-specific factors must be applied, ask your supplier if in doubt.	
Frequency	At least weekly

Technical advice about refractometers

A refractometer is a handheld optical instrument to measure the working concentration of a MWF based on the refractive index. The operator reads a number through the eyepiece of the instrument (Figure 9) which needs to be adjusted by a product specific factor to determine the MWF concentration. If not at the specified working concentration, the MWF can then be adjusted.



Calibration:

The accuracy of a refractometer is dependent on temperature and the instrument. The clean water used to calibrate the instrument and the MWF sample must be at ambient temperature before calibration is carried out.

1. Ensure that the refractometer is calibrated to zero reading on the water sample at $\sim 20^{\circ}\text{C}$.
2. Do not carry the refractometer in your pocket or leave in direct sunlight.
3. Place a few drops of the clean water (used for the mixture) between the plastic cover and the prism.
4. Hold the refractometer horizontally and point it at a light source.
5. Look into the eyepiece and adjust the scale calibrating dial until the boundary line which separates the light and dark areas of the scale is aligned with the zero line on the scale.

Figure 8: A schematic diagram of a refractometer.

Technical advice about using a refractometer

1. Lift the plastic cover and dry the prism with a clean cloth, place one or two drops of the MWF on the prism and close the plastic cover.
2. Note the refractometer scale reading at the point where the boundary line separates the light and the dark areas on the scale.
3. Determine the concentration by multiplying the scale reading by the adjustment factor of your water-mix MWF (see note below).
4. Clean the refractometer prism and plastic cover with a clean cloth and store in the carrying case.

Note: Soluble metalworking fluid concentration (%) = refractometer reading x adjustment factor for the MWF.

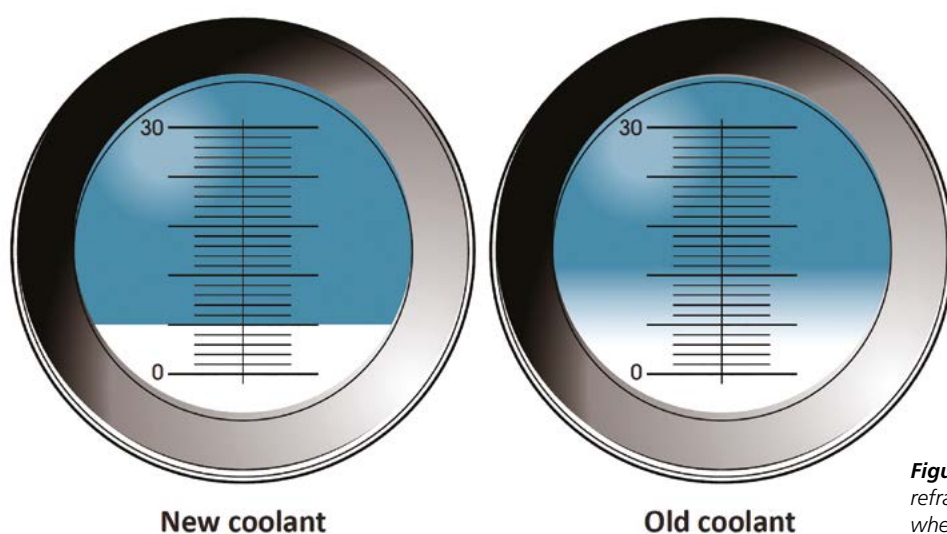


Figure 9: The view through the eyepiece of a refractometer; the right panel depicting a hazy line when tramp oil contamination is present in old MWF.

Table 7: Circulation and flow of the MWF

Actions • Keep the MWF circulating with pumps to prevent fluid stagnation in the sumps and pipes. Consider that MWF may stagnate during preventative maintenance and shutdown periods. • During installation of a MWF supply system where possible avoid including dead-ends and dead-legs where MWF may stagnate (Figure 10 and definitions in Section 9.0). • Where they are present and when it is reasonably practicable to do so, remove dead-ends and dead-legs, otherwise minimise risks for stagnation of the MWF by regular (e.g. weekly) flushing. • Undertake cleaning of the sumps to ensure that the MWF can circulate effectively to prevent stagnation.	
Checks • To ensure effective MWF circulation, check for the accumulation of swarf, deposits and biofilms in the sump and supply systems, and 'dead-ends'.	
Explanation • Blockages increase MWF supply pressure causing foaming, misting and reducing performance of the MWF.	
Frequency	At least weekly

