USER GUIDE

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Ingersoll Cutting Tools

T-ABSORBER™

ANTI-VIBRATION BORING BARS
USER GUIDE

USER GUIDE 2019

Ingersoll's anti-vibration boring bars

Deep turning solutions for machining high depth to diameter internal applications include special anti-vibration boring bar systems with a 'live' vibration dampening system located inside the tool body.

Ingersoll's innovative ***T·ABSORBER*** anti-vibration boring bars have been designed to significantly reduce and even totally eliminate vibrations when working with a high overhang from 7xD to 14xD.

Situated inside these tools is a unique damping mechanism that consists of a heavy mass that is supported by a rubber spring element containing oil to increase the required dampening effect.

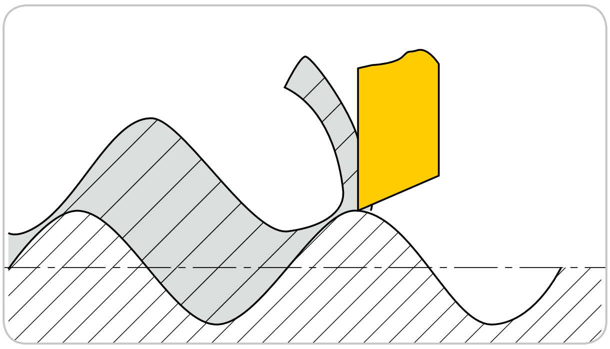
The ***T·ABSORBER*** anti-vibration turning tool line enables the fitting of a wide range of cutting heads with a range of different insert geometries, including all Ingersoll standard ISO turning inserts for different applications; thus offering great flexibility.

The ***T·ABSORBER*** boring bars represent a cost-effective, modular system with a wide range of standard shanks with diameters of 16, 20, 25, 32, 40, 50 and 60 mm. The flexible boring bars are able to carry eight different interchangeable boring heads: CCMT, VCMT, DCMT, DNMG and VNMG.

Chatter suppression method of Ingersoll's anti-vibration tools

Cutting tool vibration is a well-known problem in machining. The most common issue is that of self-excited vibrations, also known as "chatter."

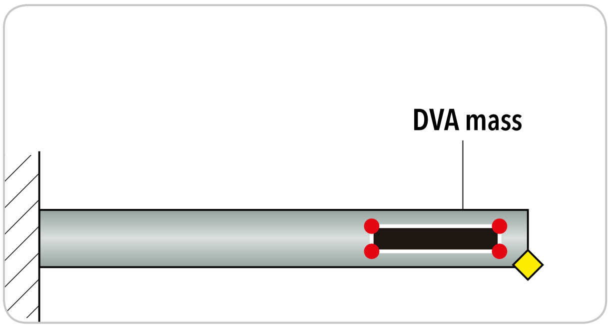
During machining, a vibrating tool generates undulation on a workpiece surface. In a subsequent tool pass, the cutting edge would then be machining the previously generated wavy surface - leaving behind a newly generated wavy pattern, as shown in the figure below. The chip thickness and therefore the cutting forces vary with time. This phenomenon can greatly amplify vibrations and develop chatter.

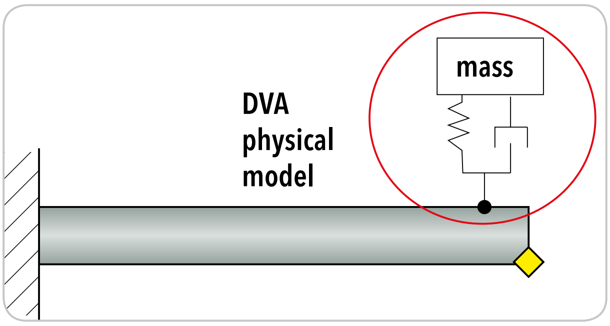


Chatter vibrations are detrimental to the safety and quality of machining operations. They cause a rough surface finish, increase cutting forces, reduce tool and machine life, decrease productivity, and create irritating high noises.

