

# MANDRELS & ACCESSORIES



A comprehensive range of tooling and accessories for  
the Engis range of multi-stroke honing machines



MULTI-STROKE HONING

# Engis – Your Partner in Superior Precision Bore Honing Technology

For more than three decades, Engis Corporation has been at the leading edge in the single-pass bore finishing process for production honing. Recognizing the need for an approach that offers enhanced flexibility for smaller batch sizes, Engis now offers a complete range of multi-stroke systems and tooling.

## State-of-the-Art Equipment and Tooling

- Engis has the ability to provide end-to-end systems solutions with full automation packages and robotic parts handling.
- We offer both single-pass and multi-stroke solutions depending upon the production requirements.
- Engis has a wide range of standard machine platforms as well as custom engineered solutions.
- Our engineering team has proven solutions for the finishing of both through and blind bores.
- Engis designs and manufactures precision part holding fixtures and tooling for achieving exceptional bore cylindricity, roundness and surface finish.
- We are a leader in seating tool technology.
- Deburring stations are also available.

## Cutting Edge Process Development

- Engis has dedicated engineering teams for designing systems, tools and fixtures.
- Our process development laboratory has full manufacturing capability in both single-pass and multi-stroke honing and is equipped with state-of-the-art metrology equipment.
- Engis can produce pilot runs of components using either single-pass or multi-stroke technology for proof-of-concept.
- We are well positioned to help you achieve your goals in terms of geometry, surface finish and overall costs.

## Unified Global Presence

- Engis has sales and service offices located in North America, East Asia and Europe, supplemented by our global distribution network.
- Both our single-pass and multi-stroke systems are operating successfully throughout the world.
- Engis has successful applications in most every market including automotive, hydraulic, compressor, gear and firearm manufacturers.
- Exceptional quality and high ethical standards are guiding principles throughout the Engis Group of Companies.



**Engis is committed to providing superior products and services. We faithfully comply with all of the requirements of our ISO 9001:2008 Quality Management System and renew this pledge through continual improvement of our products and motivation of our global staff.**



# Complete Systems Solutions

To complement our range of multi-stroke honing systems, Engis offers a complete range of precision engineered consumables, fixtures and accessories:

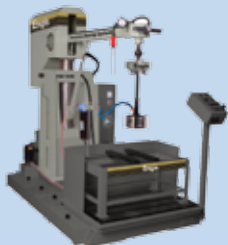
- Conventional and superabrasive honing stones
- Honing oil
- Honing assemblies and mandrels
- GHA tools
- Fixtures
- Accessories

The products contained in this catalog provide superior results in terms of geometry, finish and productivity when used in conjunction with the Engis models SH-1000, PH-1000, and PH-2000 multi-stroke systems.

Many of the products featured can also be adapted for other common multi-stroke honing machines.



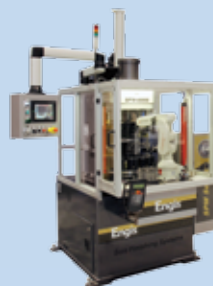
## Engis is Your One-Stop Shop for Bore Honing Machines and Supplies



**PW-1000** Vertical honing solution for large and heavy components in small to medium size batches and prototypes. Suitable for both through and blind bores, producing an excellent surface finish. This machine has been designed for safety, durability, efficiency and economical honing.



**CH-1000** Innovative long bore precision honing machine for straight and tapered bores at lengths up to 47.2" (1200mm) achieving tolerances and geometries to below  $2\mu$  for diameters up to 2" (50mm). This technically advanced machine features a unique step back "back taper" honing program which produces a controlled taper in the bore over a specified angle and length.



**Single-Pass Bore Finishing** Designed for high volume applications, Engis bore finishing systems are the unsurpassed solution for forward-thinking manufacturers to improve roundness, concentricity and finish. These systems achieve extremely tight tolerances, reliably and consistently, at a lower cost per part.



### Precision Manual Lapping Systems

The Helical Lap Division of Engis offers a complete range of standard and special I.D. and O.D. lapping tools which are capable of producing mirror surface finishes with superior geometry. Helical lapping tools can improve and correct imperfections in cylindrical geometry in barrel shaped and bellmouthed bores as well as tapered I.D.'s or O.D.'s. Cylindrical geometries of .000005" (5 millionths) and roundness of .000010" are achievable with the Helical process.

**Contact Engis at 800.99.ENGIS (toll free in the US) or [www.engis.com](http://www.engis.com). Customers outside the US, please contact your regional Engis office.**  
**[www.engis.com](http://www.engis.com)**

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# Guide to Stone Selection

Metal removal by honing is comparable with (often faster and more cost effective than) internal grinding machines. Efficient honing relies on obtaining an ideal balance between actual honing time and abrasive cost per component, therefore, choosing the correct grade of stone for each honing application is very important.

Honing differs from other methods of bore finishing in that there are a number of variable factors involved which all contribute to achieving the optimum honing operation and these are listed below:

## Determine Choice of Stone

1. Type of material
  - i) Hardness
  - ii) Special treatments such as anodizing
2. Prehone bore condition
  - i) Taper
  - ii) Ovality
  - iii) Surface roughness
3. Bore characteristics
  - i) Diameter to length ratio
  - ii) Annular grooves
  - iii) Cross holes
  - iv) Keyways
4. Stock removal allowance and tolerance
5. Desired surface finish

## Affect Performance of Stone

1. Surface speed of honing stone
2. Surface area of the honing stone
3. Stone pressure
4. Reciprocation speed
5. Type of honing fluid

These variable factors are mentioned to highlight the problems involved in recommending the ideal honing stone for any situation.

Examples:

1. A long bore component will require a softer grade of stone than a short bore of the same material.
2. A bore containing cross holes will require a harder grade of stone than a plain bore of the same material.

Engis has compiled a comprehensive selection chart based on average results achieved for various material groups. See page 5.

The deburring stone is the hardest available and is suitable for most materials. This prevents damage to the roughing or finishing stone, reduces stone wear and reduces production times and costs.

Common engineering materials can be separated into five groups:

Cast Irons	Spun, malleable, meehanite, S.G., etc.
Soft Steels	Alloy steels below HRC 55, CDS, etc.
Stainless Steels	Martensitic, austenitic
Hard Steels	Alloy steels above HRC 55, hard stainless, hard chrome
Non-Ferrous	Brass, bronze, copper, aluminium

The stones recommended in each group are based on average results. Changes in rotation and reciprocation speeds will affect the stock removal and stone wear rates and so full use of the infinitely variable rotation and reciprocation speeds are recommended to achieve optimum performance.