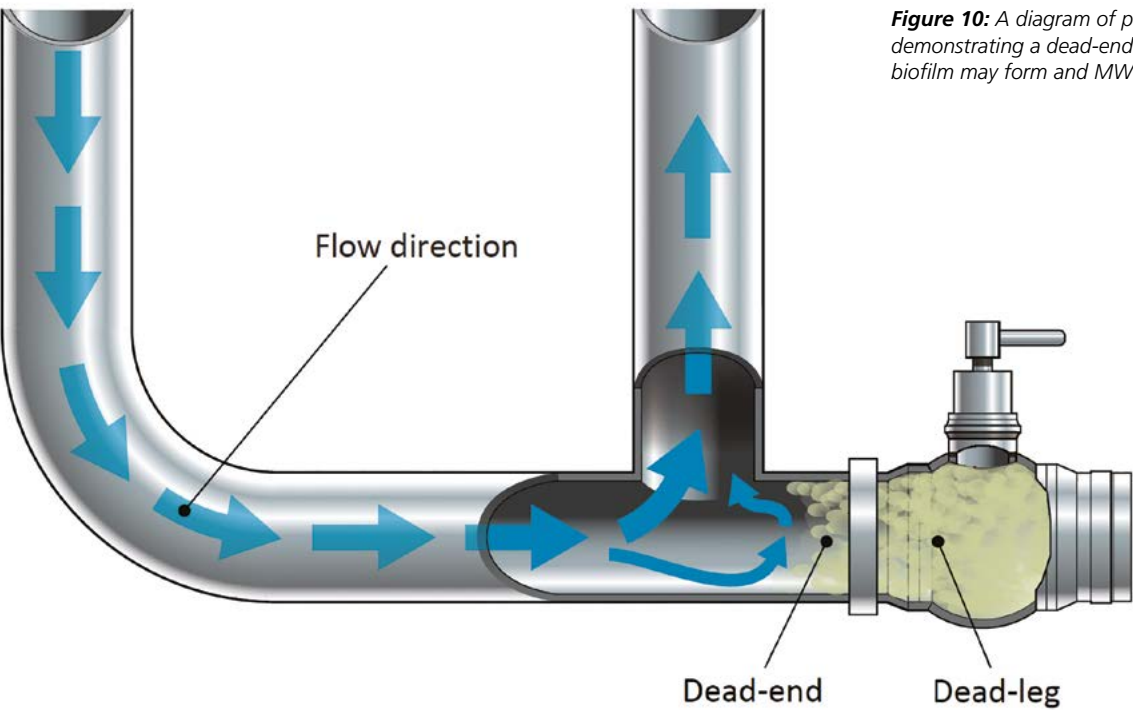


Figure 10: A diagram of part of a fluid supply system demonstrating a dead-end and dead-leg where biofilm may form and MWF stagnate.

Table 8: *Monitoring microbial growth*

Actions • Implement a regular monitoring programme for checking microbial growth in water-mix MWF. This is often done using dipslides to count colony-forming units (CFU) of live bacteria, fungi or yeast. • Other methods may be used to identify specific microorganisms and you are recommended to consult your MWF supplier about these procedures. • Bacteria growth is indicated when dipslide results are consistently at or above 10,000 CFU/ml (10^4 CFU/ml) (Figure 11). Check and review measures to maintain fluid quality (Table 9). • Immediate actions are required if the MWF is heavily contaminated with bacteria at or above 1,000,000 CFU/ml (10^6 CFU/ml). Appropriate actions may be the disposal of the MWF and a complete system clean (Section 7.0) or other equally effective measures, but seek advice from your fluid supplier. • See Figure 12 for a guide to actions to take based on the results of MWF bacterial dipslide tests. • For each fluid supply system record using a chart (Section 9.1) the results of the dipslide tests to identify trends in the number of live bacteria. This will indicate when to apply appropriate control measures to prevent further microbial growth.	
Checks • Test the MWF using dipslides to determine the number of colony forming bacteria. • Undertake weekly dipslide tests unless you can demonstrate that the controls in place are keeping bacteria growth consistently below 10,000 CFU/ml (10^4 CFU/ml) in which case the frequency of these tests may be reduced. • Inspect the machine, machine enclosure, and surface of the sump for visible signs of fungal growth. • If uncertain how to implement a suitable test regime for microbial growth, consult the MWF supplier.	
Explanation • Follow the advice provided by the dipslide kit manufacturer to determine the CFU/ml by incubating the slides under the appropriate conditions. • For the optimal dipslide methods for fungi and yeast seek advice from your supplier.	
Frequency	At least weekly

Technical advice about using dipslides to monitor bacteria, fungi and yeast

Refer to the manufacturer's instructions for dipslides, which are designed for the detection of bacteria, fungi or yeast. Check to ensure that the dipslides you are using are within the manufacturer's recommended shelf-life.

1. Wash your hands and use disposable single-use gloves to handle the dipslide and MWF sample.
2. Remove the dipslide from the storage and incubation tube. Do not allow the dipslide agar (the jelly type substance on each side) to hit the edge of the clear plastic tube.
3. Place the dipslide directly into the sample being tested. Ensure that a dipslide is also used on the water supply as a control test. Make sure the dipslide agar is fully submerged for approximately 10-15 seconds.
4. Place the dipslide into the sterile plastic tube taking care not to damage the agar.
5. Place the dipslide tube into a dipslide incubator. The temperature and duration of the incubation period will vary depending on the type of organism (bacteria, fungi or yeast) and you should consult the dipslide manufacturer if in doubt. Generally the bacterial colonies can be counted after around 24-48 hours of incubation.
6. Compare the number of colonies of bacteria, fungi or mould on the dipslide against the comparison chart provided by the dipslide manufacturer (Figure 11). Note that the shape and colour of bacterial, fungal and mould colonies differ.

