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# IMPROVING SURFACE FINISHING QUALITY BY USING RADIUS CARBIDE TIPS

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***Abstract***

*In the metal cutting industry, Tip s cutter plays an important role in cutting metal to obtain the various required shapes and sizes. It is also an essential cutting tool for the engineering productions in the various aspects of engineering industries. For example, Automobile, Aerospace, Precision Engineering, Metal Stamping and Plastic Molding industries, therefore Tip sis the most common and widely used type of milling cutters where the demand is very huge. There are many different brands and types of Tips cutters available in the market, which manufacture from Japan, America, Europe, Korea, India, Taiwan and China, etc. The increasing competition in the market region spurs the various manufacturers to constantly develop many different kinds of high performances. Tips cutters to cater the huge demand in the various aspect of engineering industries which can speed up the production time, processes and also reduce the production and lab our cost. These Tips are used in the applications of minimum surface roughness and increase in production rate*

## INTRODUCTION

The goal of this project is to develop a versatile carbide tip for cutting and engineering production by researching tip
Topologies, tool materials, and cutter surface treatments. Cutting procedures, cutting Environments, work materials, and their output features will all be evaluated as well.

It will be possible to spot and resolve common issues that Tips cutters encounter during production by doing test cuts on a variety of work materials. Its daring performances and setting are acceptable. I'll design and manufacture the MPCE as soon as I have all the necessary technical knowledge.

Multi Purpose Carbide Tips will be tested for cutting abilities and circumstances on various materials after the prototype is built. To evaluate cutting capability, cutting conditions, and tool life, I'll compare the test findings of Multi Purpose Carbide Tips to those of traditional End mills.

## Purpose

This project solves engineering production problems. Frequent problems increased manufacturing time, cost, machine, tool, and labor.Common Tips cutter issues include:

Incorrect cutter selection, Unsuitable tool materials, high milling speed or feed rate, excessive tool wear, and adequate coolant cause chips and breaks.Poor cutter alignment and inconsistent material hardness contribute to unsatisfactory finishing.Chattering markings on work materials due to cutter distortion, vibration, and spindle runout. If MPC is well-designed and studied,

Tips is a success; it will greatly aid engineering industries' manufacturing processes in resolving their usual issues with using Tips cutters. The Multi Purpose Carbide Tips will generally aid in lower production costs, production times, tooling costs, labour, and speeds up the manufacturing processes. But, it will also help my company gets a sizable profit margin.

## Project Methodology

Planning, debates, research, and development are just a few of the key stages that must be completed before work can begin on the project. This endeavour is a company initiative, and many employees have a hand in it. There is a management, engineers, supervisors, and machinists working on the project. I'm the project engineer, so it's up to me to gather all the pertinent data and draw out the blueprints.

### Fundamental steps of Project

In the Planning phase of a project, most of the ideas for starting come from theoretical brainstorming.

When a basic plan of action has been created, the debate phase can begin. his is a crucial step since it needs the cooperation of numerous people and the resolution of lots of issues. Consider how crucial it is for all parties to have their voices heard and for their ideas to be accepted before a meeting can move further.

After the discussion phase is complete, the project manager will begin assigning team members tasks so that they may get began on the project. The project engineer's first step will be to begin the research phase and gather all the required information for the following step.

In the event that all data required is available and the project manager has given the go-ahead, the supervisor will order the machinists to begin production. The above items serve as a rough outline for executing a task, and in my next section, I will talk briefly about the overall strategy I use to complete my own projects with the assistance of my coworkers.

### General Approach To Project

This project can be started two ways. Research & Design follows Planning & Discussion.

### Planning & Discussion Stage

I'm thinking of various concepts for the Multi Purpose Carbide Tips and talking them over with the project manager to get their approval. Once the motion has been agreed, a formal meeting with a large attendance will be held. The project manager makes the final decision and releases the project budget for approval after everyone has had a chance to voice their suggestions and ideas for revisions or changes in the meeting room.

### Research & Design Stage

The specifications of several types of tips cutters will be studied, following by a study of the typical issue faced when using those tips cutters. Analyze the information you have and generate a few differing views for the Multi Purpose Carbide Tips cutter. Once everything is finished, submit the Multi Purpose Carbide Tips design and AutoCAD drawing to the project manager for review nd approval.

## LITERATURE REVIEW

Normalized chip thickness needs a credible approach. The researchers used molecular thermodynamics and friction theory. Learn minimal chip thickness for different materials and cutting scenarios. These methods measure cutting shear strain and rate.Temperatures were examined for job-chip and tool-chip cutting. Slip-line field models were utilised. Completed tool radius. Kragelskii-equation Drujanov's determines ploughing-to-Micro cutting needs. Merging Johnson-(aluminum Cook's alloy) and Oxley's (carbon steel) models computed effective flow stress (high strain rate, high temperature, and high voltage). Steel 1040 and 6082-T6 make up the experimental frame.