Stones suitable for rough, finish and polishing are shown for each material. Rotation and reciprocation speed will affect the surface finish achieved with each stone.

If the rotation speed is increased and the reciprocation speed decreased, the resulting cross hatch angle is very shallow, producing a smooth, finer surface finish.

If the rotation speed is decreased and the reciprocation speed increased, the resulting cross hatch angle is much steeper, producing a coarser finish.

It can be seen that the rotation speed should be higher for polishing than for roughing and finishing.

Rotation speed can also be used to affect the hardness of any stone.

If stone wear is excessive, increasing the rotation speed will make the stone act harder, slowing down the stone wear rate AND the stock removal rate.

If stock removal rate is low, decreasing the rotation speed will make the stone act soft, increasing the stone wear AND the stock removal rate.

This is a general rule and may not necessarily work in every situation. Consideration must also be given to other conditions affecting the honing stones performance.

Refer to the "Trouble Shooting" on page 27.

# Standard Abrasives

Abrasive manufacturers use a variety of code numbers to identify the abrasive type, grit size, bond structure and treatments of their individual products. It is not practical to identify the various stones, therefore, Engis uses a coding system that is common for all stone sizes.

## Conventional Abrasives

Three types of conventional abrasive grit are commonly used in honing.

### F Silicon Carbide

A jagged, splinter-like type of free cutting abrasive grit. Used on soft materials such as brass, bronze, aluminium and cast iron. Can also be used on very hard materials such as carbon, ceramic and hardened steels.

### R Aluminium Oxide

A regular, chunky shaped grit used for deburring all materials and stock removal in most soft steels up to HRC 50.

### C Bauxilite

A special purified form of aluminium oxide having a cool cutting action. Used on wear resistant materials such as hard chrome and heat treated steels above HRC 50.

## Treatments

### /S Sulphur impregnation

Stones that are suffixed "s" are sulphur treated. An extreme pressure lubricant that helps to reduce heat, reduces clogging and loading of the stone surface and reduces pick-up in softer materials is recommended.

## Other Materials

### SF Graphite

A range of polishing stones that will produce a high degree of surface finish on most materials.

### OCO Cork

A cork stick impregnated with fine abrasive grit used for polishing especially stainless steels.

### C6Y Cork

A cork stick used mainly for plateau honing of cylinder bores.

## Grit Size

Engis honing stones are available in grit sizes from 60 - 500 and for ease of identification the following coding is used:

Engis Code	0	1	2	3	4	6	8
Grit Size	60	80	120	180	220	320	500

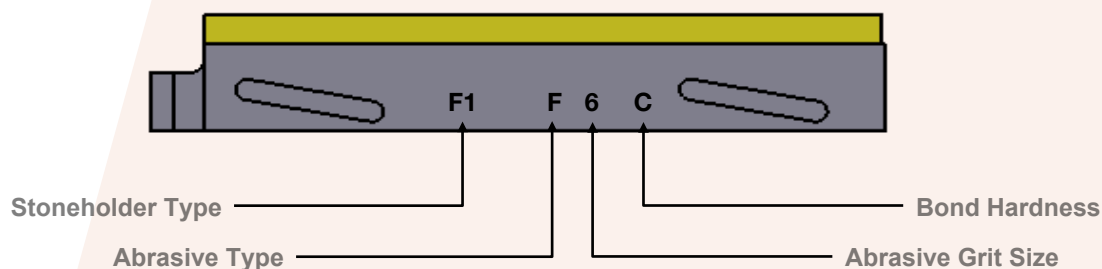
The grit sizes shown above are the most common stone grades in use. Other grades of abrasives, not listed, are available if satisfactory results cannot be obtained by selection from the chart. Please contact Engis for more details.

## Bond Hardness

Hardness or softness of grade is a measure of the tenacity with which the bonding material holds the abrasive particles together. The choice of grade depends on the material being honed. On a hard material, a soft grade should be used, allowing the abrasive particles to be released as soon as their sharp cutting points have been worn away. A hard grade is used on soft materials since the cutting points of the abrasive particles will wear away more slowly and need to be held together for a longer period before being released.

The Engis hardness code is as follows, ranging from A which is soft, to J which is very hard.

Very Soft	A - B
Soft	C - D
Medium	E - F
Hard	H - J



# Standard Abrasive Selection Chart

The stone selection chart lists the most common stone grades in use. Other grades of abrasives, not listed, are available if satisfactory results cannot be obtained by selection from the chart. Contact Engis for details.

Where a choice of stones is given for a material group, the stone in column (a) is harder than the stone in column (b) and would be used for bores containing cross holes, annular grooves, short bores, etc., while the softer stone would be used for plain bores and long bores.

Diameter Range	Deburr All Materials	Operation	Material Groups								Engis Stone-holder Types	Approx. Speed Range (rpm)	
inch			Cast Iron	Soft Steel		Stainless Steel		Hard Steel		Non-Ferrous			
mm				(a)	(b)	(a)	(b)	(a)	(b)	(a)			(b)
0.045 - 0.120" 1.14 - 3.05mm	not available (see superabrasives on page 6)												
0.120 - 0.150" 3.05 - 3.81mm	R6J	F	F6F	R6F		R6F R6C		R6F R6C		F6F		Y Z	2500
		P	F8F	F8F		F8F		F8F		F8F			
0.150 - 0.185" 3.81 - 4.70mm	R6J	F	F6F	R6F		R6F R6C		R6F R6C		F6F		AA NBB	2500
		P	F8F	F8F		F8F		F8F		F8F			
0.185 - 0.245" 4.70 - 6.23mm	R6J	R	F4F	R4F R4E		R4F R4C		R4E R4C		F3F F3C		SH WW	2500
		F	F6F	R6F		R6F C6C		R6F R6C		F6F F6C			
		P	F8F	F8F		F8F C8C		F8F		F8F F8C			
0.245 - 0.365" 6.23 - 9.27mm	R3HS	R	F3F	R4F R4E		R4F R4C		R4E R4C		F3F F3C		NA NG NEE K1	2500 1700
		F	F6F	R6F		R6F C6C		R6F R6C		F6F F6C			
		P	F8F	F8F		F8F C8C		F8F		F8F F8C			
0.365 - 0.490" 9.27 - 12.45mm	R3HS	R	F3F	R4F R4E		R3E/S R4C		R4C C3C		F3F F3C		NB NL K2 K3	1700 1300
		F	F6F	R6F R6C		R6F C6C		R6C C6C		F6F F6C			
		P	F8F	F8F		F8F C8C		F8F		F8F F8C			
0.490 - 0.615" 12.45 - 15.62mm	R3HS	R	F3F	R4F R4E		R3E/S R4C		R4C C3C		F3F F3C		SD NC K4 K5	1300 1000
		F	F6F	R6F R6C		R6F C6C		R6C C6C		F6F F6C			
		P	F8F	F8F		F8F C8C		F8F		F8F F8C			
0.615 - 0.770" 15.62 - 19.56mm	R3HS	R	F3F	R4F R4E		R3E/S R4C		R4C C3C		F3F F3C		ND GG K6 K7	1000 800
		F	F6F	R6F R6C		R6F C6C		R6C C6C		F6F F6C			
		P	F8F	F8F		F8F C8C		F8F		F8F F8C			
0.770 - 1.020" 19.56 - 25.91mm	R3HS	R	F3F	R4F R4E		R3E/S C3C		R4C C3C		F3F F3C		ND GG K8 K9 K10	800 600
		F	F6F	R6F R6C		R6F C6C		R6C C6C		F6F F6C			
		P	F8F	F8F		F8F C8C		F8F		F8F F8C			
1.00 - 2.00" 25.4 - 50.8mm	R3HS	R	F2F	R4F R4E		R3E/S C3C		R4C C3C		F2F F3C		F1 F2 K11 K12 K13	600 300
		F	F6F	R6F R6C		R6F C6C		R6C C6C		F6F F6C			
		P	F8F	F8F		F8F C8C		F8F		F8F F8C			
2.00 - 3.00" 50.8 - 79.37mm	R3HS	R	F2F	R4F R4E		R3E/S C3C		R4C C3C		F2F F3C		F1 F2 K14 K15	300 200
		F	F6F	R6F R6C		R6F C6C		R6C C6C		F6F F6C			
		P	F8F	F8F		F8F C8C		F8F		F8F F8C			

