Approx. 40,000 t of non water-miscible metalworking fluids are produced for the metalworking industries in Germany per year. Particularly, hard-to-machine broaching processes, deep hole drilling operations and deep grinding processes are almost exclusively carried out with non water miscible metalworking fluids and considered to be an „oil“ domain. The flammable metalworking fluids represent an important factor to achieve efficient and economic machining, mainly in the series production.

1 What are the reasons for fire incidents on machine tools?

In the course of metal cutting, low-pressure explosions (deflagrations) with subsequent fire may occur due to the ignition of the oil-air mixture in the interior of the machine tool. Such violent reactions are mainly caused by tool breakage, controlling errors or dry running of tools. Incandescent chips and hot surfaces act as ignition sources.

In most cases, it remains a local fire which can be quickly get under control.

Violent reactions, however, may lead to serious accidents with burn injuries and considerable material damages.

2 What has to be done in case of fire?

In such hazardous situations, a proper and circumspect behaviour is important. Decisions taken in panic can disimprove the situation considerably.

Backfires can be very insidious when the door is opened in order to “save” the machine. The sudden air supply and hot surfaces may lead to violent flame reactions, severe burns to the operator and to toxic fumes.

Generally, attention has to be drawn to the complete personal protective equipment, (e. g. safety googles, safety shoes etc.).

Furthermore, fire tests have shown that a flame propagation into the extraction system has to be expected if no adequate measures are taken.
3 Seven „hot“ mistakes

Never open the machine door in case of fire (or immediately after).

When the door is opened, a violent backfire and ejecting flames may occur due to the sudden air supply.

Never work on the machine with oil soaked clothing.

Oil soaked clothing can easily self-ignite in case of ejecting flames. Due to the large surface, even fire resistant oil soiled textiles can easily catch fire (wicking).

Never restart the machine immediately after a fire.

Hot surfaces are very effective ignition sources and may cause violent backfires when the metal working fluid is injected.

Never touch the machine immediately after a fire.

The machine enclosure may become very hot in case of a fire and create hot surfaces. Scorched electrical cables and hydraulic lines may cause an additional hazard.

Never empty cleaning agent into the metal working fluid container.

Even the introduction of low quantities of volatile flammable liquids (cleaning agent, benzine etc.) may lead to an increased fire and explosion hazard.

Never enter the interior of the machine without prior blocking of the extinguishing system.

Attention: Danger to life if CO2-extinguishing system is activated. Therefore, prior to entering the interior of the machine (e.g. for cleaning, repairs) it is essential to block the extinguishing system (e.g. by a mechanical blocking device).

Never work with machine door open.

In case of a deflagration, ejecting flames may lead to serious injuries. (see figure 5, figure 6). Generally, attention has to be drawn to the complete personal protective equipment, e.g. wearing of safety googles, safety shoes etc.

Figure 3: Blocking of the extinguishing system

Figure 4: Scorched exposed cables

Figure 5: Flame ejection out of open door gap (6 cm) during a deflagration (Dummy)

Figure 6: Dummy from figure 6, temperature distribution after a deflagration
4 Avoid ignition sources

Smouldering cigarette ends are very effective ignition sources and should not be thrown into chip containers. Generally, the observance of a general ban on smoking is indispensable in areas with a high fire risk.

Figure 7: Ignition sources cigarette ends, fire in chip container

5 Summary and limits of application

The Fachbereich Holz und Metall (Expert Committee Woodworking and Metalworking) is composed of representatives of the German Social Accident Insurance Institutions, federal authorities, social partners, manufacturers and users. It is based on experience gathered by the Expert Committee Woodworking and Metalworking.

This information sheet has been prepared by the Fachbereich Holz und Metall, Sachgebiet Maschinen, Anlagen, Fertigungsausautomation und -gestaltung (Expert Committee Woodworking and Metalworking, subcommittee Machinery, Plants, Automation and Design of Manufacturing Systems). It is intended to provide orientation to designers, manufacturers as well as to safety officers, production engineers and users of metal working machinery how the detailed requirements of the European standards in relation to the provisions of the Machinery Directive are put into practice.

This expert committee information sheet describes hazards the machine operator is exposed to as a result of fire incidents in the interior of a machine. Furthermore, it describes „cardinal faults“ that occurred in the past as well as adequate counter measures in order to protect employees from serious burn injuries. A list of fire hazards and preventive measures facilitates instructions to the employees.

This expert committee information sheet replaces the same-titled information sheet no. 043 draft 12/2009. Further information sheets of the Woodworking and Metalworking Expert Committee can be downloaded from the Internet [4].

As to the aims of the expert committee information sheets, please refer to information sheet no. 001.
Function and handling of the machine tool and extinguishing system in case of fire

Optical sensors: Avoid light flashes (lighters, welding)

**Special hazards**

- Opening of the machine door in the event of a fire in the interior: **Hazard of backfire**
- Wearing oil soaked clothing: **Fire hazard (wicking) in case of backfire**
- Restarting the machine immediately after a fire: **Possible backfire**
- Touching machine parts subsequent to fire: Possibly live (electric shock) and hot (burns)
- Emptying cleaning agent, benzine etc. in the metal working fluid: **Explosion hazard!**
- Entering the interior of machine with CO₂ extinguishing system active: **Danger to life!**
- Working with machine door open: **Flame ejection in case of deflagration**

**In case of fire or explosion (BGI 560, BGI 719):**

- When the alarm activates: Leave the danger zone immediately
- Use escape and rescue routes
- Search for help: Fire service, emergency telephone numbers

**Hazards during ignition of the WMF mixture:**

- Violent flame ejections at pressure relief devices/ subsequent fires possible
- Flame ejection at machine tool door gaps and openings
- Extinguishing agent CO₂: Hazard of suffocation (above 5 % CO₂ volume in air)
- During extinguishing process: Ejection of flames in the door area
- Hazard of suffocation in confined spaces due to fire smoke and fumes

**Reduce fire hazard – Preventive measures:**

- Regular emptying of chip container to avoid self-ignition
- Regular emptying of machine tool oil pans (extract oil)
- No combustible materials (cardboard/carton/oil-soaked rags) in the vicinity of the machine tool
- General smoking prohibition: No cigarette ends in chip containers/oil pans