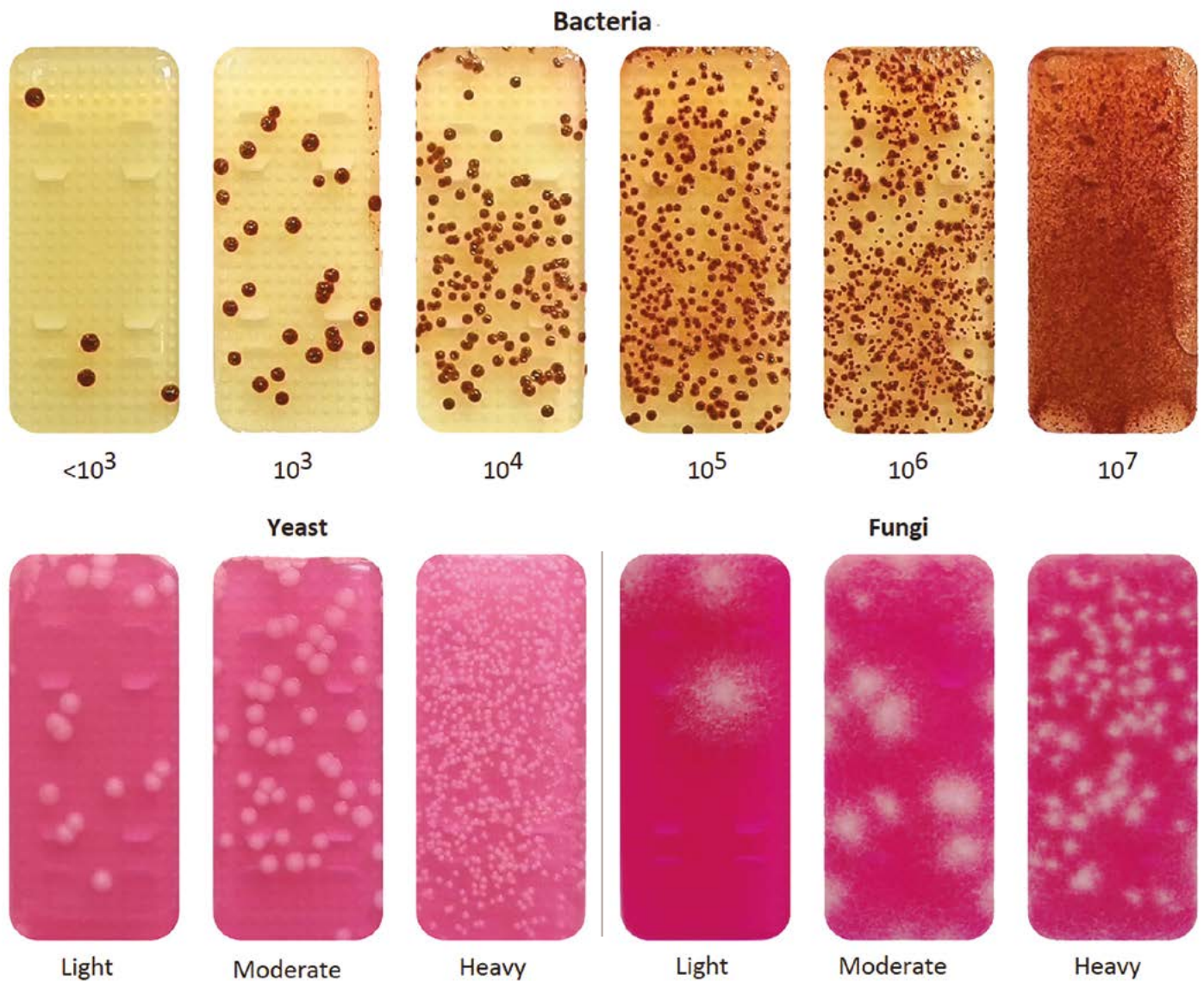


Figure 11: Dipslides showing in upper panel from left to right, increasing number of bacterial colony-forming units (CFU/ml). In the lower panel the yeast (left) and fungi colonies (right) are recorded as light, moderate and heavy contamination. Please note that the colour of dipslide and colonies may vary depending on the kit used.

Table 9: *Acting on dipslide tests and using biocides*

Actions

Where dipslide test results are at or above 10,000 CFU/ml (10^4 CFU/ml) then:

- Ensure that all good practice checks and actions are being applied to maintain the quality of the MWF (concentration, pH, tramp oil content, metal contamination, operating temperature and agitation and flow).
- If after applying these measures the growth of bacteria, yeast and fungi cannot be stopped a biocide may be required. Follow the supplier's recommended dosing regime to minimise the risk of biocide resistant bacteria forming.
- Add biocides into the sump system to ensure that adequate mixing with the MWF is achieved. To add the appropriate amount of biocide, consider the sump volume and always ensure the sump is topped up to the correct level before treatment.
- Always refer to the supplier's SDS when checking the hazardous properties of any biocide and for advice about PPE requirements.
- Immediate actions are required if the MWF is heavily contaminated with bacteria at or above 1,000,000 CFU/ml (10^6 CFU/ml). Appropriate actions may be the disposal of the MWF and a complete system clean (Section 7.0) or other equally effective measures, but seek advice from your fluid supplier.
- See Figure 12 for a guide to actions to take based on the results of MWF bacterial dipslide tests.

Checks

- Ensure that all additions of biocide are noted and records kept.

Explanation

- Do not overuse biocides as this may cause dermatitis and asthma.
- Only use biocides at the doses recommended by the manufacturer.
- Overuse of biocides may increase the risk of developing biocide resistant organisms.

Only add biocide when other corrective actions have been taken but the microbial growth continues

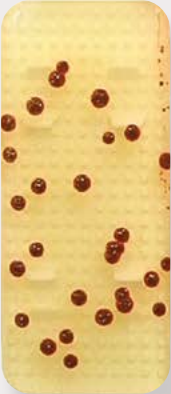
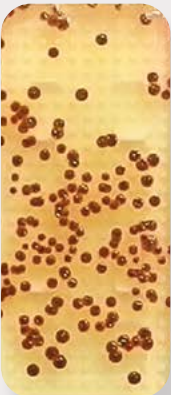
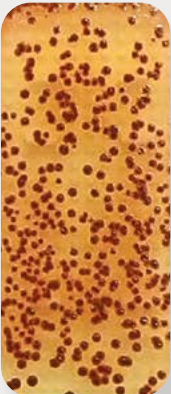
Bacteria colony counts	Typical appearance of a bacteria dipslide	Comments and required actions
Colony Forming Units (CFU/ml) observed on the dipslide. Follow the dipslide manufacturer's instructions for optimal incubation conditions.	The dark spots are colonies of growing bacteria	
Below 10,000 ($<10^4$) CFU/ml		Bacterial growth under control Regular checks and actions to maintain the fluid quality should continue.
At or above 10,000 ($\geq 10^4$) CFU/ml and below 1,000,000 ($<10^6$) CFU/ml		Caution: Increasing bacterial growth indicates deteriorating fluid quality Review and take action to check the quality of the MWF and adjust fluid parameters to those recommended by the supplier (Table 9). If bacterial growth continues despite these adjustments, add biocide at the doses recommended by the manufacturer. Dipslide tests should be undertaken one week after the addition of biocide to demonstrate that the treatment has been effective.
At or above 1,000,000 ($\geq 10^6$) CFU/ml		Immediate action required Large numbers of actively growing bacteria are present. For small sump systems dispose of the MWF. For large sump systems consult your fluid supplier about appropriate actions to take to restore fluid quality or whether disposal is necessary. When disposing of the MWF undertake a complete system clean following the advice provided in Section 7.0.

Figure 12: Actions to take based on the results of MWF bacterial dipslide tests (see Tables 8 and 9).