Operation: R = Roughing F = Finishing P = Polishing

## Speed Range

For polishing operations the spindle speed should be increased by 20% from the speed selected for roughing or finishing.

If specified stone is acting too hard, i.e. glazing and not cutting, the rotational speed should be reduced.

If the specified stone is acting too soft and stone wear is excessive, the rotational speed should be increased.

# Superabrasives (Diamond & CBN Hones)

## Diamond Hones

Diamond honing stones in metallic and resinoid bond have been used successfully for many years.

These hones can be subjected to higher working pressures and surface speeds than conventional abrasives.

The main field of application has been honing tungsten carbide and ceramics where, because of the material hardness, conventional vitrified abrasives are unsuccessful. In certain other areas the use of diamond hones can result in a reduction in honing costs. Examples of applications in these areas are:

1. Cast iron
2. Hardened steels above HRC 63
3. Components having interrupted bores

Three types of bonding materials are used to determine the hardness of the diamond hone.

### M Cobalt Iron Bond

A hard bond used for tungsten carbide with cobalt content above 25%. Also used for cast iron, glass, ceramic, etc.

### MB Bronze Bond

A medium bond used for tungsten carbide with cobalt content 11% - 25% and also used on most heat treated steels above HRC63.

### S4 Resinoid Bond

A soft bond used for tungsten carbide with a cobalt content of >11% and also used for other extremely hard materials.

## CBN "Borazon" Hones

Two types of bonding materials are used to determine the hardness of the CBN hone. The harder stone should be used for interrupted bores, short bores or when the pre-hone finish is poor.

### BR Resinoid Bond

A soft bond used for tough hardened steels including titanium up to HRC63. Also suited to sintered materials such as Alnico and special alloys like Inconel.

Generally used at higher speeds and lower pressure than diamonds or standard abrasives. Always use the lowest pressure that will give a good cutting action.

Increasing the pressure beyond this point will result in increased stone wear with very little increase in stock removal.

### BB Bronze Bond

A medium bond used for components having interrupted bores (cross holes, annular grooves, etc.) or when the surface finish prior to honing is very poor.

Because the bonding material is harder, it can be used at higher pressures than the resinoid stone and can, therefore, be used if satisfactory results cannot be achieved with the "BR" bond.

## Layer Depth

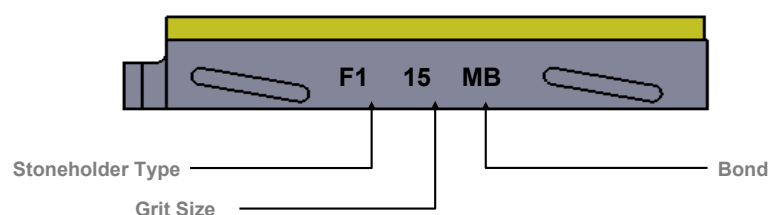
The overall height of the diamond / CBN stone determines the abrasive depth (layer depth). Typically Engis metal bonded (M, MB and BB) hones have a layer depth of 1.5mm (0.060") for hones with a height greater than this. On smaller hones the layer depth will be approximately 90% of the height. Resinoid (S4 and BR) have 100% layer depth.

## Grit Size

Engis diamond and CBN honing stones are available as standard in grit sizes from 100 - 600 and for ease of identification the following coding is used:

Engis Code	10	15	22	32	40	60
Grit Size	100	150	220	320	400	600

The grit sizes shown above are the most common in use. Other grit sizes are available to order. Contact Engis for details.





# Honing Oil

It is essential that the correct type of properly filtered honing fluid is used if the optimum cutting conditions in any given material are to be achieved.

The functions of the honing fluid are:

- to provide a lubricating film between the mandrel and bore surfaces
- to keep the surface of the stone clean and open
- to carry away the used abrasive grits and material swarf and cuttings
- to reduce and dissipate the heat generated in the honing stone and component

In conjunction with our strategic partnerships, Engis can draw upon more than 100 years in collective experience to work to exceed customer expectations. During the continuing improvement process we focus on a number of key factors to ensure the highest quality of oils are supplied at all times:

- Surface finish
- Operator health & safety
- Oil longevity
- Environmental impact
- Lubricity
- Reduced tool wear



## Engis MP-1000

Engis MP-1000 honing oil is formulated for use on standard applications that require high tolerances. Engis MP-1000 is light in color to improve work piece visibility and improve consistency on smaller components such as cylinders, gears, control bushes and injection pumps

In order to supply optimum oil we included two key additives:

- low misting additives to improve the health and safety standards for the operators using Engis MP-1000 oil
- anti-wear technology is included to reduce tool wear and improved tool life

Engis MP-1000 also features better lubricity than lower viscosity oils which only have a flushing action. This improved lubricity provides reduced tool wear, better surface finishes and consistency for your components. Engis MP-1000 is the ideal honing oil for all materials.