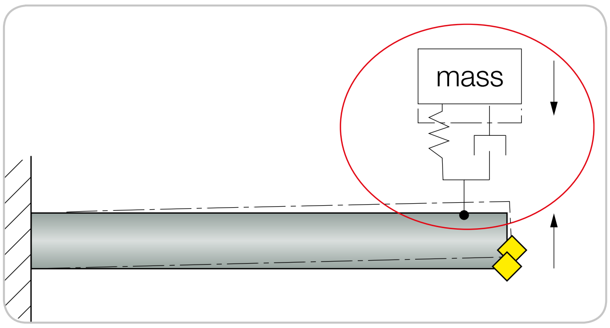
During internal turning, the tool usually has a large overhang (large L/D). In general, where L/D>3, chatter vibrations become apparent due to high tool flexibility and low damping.

The ***T·ABSORBER*** anti-vibration tools are designed for operations in which large overhangs are required. These tools include Dynamic Vibration Absorber (DVA) systems to increase damping and therefore stability during machining – see figure below. The DVA is a heavy Tungsten mass supported by elastomeric components and located in an internal cavity at the furthest available position in the tool.





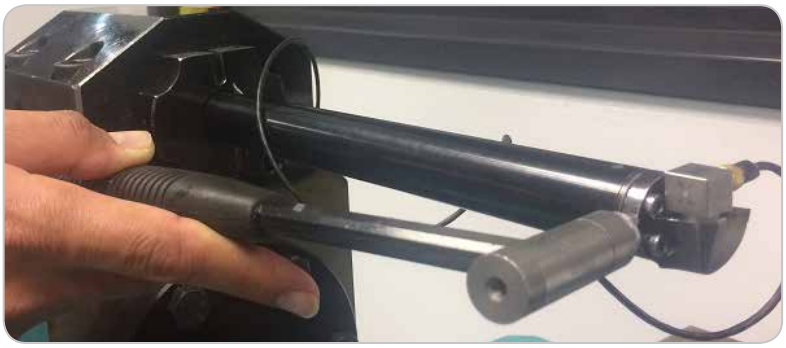
A mechanism is designed to preload the elastomers and therefore to modify the stiffness of their equivalent spring. Modification of the spring stiffness causes a change of the DVA natural frequency. The DVA system is tuned such that its natural frequency is brought close to that of the tool without DVA. This is done in order to introduce a phase shift between the tool and the DVA mass vibration, eventually causing attenuation of the oscillation amplitude of the tool.

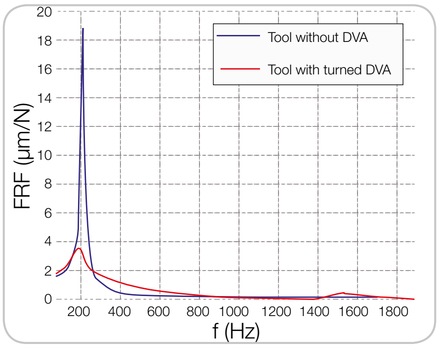


Chatter suppression method of Ingersoll's anti-vibration tools

The tuning procedure is performed by experimental modal analysis as shown in the figure below.

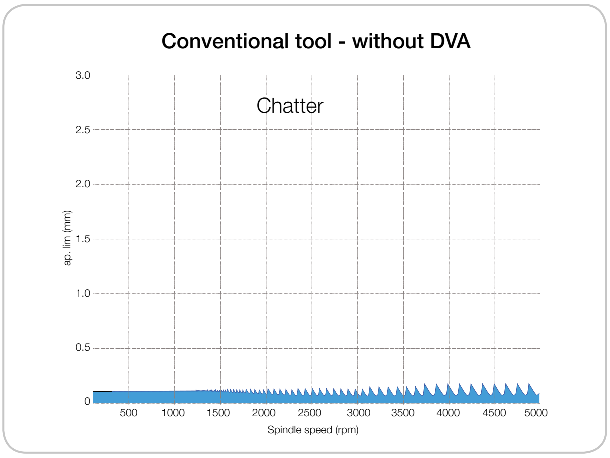
A modal hammer is used for applying and measuring impact forces and an accelerometer is used for measuring the resulting acceleration. Using these signals, the Frequency Response Function (FRF) which reflects the tool dynamic flexibility is obtained. The FRF of the ***T·ABSORBER*** anti-vibration tools may be compared to those of conventional ones without DVA at the same ovehang length – see figure below. Due to the high damping, the ***T·ABSORBER*** anti-vibration tools have relatively a very low FRF peak magnitude.