Speed influences chip thickness in two ways. Higher cutting speed improves material heating, softening and ductility. Small chips thicken. Work hardening impacts cutting and deformation.

Thinner, less flexible chips are needed. As the cutting tool's edge speed rises, the chip thickness increases while machining carbon steels. Carbon increases chip thickness. Minimum chip thickness remains constant throughout a wide range of cutting rates and tool blades. High speeds are used to boost productivity while cutting aluminium alloys, but not carbon steels.

H.S.Yoon et al. presented a slip-line-based orthogonal shear force pattern for micromachining. Consider chip generation and ploughing. Consider cutting angle, distortion, and chip thickness. Manufacturing requires edge radius. Size can impair sharpness.

Ploughing, not cutting, is crucial in micromachining. Chip thickness has consequences. Thinner unformed chips prevent "ploughing." When chip thickness exceeds a threshold, chips form. Chip formation occurs when chip thickness exceeds 30% of tip radius, according to experiments.

This paper assumes rounded edges. Cut orthogonally. Below the chip's minimum height, the substance plasticizes. Also possible: uncured work. Shear stress is same for all cutting planes. Chip is a free body, hence the cutting plane experiences no normal force. Studying dead zones' influence on metal processing. Stable edges include stagnation zones.

Eugena Xinite investigated titanium alloy micro fabricated surfaces (Ti6Al4V). The conversion of titanium alloys is challenging. First, lengthy, challenging-to-remove chips are a result of short tool lives. The ability to micro fabricate these alloys have increased. When using a tool, ridges are left behind that mirror the shape of the tool's nose. The typical stresses in trailing edge metal are substantial.

This metal becomes rougher as it moves sideways to release stress. Soft ductile materials are particularly difficult. Surface roughness reduces with feed prior to micro turning, reaches a minimum, and subsequently increases. The edge roughness connected to plastic and kinematic flow "Abrasiveness" model is the final one for predicting surface roughness.

To investigate the effect of tool sharpness on diamond cutting surface integrity and chip thickness, Z Zhou J et al. assumed ultra-precise machining. For machining, a surface's integrity must be strong. When paired with dimensional accuracy, good surface integrity lowers surface roughness and residual stresses. Machining precision refers to how precisely the cutting edge and workpiece move in relation to one another. A study of the machine tool's operation is required. Material is an alloy of aluminium. The cutting edges were found to be smoother and sharper.

Cutting is a good thing. To ascertain the effect on surface hardening, a micro Vickers was utilised to measure micro hardness. A cutting tool produces a surface that is softer than a blunt instrument. For a given cut depth, large-radius tools leave behind sharper stress remnants. Relative tensions decrease throughout a range of cut depths.

# METHODOLOGY

## Selection of Cutting Fluids

Milling affects surface precision, tool life, cutting torque, etc. Fluids cut it. Cutting fluids have 3 functions.

- Cooling
- Lubrication
- Anti-welding.

Consider these three factors when choosing cutting fluids:

- To increase tool life,
- To increase tool life, Table illustrates
- Cutting fluid qualities.

## Cutting fluids' effects on micro-grain carbide end mills

Micro-grain carbides include more cobalt for toughness. Cooling steel with cutting fluids prevents pullouts. The chart below compares two-fluted micro-grain carbide milling with and without cutting fluids.

## Surface Treatment

Surface treatments are frequently applied to metal cutting tools to increase tool performance and durability. Cutting tools generate heat when they cut through material, fusing material chips to the tools, friction, tool wear, etc. Therefore, the right kinds of coating are needed to stop all of these issues.

The heat generated when cutting tools are used on material is analysed using FEM in the diagram below.

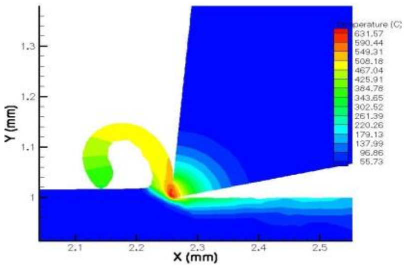



**Fig.23. FEM Analysis**

## Safety Procedures

**MPC features User-friendliness tips**

During the design stage, I have to ensure that my multipurpose Carbide End mill won't cause any operator accidents.

➢ **Handling of the Tips cutter**

Problem: Because the Tips cutter's cutting edge is so sharp, if the operators don't handle it carefully or don't wear safety gear (safety gloves), they will easily cut their hands.

Solution: - By including a corner protection chamfering at the cutting edge's tip, the risk of operators mistakenly cutting their hands is reduced, and the tips cutter will still be sharp enough to deliver excellent surface finishing quality. Operators, in addition to the other criteria, must always remember to wear protective gloves.

➢ **Work material chips produced by Tips cutter**

**Problem:** - Work-related materials the lengthy, curly chips made by traditional end mill cutters might entangle the spindle or the workpiece. It will need to be physically removed by operators. Solution: - Short and fractured chips can be produced thanks to the multipurpose Carbide Tips' distinctive shape. Because workers may manage chip ejection without having to stand next to the machine and there is less chance that their hands will get cut, this feature enhances automated milling operations..