## Engis SP-2240

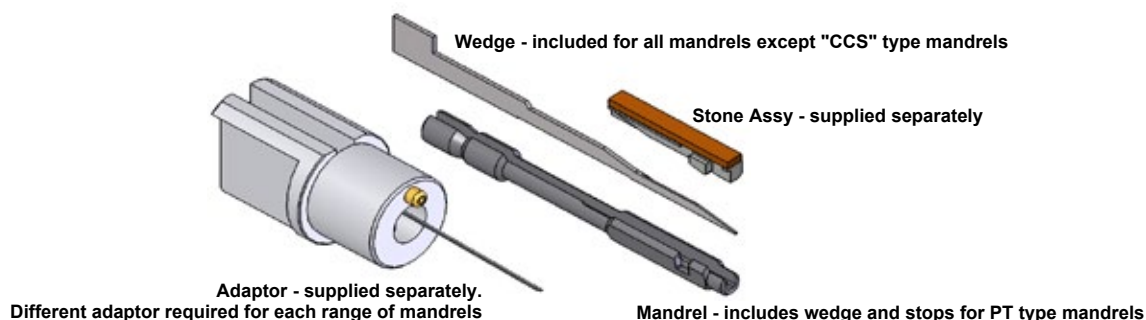
Engis SP-2240 is a general purpose sulphurized honing oil ideal for heavy duty and large diameter applications on a wide variety of materials. The special formation of the SP-2240 oil provides maximum lubrication to prevent galling between the workpiece and the tool. The SP-2240 oil also helps to reduce tool wear and improve abrasive life.

# The Honing Assembly/Using This Catalog

## The Honing Assembly

A honing assembly consists of adaptor(s), wedge, mandrel, stone and truing sleeve – details of which are listed in the mandrel selection charts (see pages 10 - 20).

For larger “permanent” type mandrels, shoes are also required in either brass or cast iron (see pages 15 - 18).



CCS Mandrels - additional "Collet Adaptor" required

PT Mandrels - supplied with brass shoes, cast iron on request.

## Which Mandrel?

Each page in this catalog lists all available mandrels for a particular honing diameter. Mandrels are available in various designs / materials (see page 9). All mandrels above diameter 3.05mm can also be modified for “Blind Hole” bores (see pages 18 and 25).

The smallest Ø represents the smallest bore the tool can enter

The largest Ø represents the maximum diameter that can be honed with a worn stone

Short Series		NA / NG	
Mandrel length A		80mm (3.15")	
Stone length B		31.7mm (1.25")	

Long Series		NEE	
Mandrel length A		118mm (4.64")	
Stone length B		57.1mm (2.25")	

Diameter Range		Mandrel (includes Wedge)			Mandrel (includes Wedge)		Truing Sleeve
		Soft	Hard	Brass	Hard	Brass	
6.22-6.60	0.245-0.260	SS245/3NA	HS245/3NA	B245/3NA	HS245/4NEE	B245/4NEE	ST245
6.60-6.99	0.260-0.275	SS260/3NA	HS260/3NA	B260/3NA	HS260/4NEE	B260/4NEE	ST260
6.99-7.37	0.275-0.290	CC275/3NA	UC275/3NA	B275/3NA	UC275/4NEE	B275/4NEE	ST275

Available types of mandrels

Truing Sleeve

Where there is a choice of mandrels available for a specific diameter, follow the following guidelines:

1. Always use the shortest mandrel commensurate with the bore length to be honed.
2. For bores that require straightness or correction of bend, use mandrels with the longest stone length.
3. When honing bores containing annular grooves, cross holes, cut outs, etc., use keyway type mandrels. The extra stone width reduces the tendency for the stone to cut faster around these areas.

As well as the mandrel, you will require a truing sleeve, stone set and adaptor: eg. diameter 6.7mm honed bore:

**Order - HS260/3NA Mandrel, ST260 Truing Sleeve with a MA156/3 Adaptor**

Adaptor	Stone Type	Replacement Wedge
MA156/3	NA / NG	10911
MA156/45	NEE	10912

Adaptor

Wedge Lift Angle	10°
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Stone reference is shown for each mandrel (see page 4 for list of grades). Always true in each new stone before use.

This operation takes only a few minutes but can save time and money, especially in production honing (see page 25).

Certain mandrels can be extended in length for special applications such as extrusion and shotgun barrels (see page 22).

# Mandrel Design and Selection

Standard mandrels listed in this catalog cover the diameter range 0.045 - 3.125" (1.14 – 79.4mm).

The mandrel design incorporates a single stone slot to locate the honing stone and the expansion wedge to provide movement of the honing stone. Unless otherwise stated, all mandrels are supplied with an expansion wedge for open hole work and, unless otherwise stated, can be modified for blind hole work (see pages 18 & 25).

## **CCS Type – Range Ø0.045-0.120" (1.14 - 3.05mm)**

A tubular mandrel designed for use with the 1651 collet adaptor. The entire mandrel body is hard chrome plated for increased life. These mandrels are NOT supplied with wedges and these must be ordered separately. CCS mandrels are NOT suitable for blind hole work. *Note: only "superabrasives" can be used on CCS type mandrels.*

## **HS Type – Range Ø0.120-1.02" (3.05 – 25.91mm)**

A range of hardened steel mandrels, available in a choice of short and long series working lengths, for general honing use and essential for honing abrasive and hard materials. Mandrels up to Ø6.22mm have a fully circular workhead. Above this diameter the unique three point workhead design eliminates chatter and ensures rapid correction in errors of roundness.

## **SS Type – Range Ø0.245-0.615" (6.22 – 15.62mm)**

A range of soft steel mandrels incorporating the same design features as the HS type. These mandrels are used for honing pick-up prone materials and are particularly suitable for super finishing of most materials.

## **B Type – Range Ø0.120-0.615" (3.05 – 15.62mm)**

A range of bronze mandrels incorporating the same design features as the HS type. These mandrels are used for honing pick-up prone materials and are particularly suitable for super finishing of most materials.

## **PT Type – Range Ø0.615-3.125" (15.62 – 79.4mm)**

A range of mandrels incorporating the unique three point workhead design and consisting of a permanent mandrel body fitted with a replaceable guide shoe. When the shoe is worn out it is simply removed and a new shoe fitted. Used for similar applications to the B type and for all holes above Ø1" (25.4mm). Available in short, long and extra long series. If mandrels above Ø1" (25.4mm) are required for blind hole work, this must be stated at the time of ordering.