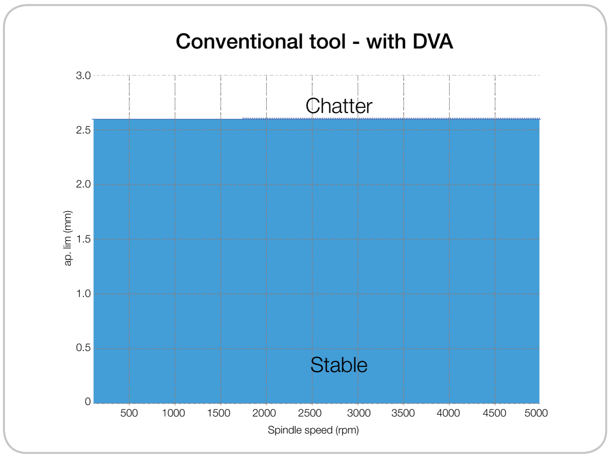




The border between a stable cut and an unstable one can be demonstrated in the plane of depth of cut (ap) and spindle speed and it is known as the Stability Lobe Diagram (SLD).
The SLD can be used to find the machining parameters that result in the maximum chatter-free material removal rate. The SLD can be obtained using a tool FRF and machining conditions.

Decreasing the FRF peak magnitude, via increasing the tool damping, yields an enhancement in its stability limit. The SLD's of ***T·ABSORBER*** anti-vibration tools and corresponding conventional tools are compared in the figure below, where ***T·ABSORBER*** anti-vibration tools show a considerably higher stability limit than that of conventional tools.
Tool stiffness and mounting rigidity also affect the FRF and the stability limit of the tool. Increasing the mentioned stiffness will cause improvement in the FRF and stability limit.





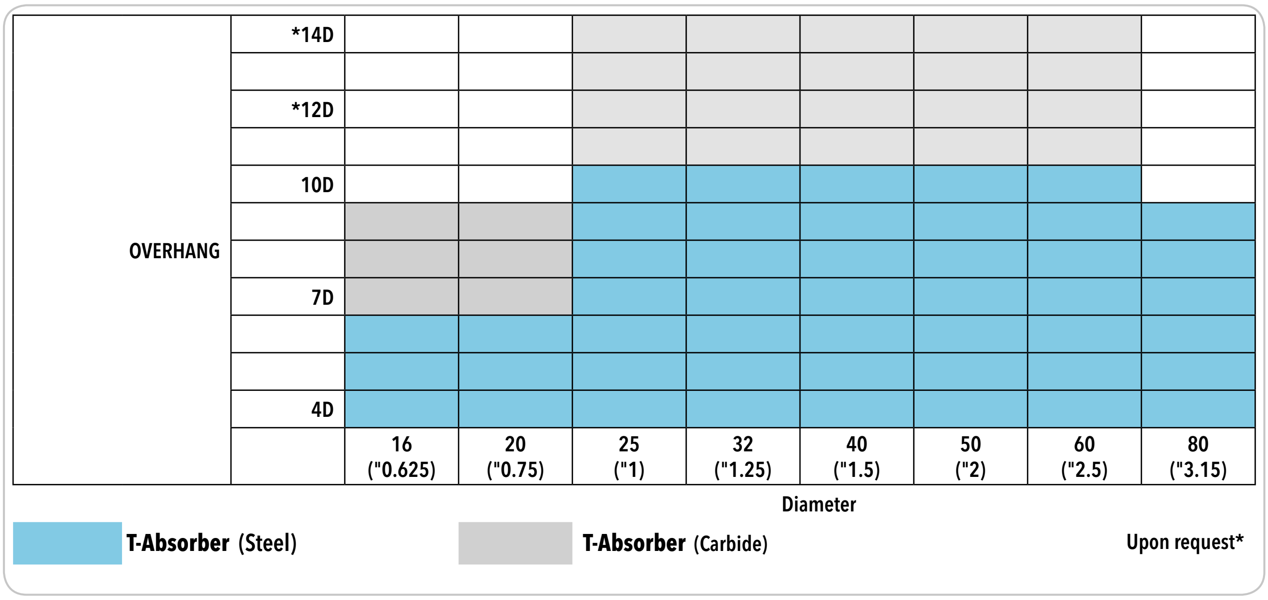
Vibration damping tools for lathe machines

