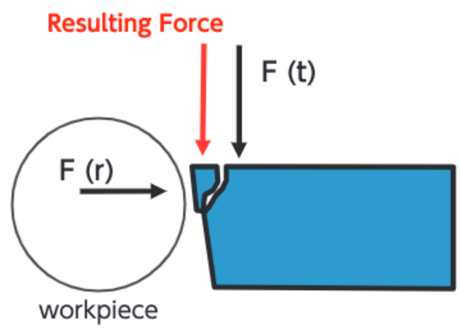
Guidelines for Edge Preparation

Selecting the appropriate Edge Preparations

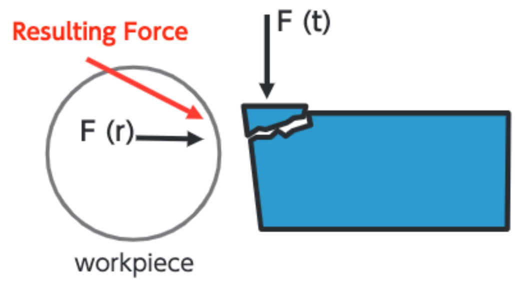
CBN insert performance is dependent upon the machining speed and the insert edge preparation. The appropriate edge condition depends on the application. It is best to use inserts with a honed and chamfered edge preparation, especially for interrupted cuts. A chamfer with a hone provides a strong edge for machining hardened steels and irons. It is ideal to have the cutting forces directed into the body of the insert (between tangential, axial and radial) this is achieved with a negative insert that has a chamfer and hone edge condition (P, S, Z style). If the forces are not balanced the insert will experience chipping and flaking. In cases requiring additional strength select an insert with a large nose radius.

Importance of edge preparation

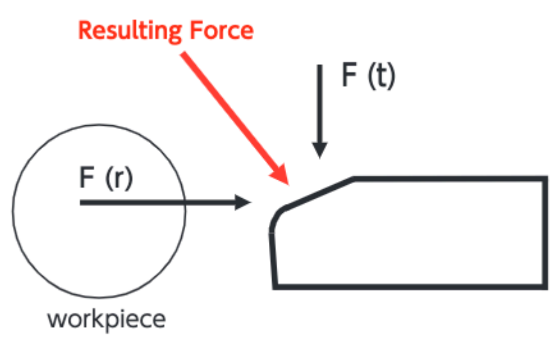
A combination of a high tangential force and a sharp insert edge can result in edge breakage. This is due to unbalanced radial and tangential forces. An example, at tool path entry or during interrupted cutting, all the pressure is directed into the top of the insert. This increases the risk of chipping.



A combination of high radial forces and a sharp insert edge can result in edge flaking. An example, If the feed rate is too high, the force generated will overpower the insert and cause flaking to occur.



This insert is placed in compression with the addition of a chamfer on the edge reducing the chances of breaking or flaking. Radial and tangential forces are balanced to provide the best tool life. The resulting force is directed into the body of the insert ; and is achieved with a negative insert geometry with a chamfer and hone for the edge preparation.



Standard edge preparations are applicable to general applications, but sometimes conditions require special edge preparations to be manufactured. It is important to understand the effect of edge preparations for the work materials.
Example: to finish a part made of pearlitic gray cast iron requires a cutting edge that is fairly forgiving, although extremely abrasive the material hardness is low compared to hardened steels. Inserts are manufactured with optimum cutting edge preparations for the grade and geometries in order to avoid cutting edge fracture caused by heavy loads generated during the machining of hardened steel.

Geometries recommended:

Strong cutting edge geometries are always preferred to reduce the chances for edge chipping.