## **HSK Type – Range Ø0.245-1.02" (6.22 – 25.91mm)**

A range of hardened steel mandrels designed specifically for honing bores containing standard ISO keyway slots. Based on the HS type design but with two or more abrasive sticks mounted side by side on the stone holder giving an overall stone width of approximately twice that of the keyway. These mandrels are available in short series working length only and are NOT suitable for blind hole work.

## **PTK Type – Range Ø0.615-2.625" (15.62 – 66.68mm)**

A range of permanent type mandrel bodies incorporating the same design features as the HSK type, and fitted with replaceable cast iron shoes that must be machined to the specific diameter to be honed. These mandrels are available in short, long and extra long series working lengths and are NOT suitable for blind hole work.

## Special Mandrels

In addition to the mandrels listed in this catalog you can order mandrels to suit your specific application based on the standard mandrels, i.e. extended, diamond or chrome coated.

Please contact Engis with your requirements. See page 22 for further details.

### Please Note

Always use the shortest mandrel commensurate with the bore length to be honed.

When honing long bores which require straightness or correction of curvature, use the mandrel with the longest stone length.

In certain instances keyway mandrels have proved superior to standard types on bores having annular grooves, cross holes, cutouts, etc. in that the extra width reduces the tendency for the stone to cut faster around these areas.

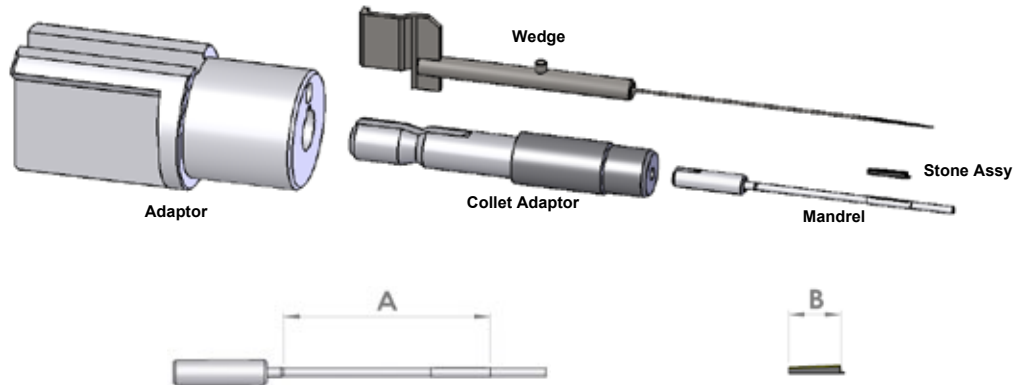
**REMEMBER - ALWAYS TRUE IN EACH NEW STONE BEFORE USE**

# Collet Type Mandrels (CCS)

J0 - J6

Diameter Range 0.045 - 0.120" (1.14 - 3.05mm)

Truing sleeve not shown



Short Series	Mandrel Length A	Stone Length B
CCS045 - CCS055	1.10" (28mm)	0.437" (11mm)
CCS060 - CCS090	1.57" (40mm)	0.437" (11mm)
CCS095 - CCS115	2.08" (53mm)	0.5" (12.7mm)

Diameter Range		Mandrel (excludes Wedge)	Truing Sleeve	Stone Type	Wedge
Inch	mm				
0.045-0.050	1.14-1.27	CCS045/J0	ST045	J0	10901
0.050-0.055	1.27-1.40	CCS050/J0	ST050	J0	
0.055-0.060	1.40-1.52	CCS055/J0	ST055	J0	
0.060-0.065	1.52-1.65	CCS060/J1	ST060	J1	
0.065-0.070	1.65-1.78	CCS065/J1	ST065	J1	
0.070-0.075	1.78-1.90	CCS070/J2	ST070	J2	
0.075-0.080	1.90-2.03	CCS075/J3	ST075	J3	
0.080-0.085	2.03-2.16	CCS080/J2	ST080	J2	10902
0.085-0.090	2.16-2.28	CCS085/J2	ST085	J2	
0.090-0.095	2.28-2.41	CCS090/J3	ST090	J3	
0.095-0.100	2.41-2.54	CCS095/J4	ST095	J4	10903
0.100-0.105	2.54-2.67	CCS100/J5	ST100	J5	
0.105-0.110	2.67-2.79	CCS105/J4	ST105	J4	10904
0.110-0.115	2.79-2.92	CCS110/J5	ST110	J5	
0.115-0.120	2.92-3.05	CCS115/J6	ST115	J6	
Collet Adaptor		1651			
Adaptor		MA156/4A			

Wedge Lift Angle	2.5°
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**Stone Selection - see page 4 for full range of abrasive types available.**  
**Note: only "superabrasives" can be used on CCS type mandrels.**

Where there is a choice of mandrels available for a specific diameter, follow the following guidelines:

1. Always use the shortest mandrel commensurate with the bore length to be honed.
2. For bores that require straightness or correction of bend use mandrels with the longest stone length.

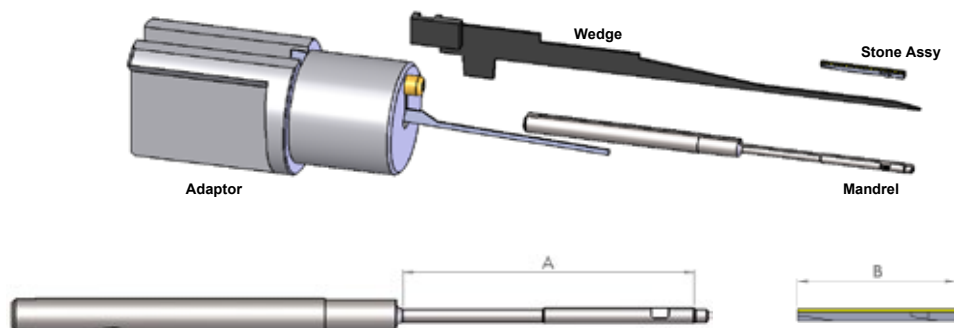
**REMEMBER - ALWAYS TRUE IN EACH NEW STONE BEFORE USE**

# Hard Steel & Brass Mandrels (HS & B)

**Y Z AA NBB**

Diameter Range 0.045 - 0.120" (1.14 - 3.05mm)

Truing sleeve not shown



Short Series	Y	AA	Long Series	Z	NBB
Mandrel length A	1.5" (38mm)	1.65" (42mm)	Mandrel length A	1.97" (50mm)	2.16" (55mm)
Stone length B	0.56" (14.5mm)	0.69" (17.5mm)	Stone length B	1.0" (25.4mm)	1.25" (31.7mm)