Vibrations are one of the most common problems that limit machining. In more severe cases an operation becomes impossible due to excessive vibrations. In other cases, Machining is possible, but at the cost of reduced cutting conditions. Additional effects of vibration include worse surface quality and a decrease in insert tool life.

Using Ingersoll's ***T-ABSORBER*** tools can greatly reduce the above problems, leading to a substantial increase in productivity, surface finish and insert toollife.

Vibration issues occur more drastically at large overhangs where, in many cases, machining becomes impossible with conventional tools. However, improvements in all machining parameters can be achieved also at shorter overhangs by implementing ***T-ABSORBER*** tools.

Availability of tools per shank diameter and machining depth



Basic considerations

Following all the recommendations below (as closely as possible) will greatly improve *T·ABSORBER* tool performance.

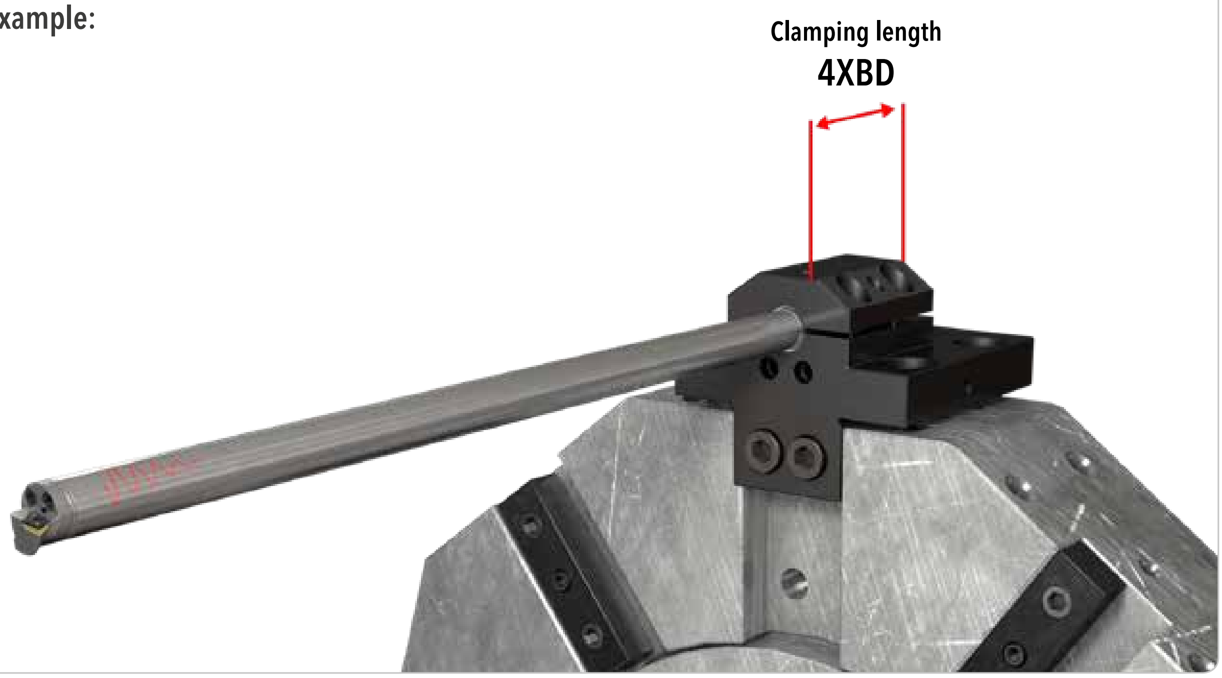
1. Bar D-min parameter should be 10%-20% smaller than the machined bore to allow stuffiness gap for chip evacuation and deflection.