Table 10: *Metal swarf and fines*

Actions • Ensure that metal swarf and fines (Figure 13) are kept to a minimum in the MWF supply. • Metal fines can be removed continuously using filtration units or a vacuum line. • Consult the supplier about setting good practice levels for metal fines in specific MWFs and machining tasks.	
Checks • Undertake visual checks for accumulation of metal fines in the MWF supply and sumps.	
Explanation • The amount of metal fines that accumulate in the MWF is highly dependent on the type of metal being machined, the machining processes and the cutting/grinding speed. It is therefore important to reduce the amount of fines to a minimum consistent with the metal and machining processes being applied. • These considerations should be addressed in your risk assessment. • If you have concerns about the risks for allergic lung disease caused by sensitising metals seek specialist medical advice, for example, from an occupational health provider.	
Frequency	At least weekly



Figure 13a: *Swarf.*



Figure 13b: *Metal fines.*

Links to relevant HSE website advice and guidance:

HSE COSHH Essentials: Managing Fluid Quality

www.hse.gov.uk/pubns/guidance/mw5.pdf

6.0 Controlling exposure to MWF mist

Used MWF may contain hazardous substances and microorganisms. Therefore, effective control measures are required to reduce exposure to MWF mist. Important factors to consider, in this order, are:

6.1 Engineering control solutions

- Where practicable enclose machining processes.
- Observe a time delay between the machine stopping and opening the enclosure doors, so when the operator opens the doors, no mist is present in their breathing zone (the space within 20-30cm of their nose and mouth). The time delay can be established by filling the enclosure with smoke (Figure 14a and 14b) or using a dust lamp to observe fine mist. Implement the time delay by including it in the machine programme or using a timer.
- Ensure that the MWF delivery variables (e.g. volume and rate of flow to the tool, operating temperature and cutting tool speed) are appropriately set to minimise MWF mist.
- Stop the MWF delivery when machining is completed.
- Ensure that all routine checks, machine breakdowns etc. are recorded and these records retained.
- Ensure that appropriate training is provided.

6.2 Effective design and provision of LEV

- It is of paramount importance to provide adequate LEV to remove MWF mist from CNC machine enclosures.
- It is essential that these systems are fitted and operated effectively.
- For recirculating LEV systems ensure that a suitable high efficiency air cleaning device is in place. Consult the LEV supplier if in doubt.
- It is recommended to seek competent advice on the design and commissioning of LEV systems.
- Refer to HSG258 Controlling airborne contaminants at work (see link at the end of this section) for detailed advice about commissioning, maintaining and testing LEV equipment.

6.3 Checking the performance of LEV

- Ensure that a preventative programme is in place to inspect and maintain control measures such as LEV.
- Operators should check and promptly report any problems with the performance of LEV.
- Daily visual inspection of engineering control systems, for example airflow pressure gauges during start-up operations, should be carried out.
- Thorough examination and testing of LEV systems must be carried out at least once every 14 months (a statutory requirement) by a competent person.
- Smoke pens and tubes (Figure 15a and 15b) can be used to demonstrate that the enclosure is under negative pressure. Back-lighting equipment is inexpensive and a practical means to visualize mist leaking from equipment.

6.4 Compressed airlines

The use of compressed air to blow down components increases the risk of inhaling MWF mist and splash contamination of skin and clothing (Figure 16a and 16b). Alternative methods which reduce the use of hand-held compressed airlines should be considered, for example, enclosed component cleaning systems fitted with LEV, vacuum lines, absorbent materials, or degreasing/washing methods. When there is no practical alternative to their use;

- Provide LEV for work with compressed air.
- Reduce compressed airline pressure to a level as low as practical for effective cleaning and to minimise mist emissions.
- Use compressed airlines designed to reduce exposure to MWF mist, for example with longer lances or different nozzle designs.
- Do not use compressed airlines close to the face or body of the operator.

6.5 Provision of information, instruction and training

Provide information, instruction and training on the health risks/symptoms associated with exposure to MWFs and the controls in place to prevent or reduce exposure. Employees should know to report any suspected symptoms as soon as possible.

6.6 Provision of appropriate PPE and RPE

- Use appropriate PPE including close-fitting easy tear disposable gloves (e.g. nitrile), safety glasses and overalls. For cleaning and maintenance tasks, provide thicker gloves which provide protection from chemical and mechanical hazards, but only when machinery is switched off.
- Remove clothing contaminated with MWF immediately to reduce skin contact. Ensure overalls are laundered regularly.
- RPE is not normally needed except when creating a mist during cleaning work e.g. if using a high pressure water hose. In these circumstances provide RPE with a UK Assigned Protection Factor (APF) of at least 20, e.g., FFP3 disposable mask or a powered TH2 respirator.
- PPE and RPE should be suitable, this means it is right for the wearer, task and environment. Choose equipment that suits the wearer – consider the size, fit and weight. Be aware that some people may be allergic to materials used in gloves, e.g. latex.
- If you are using RPE with tight-fitting facepieces you should make sure each wearer has a fit test. This is needed to ensure the selected facepiece can fit the wearer correctly. PPE and RPE must be properly looked after and stored when not in use, e.g. in a dry, clean cupboard. If it is reusable it must be cleaned and kept in good condition.



Figure 14a: Back-lit photograph of smoke generated inside a machine enclosure after 10 seconds.



Figure 14b: Shows clearance of the smoke within a minute. Note, clearance times will differ depending on the size of the enclosure and the effectiveness of the LEV.



Figure 15a: Shows a smoke tube.



Figure 15b: Shows a smoke pen.

Links to relevant HSE website advice and guidance documents:

HSE COSHH Essentials: CNC Machining

HSE Controlling Airborne Contaminants at Work

HSE COSHH Essentials: UK Standard Assigned Protection Factor 20

HSE Respiratory Protective Equipment at Work: A Practical Guide

www.hse.gov.uk/pubns/guidance/mw1.pdf

www.hse.gov.uk/pubns/priced/hsg258.pdf

www.hse.gov.uk/pubns/guidance/rpe3.pdf

www.hse.gov.uk/pubns/priced/hsg53.pdf



Figure 16: Shows a simulation of an operator using a compressed airline to remove MWF from a machined component, resulting in personal contamination with MWF droplets. The MWF was dosed with a blue dye, which under an ultra-violet lamp shows up as blue deposits on:

Figure 16a: The end of the arm and upper leg

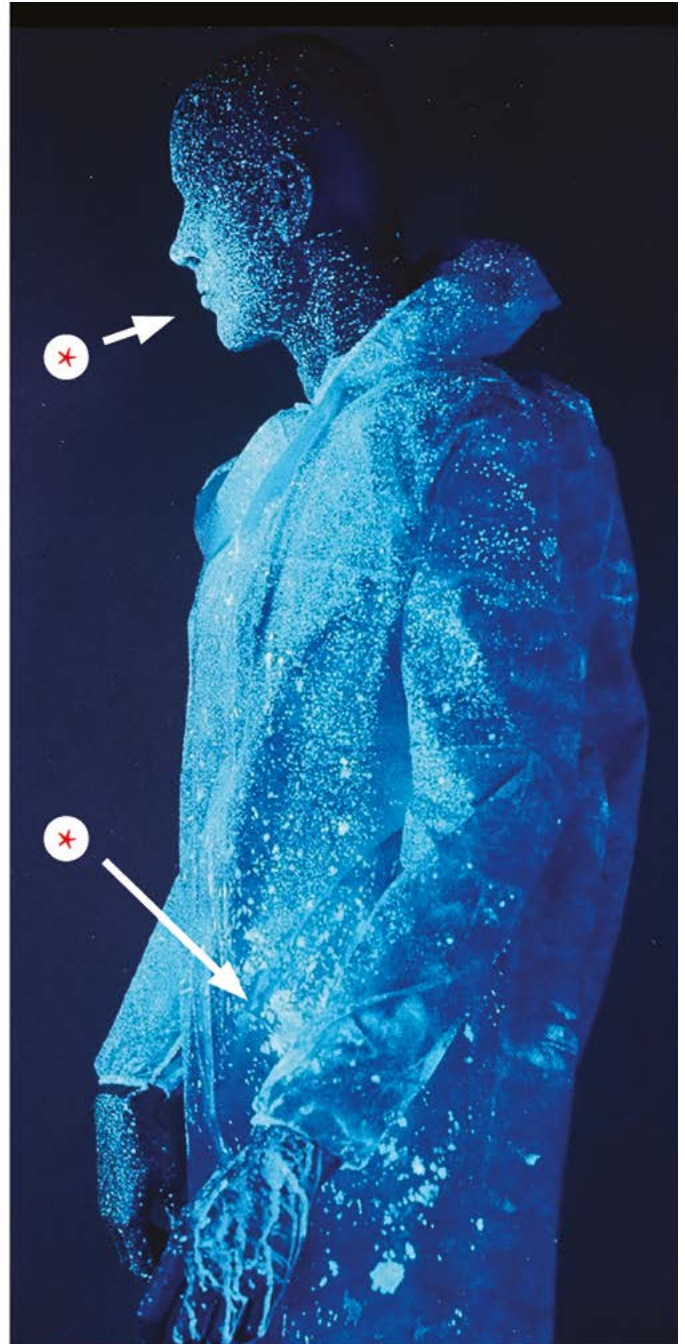


Figure 16b: The upper torso and face.

Links to relevant HSE website advice and guidance documents:

HSE Research report: Mists Created by the Use of Compressed Airlines for the Removal of Metalworking Fluids: Assessment of the Possible Exposure Health Risks

www.hse.gov.uk/research/rrpdf/rr904.pdf

7.0 Cleaning MWF Systems

It is recommended to undertake a thorough system clean when changing the MWF. There are specific risks to health that may occur when cleaning out used MWF from the supply system.

7.1 Risks associated with cleaning out a MWF system

- Inhalation of contaminated MWF mist when cleaning out biofilm and metal fines from the MWF supply system.
- Hazardous substances in system cleaning fluids, and use of biocidal products may cause skin disease and asthma (refer to the supplier's SDS for advice).
- With large sumps the potential for working in a confined space. This applies if the space is substantially or totally enclosed and there is a risk of loss of consciousness or asphyxiation arising from gas, fume, vapour or a lack of oxygen.

7.2 Cleaning out MWF systems

The frequency with which a water-mix MWF machine supply is changed will depend on your monitoring results, the type of the MWF, the volume of the sump system, or the type of work undertaken. For small or stand-alone sumps regular replacement of the MWF may be a safer and more cost-effective method which reduces overuse of biocides. If in doubt, consult your MWF supplier. A system clean should be undertaken when one of these conditions apply:

- Dipslide tests show heavy contamination with bacteria at or above 1,000,000 CFU/ml (10^6 CFU/ml).
- Visual signs of microbial growth such as biofilm and fungal growth on the internal and external surfaces of the machine. There may also be noticeable odours.
- An unstable emulsion is evident and there is heavy contamination with tramp oil and other contaminants.

Control measures

- For water-mix MWF the appropriate control measures include using equipment to remove and replace sump fluids with minimum spillage, e.g. wet vacuum. Avoid the use of high pressure water hoses where practicable.
- Provide safety glasses, or goggles, and overalls. Use thicker gloves which provide protection from chemical and mechanical hazards, but only when machinery is switched off.
- RPE is required if you are creating a mist, e.g. when using a high pressure water hose. In these circumstances provide RPE with a UK Assigned Protection Factor (APF) of at least 20, e.g. FFP3 disposable mask or a powered TH2 respirator.

Links to relevant HSE website advice and guidance documents:

HSE COSHH Essentials: Sump Cleaning: Water-mix Fluids

HSE COSHH Essentials: Sump Cleaning: Neat Oils

HSE Respiratory Protective Equipment at Work: A Practical Guide

HSE Confined Spaces: A Brief Guide to Working Safely

HSE Confined Spaces Webpages

www.hse.gov.uk/pubns/guidance/mw3.pdf

www.hse.gov.uk/pubns/guidance/mw4.pdf

www.hse.gov.uk/pubns/priced/hsg53.pdf

www.hse.gov.uk/pubns/indg258.pdf

www.hse.gov.uk/confinedspace/

7.2.1 Cleaning procedures for water-mix MWF sumps

- If the previous MWF had high levels of bacteria and biofilm it may be necessary as the first action to add an appropriate biocide directly into the sump. Consult your MWF supplier about when to add this biocide.
- Follow the supplier's instructions about using system cleaner concentrates and how they should be diluted and added to the MWF system.
- All parts of the MWF supply system should be circulated with system cleaner and flushed through, this may require valves to be opened.
- Allow sufficient time for the system cleaner to circulate and work, consult your supplier if in doubt about the optimal conditions.
- After the system is drained carry out a thorough inspection of bottle-necks, dead-legs, the sump and hoses and connections. Ensure that they are free from debris and that any sludge is removed.
- After cleaning, the MWF supply system can be flushed out with a 'top up' dilution of MWF. pH tests should then be undertaken to check that the system cleaner and other chemicals have been removed. If they have not been completely flushed out, continue the rinsing using 'top up' MWF.
- About a week after the system has been refilled with fresh MWF, it is recommended to undertake dipslide tests (or other microbiological tests).
- Plain water should not be used because of potential corrosion of metal surfaces.
- The main steps in the process are outlined in Figure 17 and links to sources of advice can be found at the end of this section.
- If in doubt about how to undertake a system clean, consult your MWF supplier.