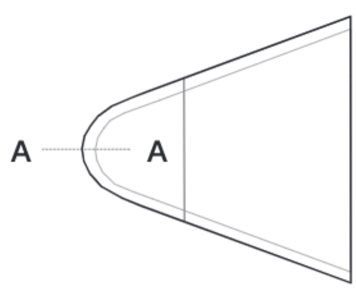
- Negative style inserts
- Chamfered + hone edge preparation
- Big nose radius

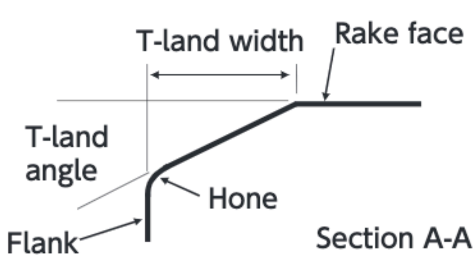
Will produce increased cutting forces, temperatures and the possibility of tool/workpiece deflection.

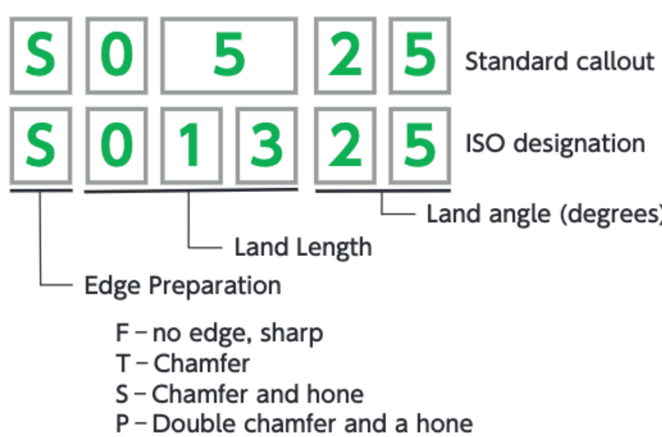
Sharp positive or neutral insert geometries can be utilized when:

- Finishing small boring applications in hardened materials without interruptions
- Finishing unstable components without interruptions
- Finishing gray cast iron parts

This style will produce lower cutting forces, temperatures, and tool/workpiece deflection.
It is important to remember that this edge will be weaker and therefore less resistant to impacts and cutting forces.







Guidelines for Edge Preparation

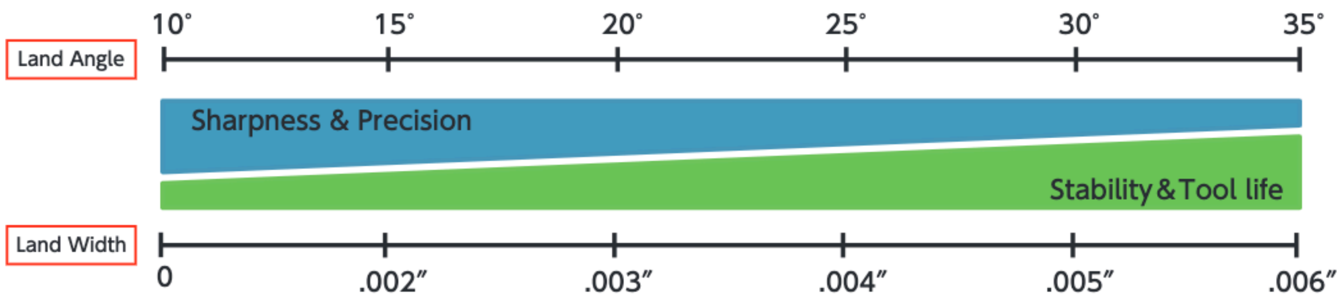
Selecting the Appropriate Edge Preparation:

To achieve success machining with CBN it is important to consider the edge preparation and insert geometry to suite the application. The insert selected must correspond to the CBN grade, the type of material being machined and the operation being performed. PCBN is the second hardest cutting tool material and is relatively brittle compared to tungsten carbide. CBN materials behave similar to ceramics which means geometry and edge preparation are key to machining success. Tool geometry is critical to the success or failure of the application. The range of applications for CBN products place different demands on the insert and creates a relatively small window for optimal performance.