Example: For a bore diameter of 80 mm it is recommended to use a 60 mm bar rather than a 80 mm bar. Although the 80 mm bar is stiffer, the lack of space for cheap evacuation will decrease the surface finish and can cause breakages.

2. Clamping stability is crucial! Please follow the guidelines below as strictly as possible:

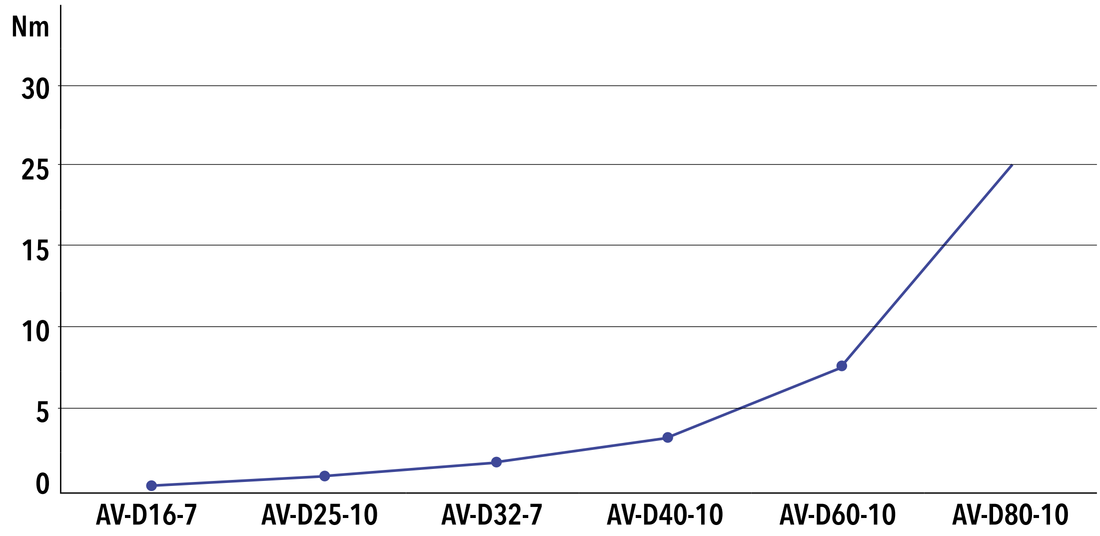
a.) Increase clamping length as much as possible. The minimum recommended length is 4 X bar diameter.

Example:



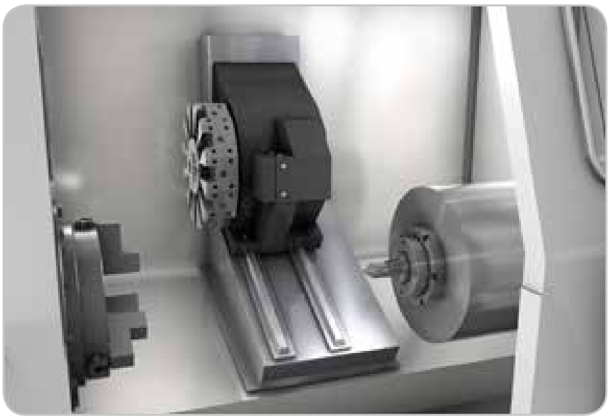
b.) Flat-bed lathe with a tool post provides higher rigidity compared to turret clamping. When using larger diameter bars, the moment exerted on the clamping tool (just by the bars weight) is increased dramatically.

Moment reated from bar weight



c.) Choose a machine that is in proportion to the tool size and overhang. Use a flat bed lathe if possible.