7.2.2 Removing metal waste

- Use suitable tools e.g. brushes and shovels to remove swarf and wear suitable cut resistant protective gloves to prevent injury when handling swarf.
- Be aware of the potential for emission of noxious gases from certain materials (e.g. cast iron).
- When cleaning out metal fines and swarf consider ignition risks from flammable metals (e.g. titanium, magnesium, aluminium).

7.2.3 Cleaning procedures for neat oil MWF sumps

- The recommended procedure for cleaning a system containing neat oil is outlined in Figure 18.
- Remove swarf, debris, and oil using scrapers or suction pumps, etc.
- Areas of accumulated dirt or oily residues should be physically removed and adequate precautions taken to wear appropriate PPE such as, gloves, safety glasses and overalls. Thicker gloves which provide protection from chemical and mechanical hazards should be used but only when machinery is switched off.
- Links to sources of advice can be found at the end of this section.

Cleaning a water-mix MWF system

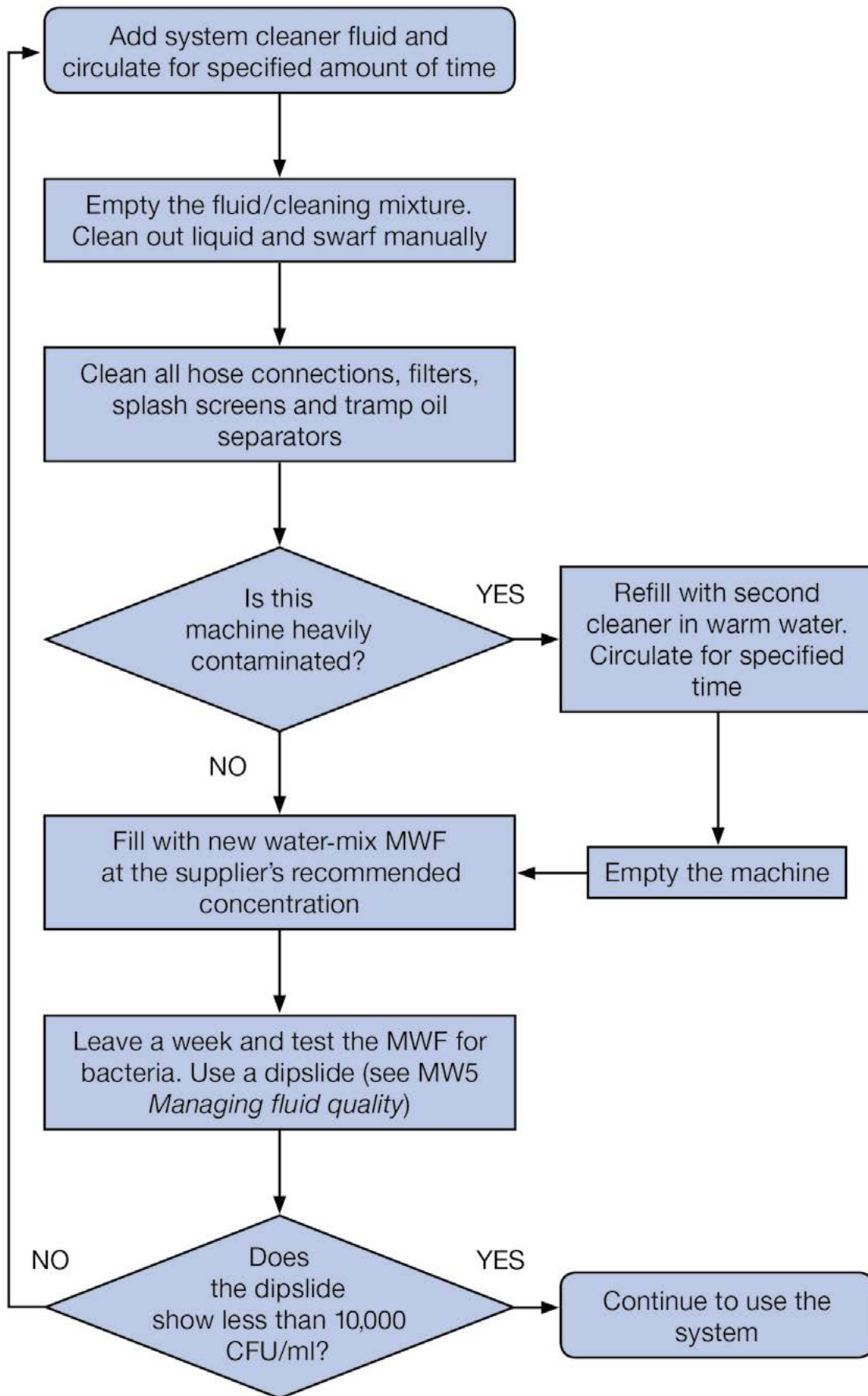


Figure 17: Decision chart outlining key steps in cleaning out a supply system containing a water-mix MWF.