**Distortion and Vibration of the Tips cutter.**

**Problem:** When utilizing a multipurpose carbide tip cutter, the milling machine vibrates and distorts, ruining the work product and endangering the workers' safety.

**Solution:**The correct technical instruction on how to utilize the multipurpose carbide tips must be given to operators, who must be informed of the precise cutting speed and feed rate. To hold the Tips cutter firmly and rigidly and prevent distortion or vibration and unneeded damage to the operators, a suitable tool chuck holder should also be implemented..

## Observe these safety precautions when using cutting tools

When starting operation, use the specified cutting conditions just as a general guide. When cutting causes an unusual vibration or different sound, the cutting condition adjusts. Void using tools with obvious wear or cracks. Breakage is a result of tool wear or fissures. Before utilizing any tools, be sureAvoid turning tools in the reverse way from how they are often used, which is to the right. Verify the linked indication package to determine what caused the left rotation.

## Idea for creating a multipurpose carbide end mill

Multi Purpose Carbide Tips were developed to solve milling problems in machining jobs, thereby improving machining time and cost.

Multi-Purpose Carbide Tips can perform complex multi-task applications, saving tooling costs. This End mill's unique design makes it effective for side milling on deep wall cavities.

Multi Purpose Carbide End Mills are tough, wear-resistant, and rigid. TiALN coating on Multi Purpose Carbide Tips improves surfaceroughness and productivity. Carbide material and TiALN coating allow high-speed milling and cutting with excellent surface finish.Test Data This second test compares TiALN-coated Multi-Purpose Carbide Tips to Micro Grain Carbide Tips. Both cutters use SUS 304 stainless steel, water-soluble coolant, and a Makino V750 CNC machine. Multi-Purpose Carbide Tips last 14 hours, Micro Grain Tips 8 hours.

Multi Purpose Carbide Tips have longer tool life than general Micro Grain Carbide End mills due to their unique flute design.

## Test Data 3

| Company: | OSG | Company C |
|---|---|---|
| End Mill: | MP-CE | Micro-Grain + TiALN |
| Size: | Ø 6 | Ø 6 |
| Speed: | 470m/min (15,000/rpm) | 470m/min (15,000/rpm) |
| Feed: | 6,000mm/min (0.2mm/t) | 5,500mm/min (0.18mm/t) |
| Tool life: | 14hrs. | 8hrs. |

| | |
|---|---|
| Work Material: | Stainless Steel (SUS 304) |
| Coolant: | Water Soluble |
| Machine: | Makino V750 (V) |
| Depth of Cut: | 0.3mm |
| Others: | 3D milling |

**Fig.31. Comparison of the deflection**

Third, Multi-Purpose Carbide Tips are compared to ordinary Tips for deflection rate. Multi-Purpose Carbide Tips do three milling steps, while End Mills perform one.Multi-Purpose Carbide Tips have the lowest deflection rates among End mills.

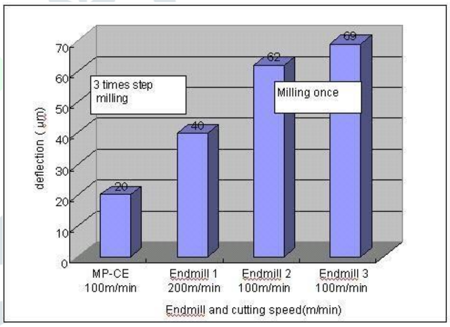
## Test data 4

The table below compares Multi-Purpose Carbide Tips to Long Series Tips. Results indicate that Multi-Purpose Carbide Tip is superior to the standard long series Tip in a number of ways. With the same radial depth of cut, the Multi-Purpose Carbide Tip is milling at high feed and speed.

## CONCLUSION

Following a battery of tests pitting Multi-Purpose Carbide Tips against more standard End Mills, it became clear that the former were superior. This new Multi-Purpose Carbide Tips can operate at high speeds, proving that its versatility is not limited to low-speed tasks. The tool life is also way longer than that of a standard End mill. When applying side milling to a deep wall cavity, the deflection rate is considerably reduced in contrast to fast milling and tool life. It has also been proven that these Multi-Purpose Carbide Tips can perform a variety of complex tasks that typical tips can't.

When this Multi-Purpose Carbide End mill is fully finalized, it will be a huge boon to the




metal cutting industry, allowing them to finally put an end to the usual machining issues they've had to deal with utilizing a wide variety of standard, general-purpose End mills. In most cases, it will speed up milling, reduced milling cycle time, reduced tooling costs, and decreased costs.

### FUTURE SCOPE OF STUDY

We hope that by doing additional research into the higher temperature capacity of iron rich binder carbide cutting tools, we will be able to achieve a finer surface finish on the material.

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