Flat bed lathe



Turret lathe

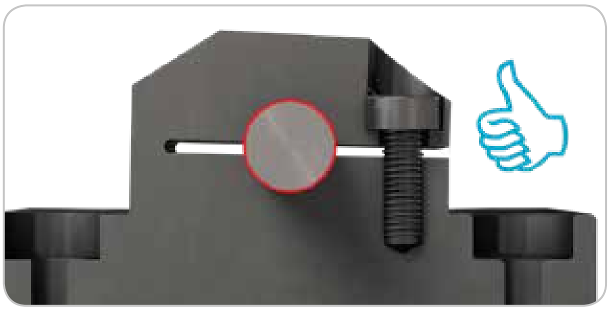
d.) You can employ several methods to decrease the negative effect of the moment:

- Install a counterweight:

- Work with the bar upside down:

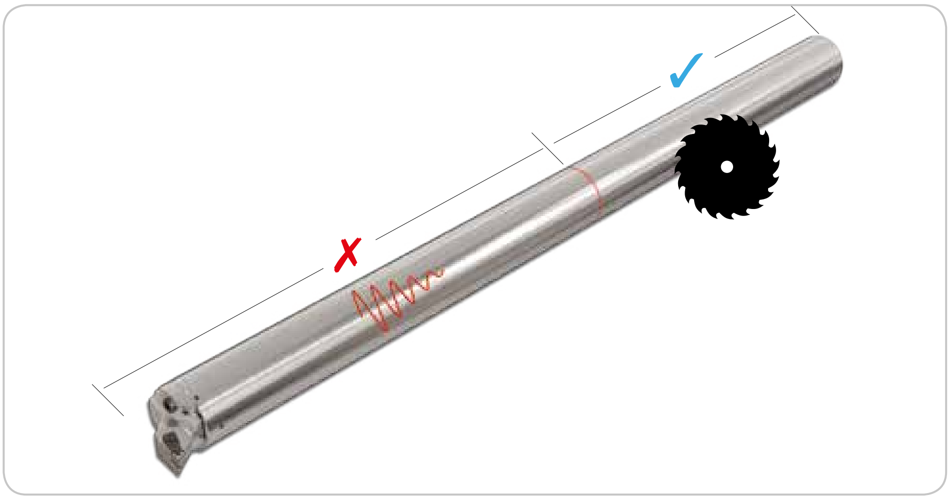
- Both methods create forces in opposite direction to the bars weight and thus reduce the moment that is exerted on the tool post.

e.) Split sleeve vs screw.
Choose a tool post with peripheral and uniform clamping forces



3. Shortening the bar:

In case the bar is too long for your machine or application, it is possible to shorten it.
Each bar has a red marking that shows the minimum length to which the bar can be shortened.

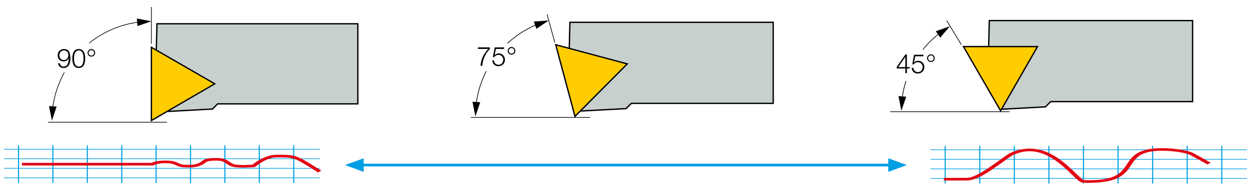


Bar diameter	Minimum length after shortening	
DCONMS [mm]	OAL 7D [mm]	OAL 10D [mm]
16	100	Not Recommended
20	125	Not Recommended
25	158	255
32	190	320
40	240	410
50	305	520
60	380	630