Diameter Range	
Inch	mm
0.120-0.125	3.05-3.17
0.125-0.130	3.17-3.30
0.130-0.135	3.30-3.43
0.135-0.140	3.43-3.56
0.140-0.145	3.56-3.68
0.145-0.150	3.68-3.81
Adaptor	
Stone Type	
Replacement Wedge	

Mandrel (includes Wedge)	
Hard	Brass
HS120/Y	B120/Y
HS125/Y	B125/Y
HS130/Y	B130/Y
HS135/Y	B135/Y
HS140/Y	B140/Y
HS145/Y	B145/Y
MA156/22	
Y	
10905	

Mandrel (includes Wedge)		Truing Sleeve
Hard	Brass	
HS120/Z	B120/Z	ST120
HS125/Z	B125/Z	ST125
HS130/Z	B130/Z	ST130
HS135/Z	B135/Z	ST135
HS140/Z	B140/Z	ST140
HS145/Z	B145/Z	ST145
MA156/22		
Z		
10906		

Diameter Range	
Inch	mm
0.150-0.155	3.81-3.94
0.155-0.160	3.94-4.06
0.160-0.165	4.06-4.19
0.165-0.170	4.19-4.32
0.170-0.175	4.32-4.45
0.175-0.180	4.45-4.57
0.180-0.185	4.57-4.70
Adaptor	
Stone Type	
Replacement Wedge	

Mandrel (includes Wedge)	
Hard	Brass
HS150/AA	B150/AA
HS155/AA	B155/AA
HS160/AA	B160/AA
HS165/AA	B165/AA
HS170/AA	B170/AA
HS175/AA	B175/AA
HS180/AA	B180/AA
MA156/22	
AA	
10907	

Mandrel (includes Wedge)		Truing Sleeve
Hard	Brass	
HS150/NBB	B150/NBB	ST150
HS155/NBB	B155/NBB	ST155
HS160/NBB	B160/NBB	ST160
HS165/NBB	B165/NBB	ST165
HS170/NBB	B170/NBB	ST170
HS175/NBB	B175/NBB	ST175
HS180/NBB	B180/NBB	ST180
MA156/22		
NBB		
10908		

Wedge Lift Angle
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18°
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10°
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Stone Selection - see page 4 for full range of abrasive types available.

Where there is a choice of mandrels available for a specific diameter, follow the following guidelines:

1. Always use the shortest mandrel commensurate with the bore length to be honed.
2. For bores that require straightness or correction of bend use mandrels with the longest stone length.

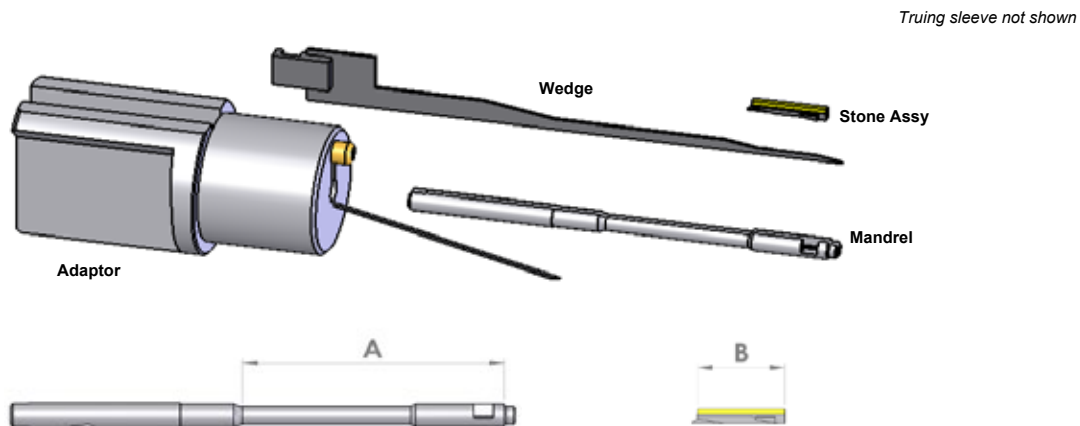
**REMEMBER - ALWAYS TRUE IN EACH NEW STONE BEFORE USE**



# Hard Steel and Brass Mandrels (HS & B)

**SH WW**

Diameter Range 0.185 - 0.245" (4.70 - 6.22mm)



Short Series	SH
Mandrel length A	2.08" (53mm)
Stone length B	0.75" (19mm)

Long Series	WW
Mandrel length A	3.23" (82mm)
Stone length B	1.37" (35mm)

Diameter Range		Mandrel (includes Wedge)		Mandrel (includes Wedge)		Truing Sleeve
Inch	mm	Soft	Hard	Hard	Brass	
0.185-0.190	4.70-4.83	HS185/2SH	B185/2SH	HS185/WW	B185/WW	ST185
0.190-0.195	4.83-4.95	HS190/2SH	B190/2SH	HS190/WW	B190/WW	ST190
0.195-0.200	4.95-5.08	HS195/2SH	B195/2SH	HS195/WW	B195/WW	ST195
0.200-0.205	5.08-5.21	HS200/2SH	B200/2SH	HS200/WW	B200/WW	ST200
0.205-0.210	5.21-5.33	HS205/2SH	B205/2SH	HS205/WW	B205/WW	ST205
0.210-0.215	5.33-5.46	HS210/2SH	B210/2SH	HS210/WW	B210/WW	ST210
0.215-0.220	5.46-5.59	HS215/2SH	B215/2SH	HS215/WW	B215/WW	ST215
0.220-0.225	5.59-5.72	HS220/2SH	B220/2SH	HS220/WW	B220/WW	ST220
0.225-0.230	5.72-5.84	HS225/2SH	B225/2SH	HS225/WW	B225/WW	ST225
0.230-0.235	5.84-5.97	HS230/2SH	B230/2SH	HS230/WW	B230/WW	ST230
0.235-0.240	5.97-6.10	HS235/2SH	B235/2SH	HS235/WW	B235/WW	ST235
0.240-0.245	6.10-6.22	HS240/2SH	B240/2SH	HS240/WW	B240/WW	ST240
Adaptor		MA156/1		MA156/36		
Stone Type		SH		WW		
Replacement Wedge		10909		10910		

Wedge Lift Angle	10°
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**Stone Selection - see page 4 for full range of abrasive types available.**

Where there is a choice of mandrels available for a specific diameter, follow the following guidelines:

1. Always use the shortest mandrel commensurate with the bore length to be honed.
2. For bores that require straightness or correction of bend use mandrels with the longest stone length.