The strength of the cutting edge on CBN inserts increases as the chamfer angle and width increases but with this geometry comes higher cutting forces and temperatures. A large chamfer spreads the forces over a larger area and provides a more durable cutting edge allowing for higher machining feed rates. This larger edge preparation can be applied when process stability and consistent tool life are important to the manufacturer.

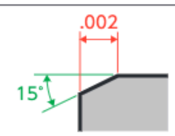
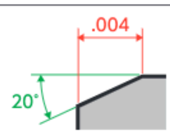
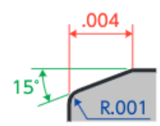
If the surface finish and part dimensioning and tolerances are key requirements then a smaller chamfer will be the best solution. The forces and temperatures will be reduced and vibration will be minimal. In cases where surface finish is critical, then a sharp edge is ideal but will reduce the insert tool life.

It is important to determine the appropriate edge preparation to manufacture quality parts, provide a stable machining process and good tool life.

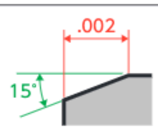
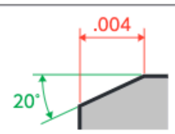
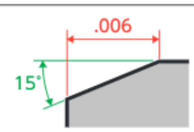
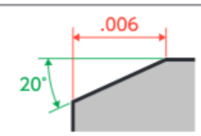


Edge Preparation

Edge Sharpness

Part Specification : FNX Edge : Sharp edge	Edge specification : T0215 Part number : TBD	Edge specification : T0420 Part number : TCE	Edge specification : S0415 Part number : SCD
			

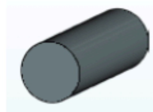
Edge Sharpness

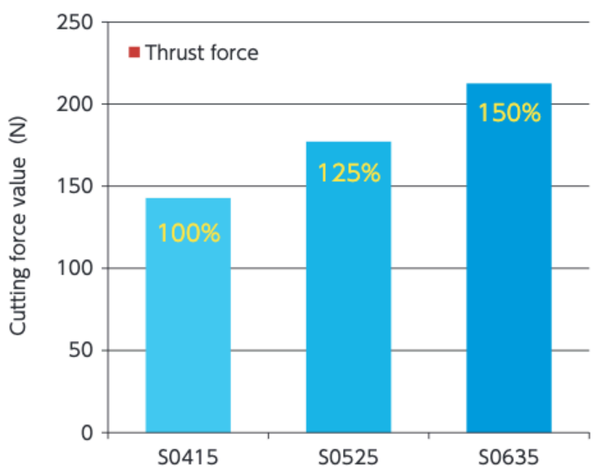
Edge specification : T0215 Part number : TCD	Edge specification : T0420 Part number : TCE	Edge specification : T0615 Part number : TED	Edge specification : T0620 Part number : TEE
			

Performance comparison by edge preparatrion

Cutting force

Material : Alloy Steel (HRC63-65) [SCM415]
Insert : TNGA 332
Parameters : SPEED : 650 SFM
FEED : 0.004 IPR
DOC : .008"
DRY

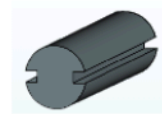

Continuous cutting

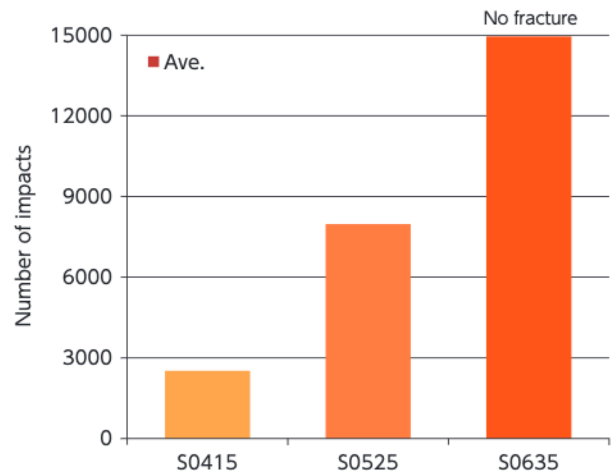


As the edge preparation gets larger the cutting force on the insert edge goes up.