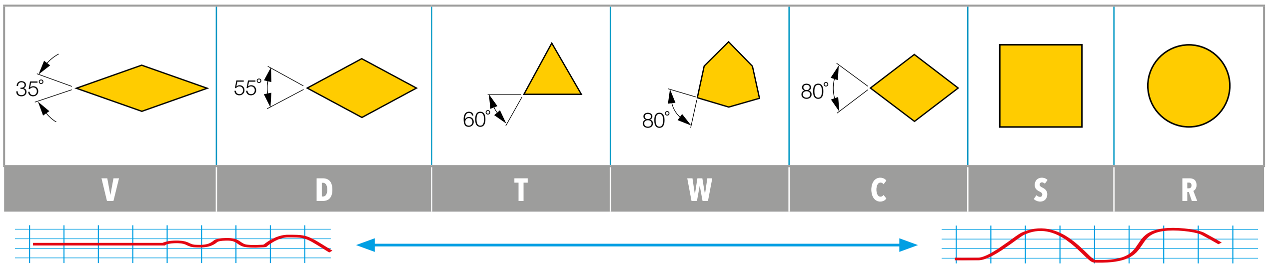
Choosing the Correct Insert

Choosing the correct insert can have a big influence on the overall success of vibration damping. The main way the insert can improve the machining stability is by minimizing the cutting forces. Following the guidelines below should be your first step to eliminate vibrations:

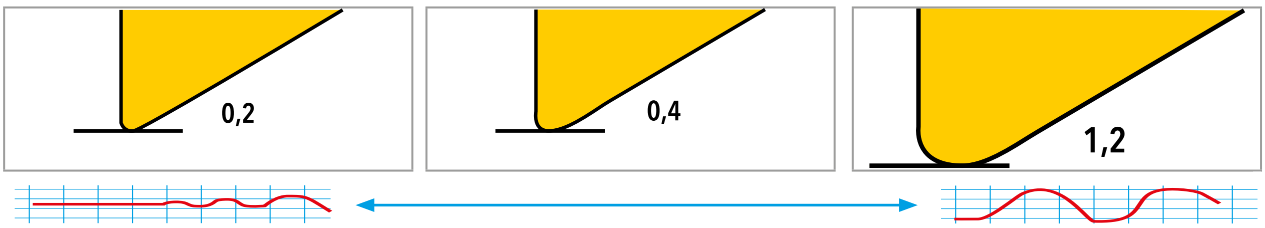
- Choose an entry angle that is as close as possible to 90° to reduce the radial forces to a minimum.



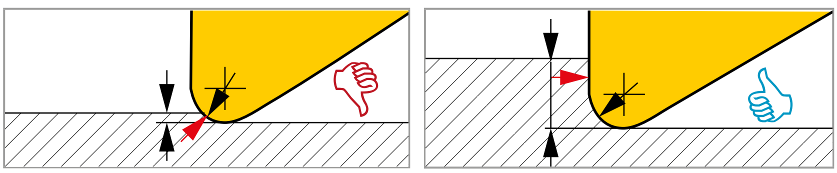
- Choose the smallest insert head angle possible. This will reduce overall cutting forces and increase the clearance.



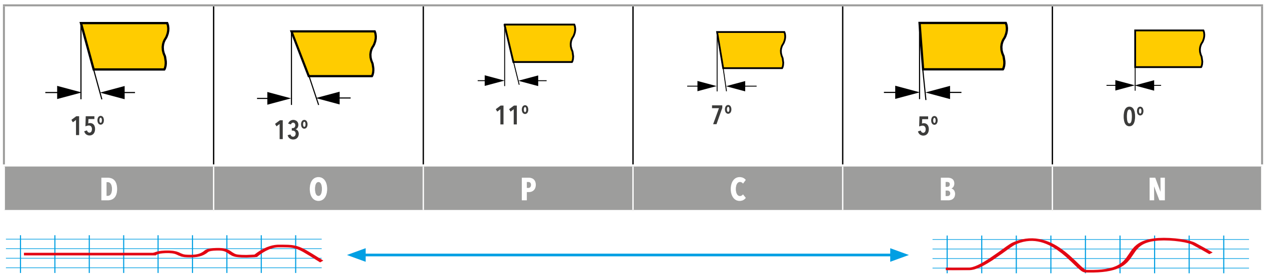
- Choose a small nose radius to reduce the cutting forces and to enable machining in a lower depth of cut. (Depth of cut should be larger than the nose radius)



