

# Process Specific Control Summary

## Computer Numerically Controlled (CNC) Milling on Copper Beryllium Alloys

### Purpose

This document has been developed to communicate the results of case studies performed on specific operations where copper beryllium (CuBe) alloys are processed and to provide the reader with information on exposure and exposure control options such as work practice, administrative and engineering controls.

### Introduction

An airborne beryllium exposure assessment was conducted during CNC Milling of CuBe Alloy 25. The intent of the study was to characterize worker exposure to airborne beryllium and identify work practice and local exhaust ventilation (LEV) controls necessary to maintain exposures to consistently below the beryllium industry's Recommended Exposure Guideline (REG).

### CNC Milling

CNC Milling involves digitally automated machining of a stationary part mounted onto a fixture. In this study CNC milling was performed in enclosed machining centers with a flooding of machining fluids. These machining centers allow for a variety of complex milling operations. The water soluble machining fluids are used to lubricate and cool the cut and to flush away the resulting swarf. This containment and flooding of swarf in the enclosed machining centers minimizes the release of particulate.

*Read the SDS specific to the products in use at your facility for detailed information on the health effects of exposure to beryllium.*



CNC Milling/Machining Center

### Airborne Exposure Standards

- BeST utilizes a Recommended Exposure Guideline (REG) of 0.6  $\mu\text{g}/\text{m}^3$  (inhalable sampling method) and 0.2  $\mu\text{g}/\text{m}^3$  (total-closed face filter cassette/CFC Total sampling method) which has proven effective when used in concert with the remaining elements of the Beryllium Worker Protection Model.

### Baseline Exposure Evaluation

Fourteen (14) full shift exposure samples, using the CFC Total method, were collected in the breathing zone of operators performing CNC milling of CuBe Alloy 25.

## Personal Sample Results

(CFC Total Method)

Number of Samples	Range $\mu\text{g}/\text{m}^3$	Percent Exceedance <sup>1</sup> at $0.2 \mu\text{g}/\text{m}^3$	UTL <sub>(95/95)</sub> <sup>2</sup> $\mu\text{g}/\text{m}^3$
14	<0.007 – 0.020	<0.000	0.030
<p><sup>1</sup>Percentage of exposures expected to exceed <math>0.2 \mu\text{g}/\text{m}^3</math> (comparable to <math>0.6 \mu\text{g}/\text{m}^3</math> Inhalable). A percent exceedance of &lt; 5% is considered to be "Well Controlled".</p> <p><sup>2</sup>Upper Tolerance Limit – one can be ninety-five-percent confidence that fewer than 5% of measurements are above the UTL(95/95)</p>			

### Operating Conditions

Coolant management - Chips are removed by a separation screen, supplied as original equipment by the manufacturer. Coolant is filtered by a filtration system utilizing a 100  $\mu\text{m}$  rated, string wound filter recirculation loop and a 5  $\mu\text{m}$  pleated cartridge filter in line with the coolant feed to the tooling head. The coolant rate at the tool ranges from 1-3 gallons per minute (gpm) and 20 gpm for the chip flusher. The range of sizes for the cutting tools is 0.132" – 2.0" and the range of spindle speeds is 5000-10,000 revolutions per minute (rpm). Single cut depths range from 1/4" to 0.0001".

### Exposure Controls in use during Baseline Characterization

No special ventilation controls were installed on CNC Mills processing CuBe alloys during this study.

### Exposure Characterization Summary - Evaluation Interpretations

- The operator's personal exposure results were reliably below the REG for airborne beryllium.
- The enclosed work center using a flood of coolant is adequate to maintain exposures to reliably below the REG for airborne beryllium.

### Recommendations

- Instruct operators to wear gloves when handling parts that are not visibly clean or are wet with coolant.
- Implement the remaining elements of the Beryllium Worker Protection Model. Please review the Be Responsible at [www.berylliumsafty.eu](http://www.berylliumsafty.eu).



## SUMMARY

### OPERATIONS

Good work practices such as avoiding activities that result in airborne dust creation (dry cleaning or use of compressed air to remove particulate) and implementation of procedures for keeping the milling center and floors clean and free of CuBe chip accumulations are important methods for maintaining exposures reliably below the REG.

### MAINTENANCE

Under certain conditions, the repair or maintenance of equipment can generate airborne particles. Protecting workers can require the use of specific work practices or procedures involving the combined use of ventilation, wet and vacuum cleaning methods, respiratory protection, decontamination, special protective clothing and when necessary, restricted work zones. Detailed procedures for safely maintaining the process equipment and ventilation systems should be developed. All operators and maintenance personnel need to be trained in the established procedures prior to performing maintenance or service activities.

## ADDITIONAL INFORMATION

The information contained in this document applies only to the subject referenced in the title. Read the SDS specific to the products in use at your facility for more detailed environmental, health and safety guidance.

The Be Responsible can be viewed at [www.berylliumsafety.eu](http://www.berylliumsafety.eu).

The foregoing is provided solely for informational purposes, based upon data believed to be correct and up to date, and is not to be construed as a warranty, express or implied, of any kind. The information above may not apply to a user's manufacturing operations; it is the responsibility of the user to determine safe conditions for the use of beryllium-containing products in its own operations and to comply with all applicable health and safety laws. Users of beryllium containing products should not rely solely on this information to make decisions about exposure control, but should consult with experts who can evaluate the users' operations and make specific recommendations tailored to those operations.

Additional information may also be available by contacting:  
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