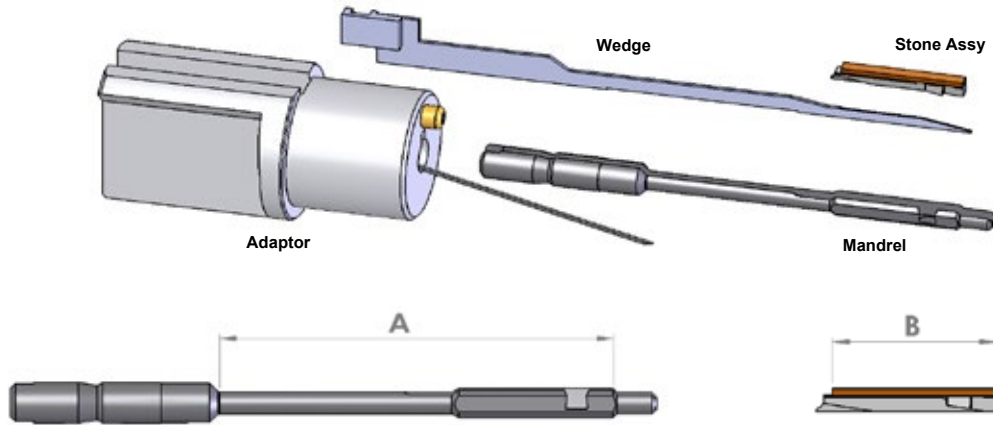
**REMEMBER - ALWAYS TRUE IN EACH NEW STONE BEFORE USE**

# Soft, Hard Steel and Brass Mandrels (SS, HS & B)

**NA NG NEE**

Diameter Range 0.245 - 0.365" (6.22 - 9.27mm)

*Truing sleeve not shown*



Short Series	NA / NG
Mandrel length A	3.15" (80mm)
Stone length B	1.25" (31.7mm)

Long Series	NEE
Mandrel length A	4.64" (118mm)
Stone length B	2.25" (57.1mm)

Diameter Range		Mandrel (includes Wedge)			Mandrel (includes Wedge)		Truing Sleeve
Inch	mm	Soft	Hard	Brass	Hard	Brass	
0.245-0.260	6.22-6.60	SS245/3NA	HS245/3NA	B245/3NA	HS245/4NEE	B245/4NEE	ST245
0.260-0.275	6.60-6.99	SS260/3NA	HS260/3NA	B260/3NA	HS260/4NEE	B260/4NEE	ST260
0.275-0.290	6.99-7.37	SS275/3NA	HS275/3NA	B275/3NA	HS275/4NEE	B275/4NEE	ST275
0.290-0.305	7.37-7.75	SS290/3NA	HS290/3NA	B290/3NA	HS290/4NEE	B290/4NEE	ST290
0.305-0.320	7.75-8.13	SS305/3NG	HS305/3NG	B305/3NG	HS305/4NEE	B305/4NEE	ST305
0.311-0.331	7.90-8.40		HS310/3NG				ST310
0.320-0.335	8.13-8.51	SS320/3NG	HS320/3NG	B320/3NG	HS320/4NEE	B320/4NEE	ST320
0.335-0.350	8.51-8.89	SS335/3NG	HS335/3NG	B335/3NG	HS335/4NEE	B335/4NEE	ST335
0.350-0.365	8.89-9.27	SS350/3NG	HS350/3NG	B350/3NG	HS350/4NEE	B350/4NEE	ST350
Adaptor		MA156/3			MA156/45		
Stone Type		NA / NG			NEE		
Replacement Wedge		10911			10912		

Wedge Lift Angle	10°
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**Stone Selection - see page 4 for full range of abrasive types available.**

Where there is a choice of mandrels available for a specific diameter, follow the following guidelines:

1. Always use the shortest mandrel commensurate with the bore length to be honed.
2. For bores that require straightness or correction of bend use mandrels with the longest stone length.

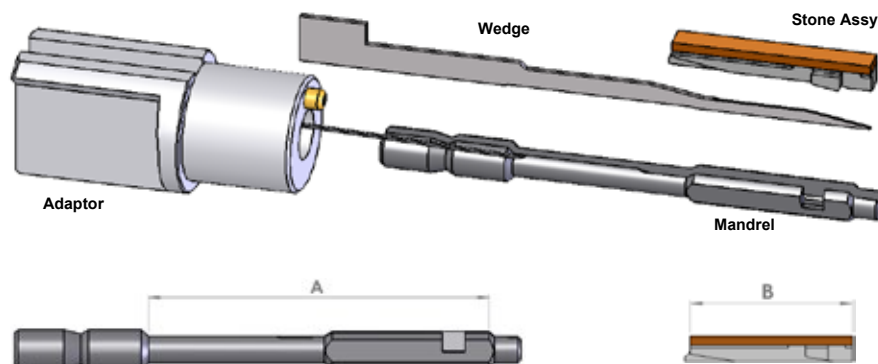
**REMEMBER - ALWAYS TRUE IN EACH NEW STONE BEFORE USE**

# Soft, Hard Steel and Brass Mandrels (SS, HS & B)

**NB NL SD NC**

Diameter Range 0.365 - 0.615" (9.27 - 15.62mm)

Truing sleeve not shown



Short Series	NB	SD
Mandrel length A	3.66" (93mm)	4.33" (110mm)
Stone length B	1.75" (44.4mm)	2.25" (57.1mm)

Long Series	NL	NC
Mandrel length A	6.22" (158mm)	6.30" (160mm)
Stone length B	3.25" (82.5mm)	3.37" (85.7mm)

Diameter Range	
Inch	mm
0.365-0.380	9.27-9.65
0.380-0.395	9.65-10.03
0.390-0.413	9.90-10.50
0.395-0.410	10.03-10.41
0.410-0.425	10.41-10.80
0.425-0.440	10.80-11.18
0.440-0.460	11.18-11.68
0.460-0.490	11.68-12.45
0.468-0.492	11.90-12.50
Adaptor	
Stone Type	
Replacement Wedge	

Mandrel (includes Wedge)		
Soft	Hard	Brass
SS365/3NB	HS365/3NB	B365/3NB
SS380/3NB	HS380/3NB	B380/3NB
	HS390/3NB	
SS395/3NB	HS395/3NB	B395/3NB
SS410/3NB	HS410/3NB	B410/3NB
SS425/3NB	HS425/3NB	B425/3NB
SS440/3NB	HS440/3NB	B440/3NB
SS460/3NB	HS460/3NB	B460/3NB
	HS468/3NB	
MA156/4		
NB		
10913		

