CNC Metal Cutting Mill-Turn Centres
Guidance and Good Practice in Prevention of Flash Fires

In today's era of lean manufacturing, users of metal cutting machinery demand an element of unattended operation, it is no longer always appropriate for machine tools to be individually attended. 'Unattended operation' can range from occasional unattended operation in a staffed area to 'lights-out' operation in an unattended area and/or building.

Citizen Cincom and Miyano CNC lathes and mill-turn centres can be suitable for unattended operation subject to the correct machine specification; a stable, fully proven production process, good maintenance practices and risk reducing measures. There are a number of risks but it is that of fire in the production process that is generally regarded as the most significant.

Citizen Machinery UK recommends the use of automatic fire extinguishers on machines running on neat cutting oil and fits these as standard on all Citizen Cincom models and as an option on Citizen Miyano models.

The purpose of this document is to serve as a reminder to our customers of the principles of operation, the need for thorough working practices and of maintenance responsibilities, both generally and specifically in relation to fire extinguishers to enable fire incidents to be avoided.

There are generally two types of fire suppression systems fitted to Citizen Cincom and Miyano machines; these being
Heat Sensitive Pressurised System ('Fire-Trace' type), or Heat Sensitive Stat-X Canister System.

1. **Heat Sensitive Pressurised System ('Fire-Trace' type)**
   In the event of a fire caused by failure of the machining process, the heat sensitive tube softens and melts; this in turn triggers the discharge of the extinguishant into the cabin. During discharge activation of the pressure switch cuts power to the machine and ancillary equipment e.g. mist/smoke extractor, swarf conveyor, auxiliary coolant etc.

   The pressurised system is CO_2 based and as such requires annual inspection and service by a qualified and accredited fire extinguisher servicing company or the supplier (Firetrace). However, regular visual inspection of the pressure gauge for early detection of pressure loss is recommended. This type of system is often incorporated into the normal factory fire extinguisher inspection routine (usually annually) by an accredited fire extinguisher servicing company (please refer to guidance notes for Citizen Machines fitted with Firetrace FSS).
   It is the customer's responsibility to ensure the fire suppression unit is fully maintained and serviced as per the manufacturer's instructions.

2. **Nobel 250ME 'Heat Sensitive Stat-X' Canister System**
   The Stat-X is a potassium based aerosol fire suppression system. A sensor cable in the machining area melts and detects the fire; this in turn triggers the discharge of the suppressant and simultaneously cuts power to the machine and ancillary equipment, e.g. mist/smoke extractor, swarf conveyor, auxiliary coolant etc. The extinguishant remains suspended in the machining area for up to an hour, which helps prevent re-ignition of the fire. Additionally a manual activation button is provided on the unit control panel.

   The Stat-X type of unit requires regular visual inspection of the sensor cable in the machining area. The canister of extinguishant has a life of up to 5 years. Periodic replacement of back-up batteries in the Stat-X control unit may be required. The unit is mostly self-diagnosing of faults. Like all fire extinguishing appliances it should be inspected and serviced as per supplier recommendations and we recommend a servicing contract with Nobel for this specialist equipment.
   It is the customer's responsibility to ensure the fire suppression unit is fully maintained and serviced as per the manufactures instructions.

Any element of unattended operation whether within a staffed area or lights-out/unattended operation requires a production proven machining process with known tool life. Unattended operation should not be attempted on a process that has not proven to be consistent and stable under attended operation. Build-up of cutting swarf sometimes referred to as 'birds-nesting' is one of the common causes of machine fires, therefore 100% reliable swarf control is an essential prerequisite of unattended operation.

The following is a list of items that can contribute to the risk of a machine tool flash fire and recommendations on how to avoid them:

Fire Risk	Recommendation
1. Using a neat grade of mineral/petroleum based oil with a low flash point	Use an oil with a high flash point preferably above 200 degrees centigrade. Consider using neat cutting oil made from vegetable based extracts which naturally have a higher flash point.
2. Oil vapours produced by mineral/petroleum based neat cutting oils which are not effectively removed from the machine by a mist extraction or mist control unit	If you are producing high amounts of coolant mist/vapour, consider fitting a mist extraction device to the machine. Be sure to make sure it is wired in to the machine so that it is switched off in the event of a fire.
3. Running the machine very hot due to continuous recirculation of a small amount of cutting fluid, or aggressive cutting	Always make sure the machine is filled up with cutting oil to the correct amount. Make sure to do this with the machine fully stopped to prevent over filling. In some cases it may be necessary to fit a cooler to the cutting oil.
4. Programming mistakes	Always check and prove new programs (or modified programs) thoroughly and especially after changing tools. Use single block, distance to go and feed override to make sure all is OK before commencing continuous automatic operation.
5. Tooling failures	Do not cut corners by using the wrong type of tool or cutting insert for the material type. Be sure to run effective Tool Life Management practices to make sure tools/tips are changed after the recommended cutting time.
6. Electrical failure	If you notice a damaged cable on the machine make sure to have it repaired or replaced quickly. Have your machine serviced regularly by the OEM to make sure it is in good working order.
7. Low levels of coolant oil or coolant oil supply failure	Keep an eye on the level of cutting oil in the machine. Make sure the filters/baskets are cleaned regularly to ensure an effective supply of cutting oil. Clean the machine sump out regularly to make sure the tank is clean to prevent premature coolant pump blockage or failure.
8. Poor housekeeping	It is essential that the interior area of the machine cabin is cleaned on a regular basis to prevent the build-up of swarf. A reliable cutting process should be established to prevent swarf collecting on tools, often referred to as 'birds nesting'. A machine tool is designed to run for extended periods, however none are completely self-cleaning.
9. Machining combustible metals	Special precautions and advice are needed if titanium or magnesium metals or alloys are to be machined and standard fire suppression systems are not effective for combustible metal fires.
10. Safety and security	Apart from being a legal requirement it is essential that the machine is run with the door interlocks in place and correctly functioning to make sure the machine is run with the door fully closed. All covers on the machine must be in place. This is to help prevent the spread of fire. The outside surfaces of the machine should be kept in a clean and oil free condition and you should not store combustible items on top of the machine. This is to make certain should any fire start that it is contained within the confines of the cabin and cannot spread to the outside.
11. Failure of the fire suppression system to activate	It is essential that the fire suppression system is regularly maintained under an appropriate service agreement to make sure it is in correct working order.

The above are for guidance only and not an exhaustive list of possibilities.

Every company should have a plan in place for fire prevention and how to deal with such an event. The fire suppression system fitted inside a machine tool is designed to supplement existing fire precautions, not replace them. It is necessary in any place of work to have an adequate number of other suitable fire extinguishers readily accessible and to ensure that they are serviced. (5kg carbon dioxide units are appropriate for oil fires in machines but specialist extinguishers are needed for combustible metal fires). Make sure your employees are well trained in the correct ways to deal with a fire and how to select the correct extinguisher to use to prevent risk of injury and there is a clear fire procedure. This should include how to ventilate the area where such an extinguisher has been discharged and ensuring that carbon dioxide extinguishers are not discharged in restricted spaces where there is poor ventilation. For details on this point see our Guidance Note on Citizen machines fitted with Firetrace FSS fire extinguishers.

If the machine is cutting magnesium based alloys, titanium alloys or other such combustible metals, then special consideration should be given to the risks of Class D fires where a standard fire suppression system designed for dealing with flash fires will not be suitable. If you are machining such materials you need to take specialist advice on fire suppression arrangements.

Careful consideration is given by Citizen Machinery UK when selecting the size and mounting location of a fire suppression system to match the specification of the metal cutting machine. The size of the machine and type of accessories fitted all have a bearing on the selection process. Should the need arise to change the specification of the machine package from that originally supplied, then advice should be sought to make sure that the changes do not make the fire suppression system ineffective. In particular, changes to high pressure coolant and mist extraction are of prime importance.

If the metal cutting machine supplied by Citizen Machinery includes a mist extraction device then this is for the exclusive use of that machine only. It should not be used to extract mist from more than one machine. Citizen Machinery UK will not connect more than one machine to one mist extraction unit.

If the Citizen machine is to be connected to a shared extraction system, either by the customer or extraction system supplier, then specialist advice should be sought to determine its suitability and to ensure the provision for immediate shut-off of the extraction port to the Citizen machine in the event of activation of the fire suppression system. The consequences elsewhere in the shared system of such immediate shut-off should be considered as well as how to isolate the machine power in the event of a fire detected elsewhere in the shared system. Specific precautions such as duct cleaning and in duct fire suppression systems may be necessary with such shared extraction systems which are beyond the scope of this guidance note.

If there is any doubt or you need further advice, please contact Citizen Machinery UK or a specialised fire protection company.

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