Cleaning a neat oil MWF system

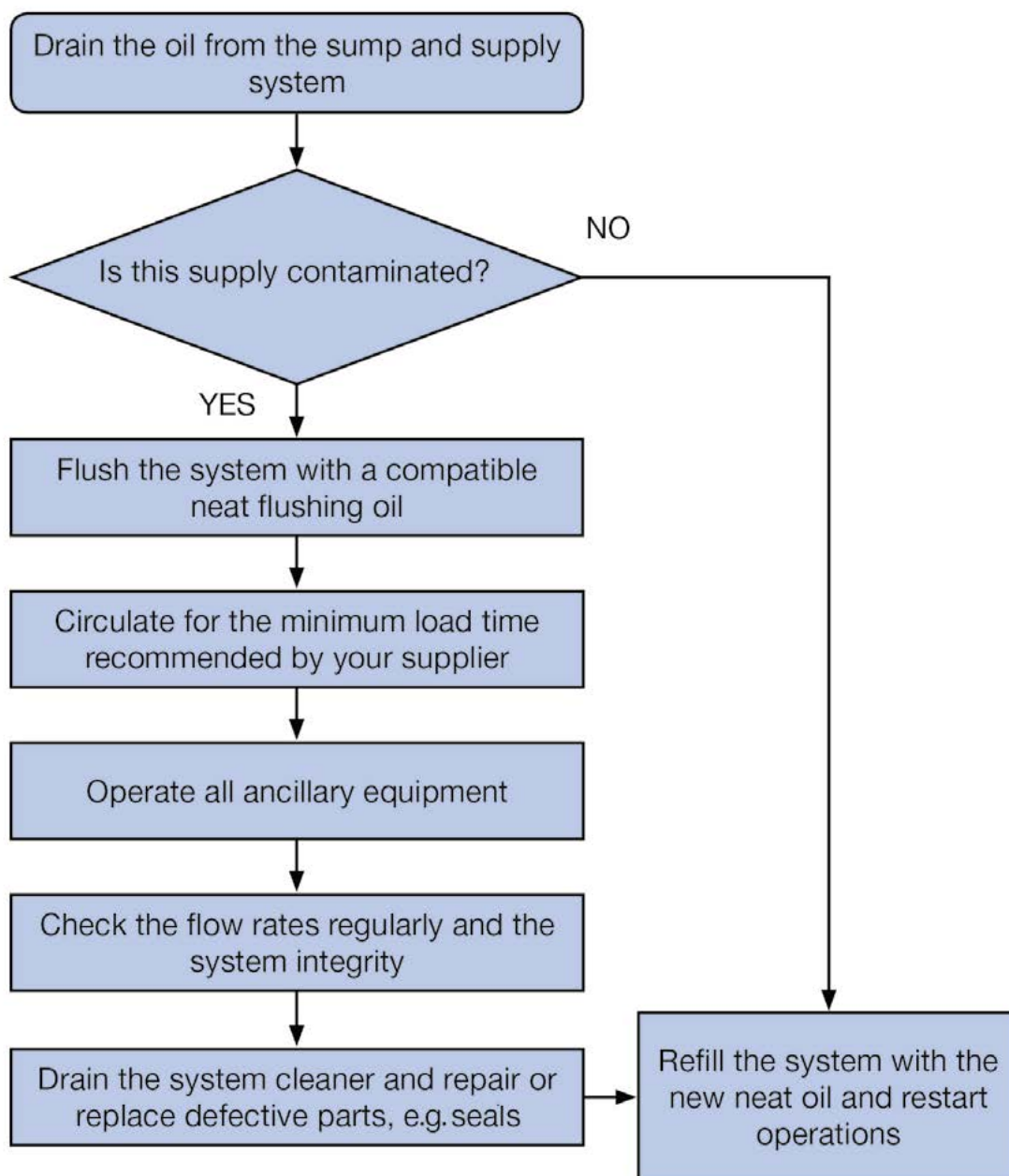


Figure 18: Decision chart outlining key steps in cleaning out a supply system containing neat MWF.

7.3 Additional advice

- Ensure that the risk assessment for this work considers all of the key safety and health related concerns.
- Ensure that staff wear suitable PPE to ensure that cleaning solutions and biocides do not contact the skin and eyes.
- Restrict access to places where this cleaning work is carried out.
- Do not return recovered MWF to the sump without first obtaining evidence that its quality is acceptable for further use. This will ensure that microorganisms and other contaminants are not reintroduced into the MWF, reducing operational life and performance.
- Be aware of protective treatments which may have been applied to newly commissioned machinery which may contribute to bacterial growth. It is recommended to clean out this machinery thoroughly before adding the MWF.
- During preventive maintenance and shutdown periods ensure that MWF supplies are regularly circulated and not left to stagnate in sumps and supply systems.

8.0 Safe Disposal of Used MWF

8.1 Emergency spillage procedures

- Ensure that all health and safety risks have been considered and take appropriate precautions for MWF spillages. If in doubt refer to the product SDS.
- Ensure that a relevant operating procedure and spill kit (i.e. absorbent materials) are in place for dealing with spillages. If in doubt refer to the product SDS.
- Raise awareness of spillages using proper signage and barriers.
- Ensure that correct PPE is worn by staff cleaning spills of MWF (refer to the product SDS and Figure 4b).
- Do not return spilled and contaminated MWF back to the sump supply.
- It is good practice to put in place a system to record spillages and leaks from machines.

8.2 Disposal of used MWFs

- Used MWF needs to be disposed of safely so follow appropriate advice from the MWF supplier and industry best practice advice (Figure 19). For more information regarding the disposal of MWF see links at the end of this section.
- Ensure used MWF does not enter the general environment or create a risk to health during storage or transport.
- All MWF should be disposed of in accordance with national and local legislative requirements and an approved waste disposal contractor should be used

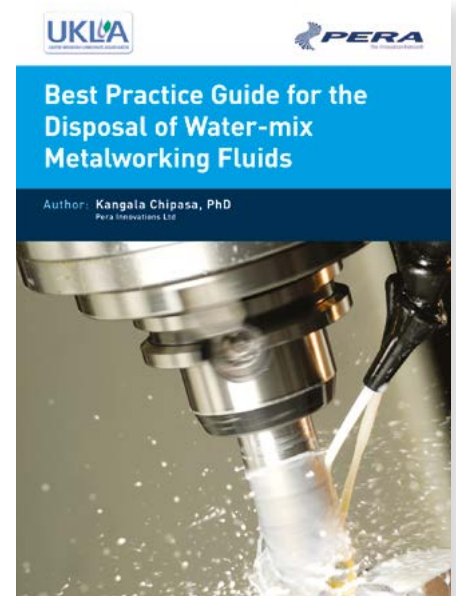


Figure 19: The UKLA best practice guide for the disposal of water-mix metalworking fluids.