Fracture resistance

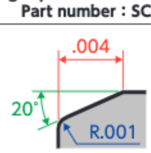
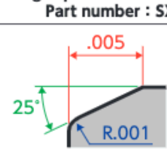
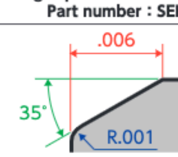
Material : Alloy Steel (HRC63-65) [SCM415]
Insert : TNGA 332
Parameters : SPEED : 250 SFM
FEED : 0.004 IPR
DOC : .012"
DRY


Heavy Interrupted cutting

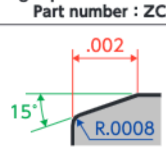
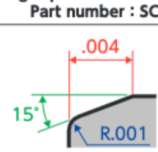
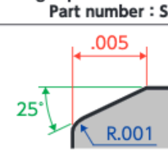
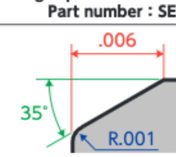


There is a direct correlation between an increase in the edge preparation and improvement of insert fracture resistance.

Edge Strength →

Edge specification : S0420 Part number : SCE	Edge specification : S0525 Part number : SXF	Edge specification : S0635 Part number : SEH
		

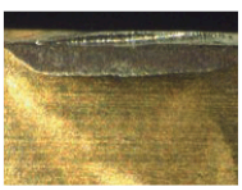
Edge Strength →

Edge specification : Z 0215 Part number : ZCD	Edge specification : S0415 Part number : SCD	Edge specification : S0525 Part number : SXF	Edge specification : S0635 Part number : SEH
			

Troubleshooting

CBN Application		
Problem	Cause	Suggested Action
Poor Surface Quality	Vibration	Check rigidity of tool & set-up
	Too High Feed	Lower feed rate, increase nose radius or change to wiper
	Too Sharp Insert	Increase chamfer angle
	Wrong Grade	Choose finer grain size
Premature Wear	Wrong Speed	Increase speed
	Too sharp of Insert	Increase chamfer angle
	Wrong Grade	Choose finer grain size
Vibration	Poor set-up	Check rigidity of tool & set-up
	Too Light Feed	Increase feed / of DOC
	Too much Pressure	Choose more positive insert geometry / cutting edge angle
	Improper Edge Prep	Reduce chamfer angle
	Too much Pressure	Reduce nose radius

Flank Wear



- Increase cutting speed
- Increase feed rate
- Increase DOC
- Check tool centerline height
- Check material's iron content

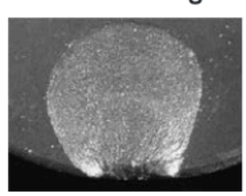
Notch Wear

- Increase cutting speed
- Reduce feed rate
- Increase insert approach angle (with a round insert)
- Vary the DOC
- Use insert with chamfered edge

Crater Wear

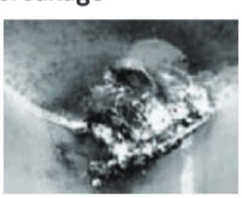
- Reduce cutting speed
- Reduce feed rate
- Reduce insert chamfer angle
- Use sharp edge condition
- Use coated insert
- Use coolant (continuous cuts only)

Rake Face flaking



- Reduce feed and speed
- Consider coolant as factor
- Use insert with larger edge prep: chamfer + hone edge
- Increase cutting edge
- Check tool centerline height
- Reduce insert approach angle

Catastrophic edge breakage



- Reduce DOC (reduce insert load)
- Reduce cutting speed
- Increase nose radius (if possible use round insert)
- Use insert with chamfer + hone
- Check centerline height
- Check condition of holder

Edge Chipping

- Use insert with chamfer and hone
- Increase tool rigidity
- Interrupted cuts– chamfer the tool entry and exit path of slots and holes
- Vary cutting speed to eliminate vibration
- Check tool rigidity and centerline height