Spark Erosion Machining

There have been a number of fires, some serious, involving the use of spark erosion machines, where hydrocarbon based dielectric fluids are used. This document has been produced to provide best practice guidance, to help your business limit the fire risks posed by spark erosion machines.

The principal hazard is the ignition of the dielectric fluid by faults developing within the sparking operation which can lead to intense and quickly developing fires. Other hazards include: incorrect setting, poor user operation and leaving the machine unattended while it is in operation.

The latest machines are very sophisticated with computerised controls that allow the machines to operate automatically and with minimal supervision. Several hours can elapse between visits by the operator and it is not uncommon for machines to run overnight with no-one at the premises. In such circumstances, any fire starting within the machine could spread and develop undetected, with potentially disastrous results.

There are a number of measures that can be taken in order to reduce potential hazards. These include: the selection of a less hazardous dielectric fluid, the provision of in-built safety devices, adequate maintenance, the correct operation of machines, the provision of automatic fire extinguishing systems and the elimination of unattended operations.

Zurich considers the following recommendations to be best practice guidelines.

### Dielectric Fluid

- Wherever possible, readily flammable dielectric fluids should not be used. White spirit and paraffin, for example, have Flash Points as low as 38°C and 55°C respectively. There are several types of proprietary fluids available which have significantly higher Flash Points (some at 140°C) and therefore reduce the potential fire risk. They are suitable for a wide range of machining applications and finishes.

- The flashpoint of any dielectric fluid used should be above 75 °C.
Safety Devices

A number of safety devices can be built into the machines in order to reduce the potential risks.

- **Level Control**: When there is a danger of the sparking electrode causing localised overheating of the surface of the fluid, a float switch will close down the machine should the dielectric fluid level fall too low. For additional safety, two switches are recommended, one acting as a back-up.

- **Back-Off Switch**: Should any debris lodge between the electrode and work piece, the machine will automatically back-off the electrode in order to maintain the correct spark gap.

- **Anti-Arc Control**: Should the spark gap be bridged (by debris or a piece of broken electrode tip), a continuous arc may occur which leads to a rapid local temperature rise within the dielectric fluid. An anti-arc control built into the electronic system will sense this and cause the electrode to back-off, enabling the debris to clear.

- **Fixed Start Point Monitoring**: This device will shut down the machine should the electrode retract above the point at which it started its operation. This feature should be independent of the back-off device.

- **Dielectric Fluid Temperature Control**: This device comprises a thermostat designed to shut off the machine should the fluid temperature rise above a pre set point, usually set 10°C below the known flash point of the dielectric fluid. Two thermostats operating at the same setting are advised, with one acting as a back-up.

Not all of these devices may be fitted to some machines, particularly older types. It may be possible however to retrofit these where deficiencies are identified. Zurich recommends that the manufacturer or specialist suppliers are consulted to verify whether the machine can be upgraded.

Maintenance

- Spark erosion machines should always be maintained and inspected in accordance with the manufacturer’s instructions, which should include the operation of the various safety devices. This operation is best carried out where there is a planned preventative maintenance programme which extends to other items of plant and machinery.

- Operators of spark erosion machines should be fully trained on the use of the machine, including the operation of any built-in safety devices, especially as most safety devices are capable of being overridden.

- Machines should be sited well clear of combustible materials which could become involved in any fire. This includes any combustible building or lining materials (such as, foam insulated lining boards and timber cladding). Where it is not possible to separate spark erosion machines from combustible construction materials, the machine should be sited within a 60 minute fired rated booth.
Automatic Fire Extinguishing Systems

- It is strongly recommended that an effective automatic fire extinguishing system is installed for all spark erosion machines. There are a number available on the market, most of which can be retro fitted and which use either carbon dioxide or foam as the extinguishing agent. See figure 1 below for an example.

- Foam systems should have enough stored extinguishing agent, which is sufficient to cover the surface of the exposed tank. The amount is calculated based on the surface area. In the case of gaseous systems, the agent should be evenly distributed across the surface of the fluid, using nozzles.

- If the system is activated, the machine should be turned off automatically and an alarm sounded, using either an audible local warning or a warning given at a remote permanently manned site (e.g. a watch room or at an approved alarm receiving centre).

![Figure 1: Spark Erosion Machine with Automatic Fire Extinguishing Fitted](image)

Unattended Operations

The latest generation of spark erosion machines, with spark pulse monitoring and correction facilities, are designed to work with minimal supervision. Unattended operations of spark erosion machines present an increased risk of a fire starting and growing out of control without anyone noticing.

- Machines without spark pulse monitoring controls fitted should not be run unattended.

- Where possible, the full range of safety devices should be built-in.

- If machines are to be run unattended, a maximum time period between checks of the machine should be established.

- It is essential that an effective automatic fire extinguishing system is fitted.

- Unattended operation out of normal working hours without any form of supervision should be avoided. Where unattended overnight operation is essential, the spark erosion machine should not only be fitted with a suitable fire suppression system but the premises should also be protected by a suitable fire alarm system, incorporating remote monitoring to an approved alarm receiving centre.
Summary

Spark erosion machines are capable of precision engineering intricate metal parts and can be a valuable piece of equipment for manufacturers. This type of machinery does present additional fire risks but these risks can be controlled through use of a high flashpoint dielectric fluid, correct user operation, good maintenance and proper supervision. As well as acting on these recommendations, any spark erosion machines should be included within your premises fire risk assessment as a potential source of fire. The storage arrangements of dielectric fluids will also need to be considered. The recommendations in this document contain best practice advice on the use of spark erosion machinery. By following all of these recommendations, the risk of a fire being caused by the spark erosion machining process could be reduced.
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