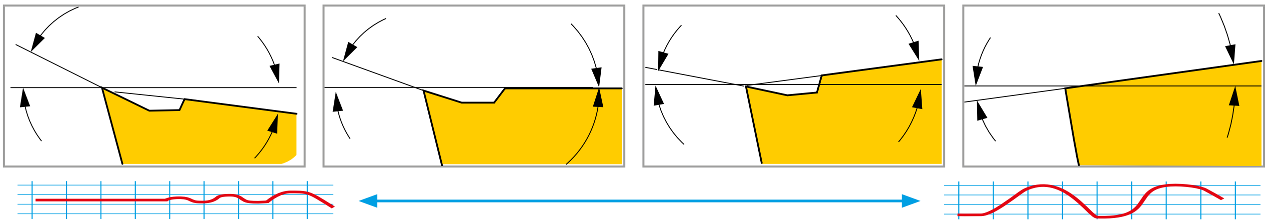
- Machining depth (ap) should be larger than the nose radius.



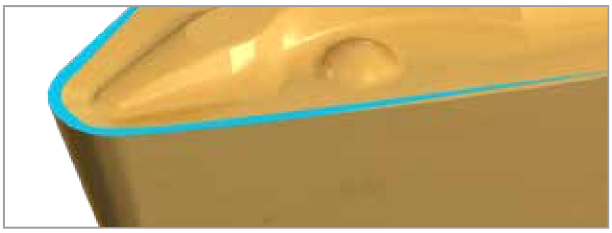
- Use an insert with an overall positive geometry to reduce the cutting forces:



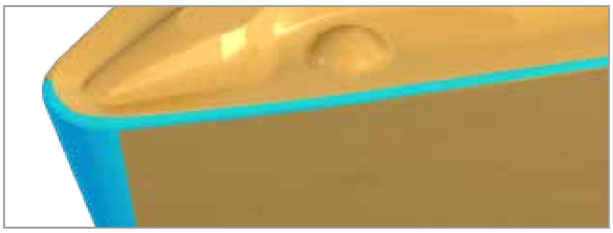
- Choose a positive top rake geometry:



- Use an insert with a small honing size. This can usually be achieved by choosing ground inserts and /or inserts with thin coating.



Small Honing



Big Honing

- Avoid using wiper inserts. These types of inserts improve surface finish but this is achieved at the expense of increasing the cutting forces

Each one of these steps reduces the cutting forces. You can use all or a combination of some of them depending on the limitations of your application.

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Ingersoll Cutting Tools
Marketing & Technology

Germany
Ingersoll Werkzeuge GmbH

Main Office:
Kalteiche-Ring 21–25
35708 Haiger, Germany
Telefon: +49 (0)2773-742-0
Telefax: +49 (0)2773-742-812
E-Mail: info@ingersoll-imc.de
Internet: www.ingersoll-imc.de

Office South:

Florianstraße 13–17
71665 Vaihingen-Horrheim, Germany
Telefon: +49 (0)7042-8316-0
Telefax: +49 (0)7042-8316-26
E-Mail: horrheim@ingersoll-imc.de

Office Wulften:

Steinstraße 11
37199 Wulften
Telefon: +49 (0)556-99 55 98-0
Telefax: +49 (0)556-99 55 98-25
E-Mail: wulften@ingersoll-imc.de

USA
Ingersoll Cutting Tools

845 S. Lyford Road
Rockford, Illinois 61108-2749, USA
Telefon: +1-815-387-6600
Telefax: +1-815-387-6968
E-Mail: info@ingersoll-imc.com
Internet: www.ingersoll-imc.com

France
Ingersoll France

22, rue Albert Einstein
F-77420 CHAMPS-sur-MARNE
Telefon: +33 (0) 1 64 68 45 36
Telefax: +33 (0) 1 64 68 45 24
E-Mail: info@ingersoll-imc.fr
Internet: www.ingersoll-imc.fr