UKLA and industry guidance documents:

UKLA Best Practice Guide for the Disposal of Water-mix Metalworking Fluids

www.ukla.org.uk/wp-content/uploads/UKLA-PERA-Best-Practice-Guide-for-the-Disposal-of-Water-mix-Metalworking-Fluids.pdf

The Oil Care Campaign

www.oilcare.org.uk/

9.0 Glossary

Term	Definition
Aerobic/anaerobic	Microorganisms in metalworking fluid that require oxygen to grow (aerobic)/grow with no oxygen (anaerobic)
Airflow pressure gauge	An instrument used to measure the air pressure (positive, negative or differential) in a local exhaust ventilation system
ALARP	As low as reasonably practicable
Asthma	A chronic inflammatory disease of the lung characterised by episodes of shortness of breath, wheezing, chest tightness and cough
Biocide	A substance or mixture of substances used to kill microorganisms
Biofilm	Bacteria and other microorganisms, embedded in a visible protective slimy layer attached to the inner surface of a sump or pipe
CFU	Colony forming unit, the number of individual bacteria capable of dividing to form a visible colony
Confined space	A confined space is a place which is substantially enclosed (though not always entirely), and where serious injury can occur from hazardous substances or conditions within the space or nearby (e.g. lack of oxygen)
COSHH	Control of Substances Hazardous to Health Regulations 2002 (as amended)
Dead-end	A section of the MWF supply system that is sealed at one end preventing continuous flow through and where fluid stagnation may occur
Dead-leg	Dead-leg pipes refers to fittings through which MWF passes infrequently or to redundant legs of pipework where stagnation may occur
Dermatitis	Inflammation of the skin caused by allergens or irritants
Dipslide	A sterile layer of agar coating on both sides of a plastic slide. This is used to determine the number of growing bacteria, fungi and yeast in the MWF
Fines	Metal particles which may be small and invisible to the naked eye
LEV	Local exhaust ventilation is extraction at source removing air contaminated with hazardous substances

Term	Definition
Mechanical skimmers	A device to remove tramp oil from the surface of a metalworking fluid supply
Microorganisms	This term includes bacteria, yeast and fungi
MWF	Metalworking fluid: either soluble (emulsion in water), semi-synthetic, synthetic or neat 'straight' oils
MWF mist	An airborne cloud of very small droplets typically caused by high speed rotation of cutting machines or dispersal of MWF under pressure (e.g. from the use of compressed airlines)
OA	Occupational Asthma
OHP	Occupational Hypersensitivity Pneumonitis: an inflammation of the lung caused by MWF inhalation. This may also be called Extrinsic Allergic Alveolitis (EAA)
Oil coalescers	A device to separate tramp oil from MWF
PPE	Personal Protective Equipment
pH	Expressed as a number between 1 and 14 to indicate how acidic or alkaline the MWF is. Values below 7 are increasingly acidic, 7 is neutral, and values higher than 7 are progressively alkaline
pH meter	An instrument to measure acidity or alkalinity in a MWF
Refractometer	An optical device to determine the concentration of MWF by measuring the way that it bends light
RPE	Respiratory Protective Equipment
SDS	Safety Data Sheet
Smoke pens/tubes	A device for releasing non-hazardous particles as a visible smoke to demonstrate an enclosure is under negative pressure
Swarf	Metal shavings removed by a cutting or grinding tool
System clean	Removing the MWF supply to clean the circulation system and sump
Tramp oil	Any unwanted oil contaminating the MWF from external sources (e.g. leaking hydraulic fluid)
UKLA	United Kingdom Lubricants Association
VOCs	Volatile Organic Compounds

9.1 Chart for recording MWF quality (page 1)

Location													Product		Sump capacity	
Machine													Operating concentration range %		MWF refractometer correction factor	
Asset Ref													Operating pH range			
	Day	Month														
Concentration % (refractometer reading x fluid correction factor)	9.0															
	8.0															
	7.5															
	7.0															
	6.5															
	6.0															
	5.5															
	5.0															
	4.5															
	4.0															
pH reading	3.0															
	2.0															
	10.0															
	9.5															
	9.2															
	9.0															
	8.8															
	8.6															
	8.4															
	8.2															
Dipslide colony forming units (CFU)	8.0															
	7.0															
	<6.0															
	>10 ⁶ CFU															
	10 ⁶ CFU															
	10 ⁵ CFU															
	10 ⁴ CFU															
10 ³ CFU																
<10 ³ CFU																

Example chart for recording variables when monitoring the quality of MWF. Note the shaded areas are examples of an acceptable operating range for variables such as pH or concentration.

Chart for recording MWF quality (page 2)

Location	Product										Sump capacity
Machine	Operating concentration range %										MWF refractometer correction factor
Asset Ref	Operating pH range										
	Day	Month	Heavy	Moderate	Light	None					
Tramp Oil											Comments & actions taken
System specific check MWF temperature °C	38										
	36										
	34										
	32										
	30										
	28										
	26										
	24										
	22										
	20										
Visual Inspection*	Biofilm/ slime										
	Mould										
	Smell										
	Colour										
	Rust										
	Agitation										
	Excessive cuttings										
	* Biofilm accumulation, strong smells and accumulation of metal fines are signs that the MWF supply system should be cleaned and fresh MWF added.										
Primary contact:											

Example chart (continued) for recording variables when monitoring the quality of MWF. Note the shaded areas are examples of an acceptable operating range for variables such as pH or concentration.

10.0 Membership of the Advisory Panel

Chair: Jennifer Smith	Fuchs Lubricants (UK) PLC
Andrew McClean	Pennine Lubricants
Ian Harris	Quaker Houghton PLC
Stephen Rushton	Quaker Houghton PLC
Matt Bloomer	Q8Oils UK
Stuart Duff	Q8Oils UK
Stephen Birch	MacDermid
Fiona McGarry	HSE
Gareth S Evans	HSE
Paul Smith	HSE
Jodi Brookes	HSE

Dr Christopher Barber (HSE Deputy Chief Medical Officer) and Dr Steve Forman (HSE Principal Medical Inspector) provided advice about the occupational health section of the guide.

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