Mandrel (includes Wedge)		Truing Sleeve
Hard	Brass	
HS365/6NL	B365/6NL	ST 365
HS380/6NL	B380/6NL	ST 380
		ST 390
HS395/6NL	B395/6NL	ST 395
HS410/6NL	B410/6NL	ST 410
HS425/6NL	B425/6NL	ST 425
HS440/6NL	B440/6NL	ST 440
HS460/6NL	B460/6NL	ST 460
		ST 468
MA156/28		
NL		
10914		

Diameter Range	
Inch	mm
0.490-0.520	12.45-13.21
0.520-0.550	13.21-13.97
0.543-0.571	13.80-14.50
0.550-0.580	13.97-14.73
0.580-0.615	14.73-15.62
Adaptor	
Stone Type	
Replacement Wedge	

Mandrel (includes Wedge)		
Soft	Hard	Brass
SS490/4SD	HS490/4SD	B490/4SD
SS520/4SD	HS520/4SD	B520/4SD
	HS543/4SD	
SS550/4SD	HS550/4SD	B550/4SD
SS580/4SD	HS580/4SD	B580/4SD
MA156/5		
SD		
10915		

Mandrel (includes Wedge)		Truing Sleeve
Hard	Brass	
HS490/6NC	B490/6NC	ST 490
HS520/6NC	B520/6NC	ST 520
		ST 543
HS550/6NC	B550/6NC	ST 550
HS580/6NC	B580/6NC	ST 580
MA156/29		
NC		
10916		

Wedge Lift Angle	10°
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**Stone Selection - see page 4 for full range of abrasive types available.**

Where there is a choice of mandrels available for a specific diameter, follow the following guidelines:

1. Always use the shortest mandrel commensurate with the bore length to be honed.
2. For bores that require straightness or correction of bend use mandrels with the longest stone length.

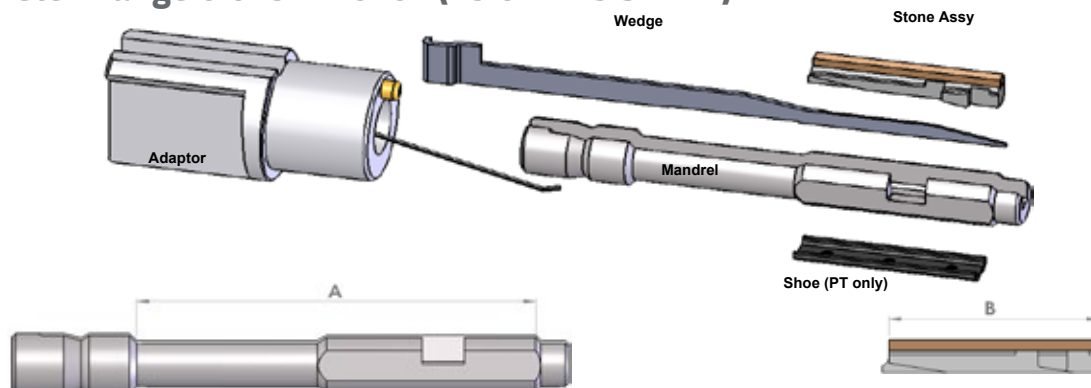
**REMEMBER - ALWAYS TRUE IN EACH NEW STONE BEFORE USE**

# Hard Steel and Permanent Mandrels (HS & PT)

**ND GG**

*Truing sleeve not shown*

**Diameter Range 0.615 - 1.020" (15.62 - 25.91mm)**



Short Series	ND	Long Series	GG
Mandrel length A	4.21" (107mm)	Mandrel length A	9.33" (237mm)
Stone length B	2.25" (57.1mm)	Stone length B	4.50" (114.3mm)

Diameter Range		Mandrel (includes Wedge)		Truing Sleeve	Mandrel (includes Wedge)		Truing Sleeve	Shoe (PT only)	
Inch	mm	Hard	Permanent		Hard	Permanent		Brass	Cast Iron
0.615-0.645	15.62-16.38	HS615/4ND	PT615/4ND	ST 615	HS615/8GG	PT615/8GG	STL 615	L1057B (2-off each for GG mandrels)	L1057C (2-off each for GG mandrels)
0.622-0.650	15.80-16.50	HS622/4ND		ST 622					
0.645-0.675	16.38-17.15	HS645/4ND	PT645/4ND	ST 645	HS645/8GG	PT645/8GG	STL 645		
0.675-0.705	17.15-17.91	HS675/4ND	PT675/4ND	ST 675	HS675/8GG	PT675/8GG	STL 675		
0.705-0.740	17.91-18.80	HS705/4ND	PT705/4ND	ST 705	HS705/8GG	PT705/8GG	STL 705		
0.740-0.770	18.80-19.56	HS740/4ND	PT740/4ND	ST 740	HS740/8GG	PT740/8GG	STL 740		
Adaptor		MA156/6			MA156/50				
Stone Type		ND			GG				
Replacement Wedge		10915			10917				

Diameter Range		Mandrel (includes Wedge)		Truing Sleeve	Mandrel (includes Wedge)		Truing Sleeve	Shoe (PT only)	
Inch	mm	Hard	Permanent		Hard	Permanent		Brass	Cast Iron
0.770-0.800	19.56-20.32	HS770/4ND	PT770/4ND	ST 770	HS770/8GG	PT770/8GG	STL 770	L1058B (2-off each for GG mandrels)	L1058C (2-off each for GG mandrels)
0.800-0.830	20.32-21.08	HS800/4ND	PT800/4ND	ST 800	HS800/8GG	PT800/8GG	STL 800		
0.830-0.865	21.08-21.97	HS830/4ND	PT830/4ND	ST 830	HS830/8GG	PT830/8GG	STL 830		
0.865-0.895	21.97-22.73	HS865/4ND	PT865/4ND	ST 865	HS865/8GG	PT865/8GG	STL 865		
0.895-0.925	22.73-23.49	HS895/4ND	PT895/4ND	ST 895	HS895/8GG	PT895/8GG	STL 895		
0.925-0.955	23.49-24.25	HS925/4ND	PT925/4ND	ST 925	HS925/8GG	PT925/8GG	STL 925		
0.955-0.990	24.25-25.14	HS955/4ND	PT955/4ND	ST 955	HS955/8GG	PT955/8GG	STL 955		
0.976-1.004	24.80-25.50	HS976/4ND		ST 976					
0.990-1.020	25.14-25.91	HS990/4ND	PT990/4ND	ST 990	HS990/8GG	PT990/8GG	STL 990		
Adaptor		MA156/18			MA156/51				
Stone Type		ND			GG				
Replacement Wedge		10915			10917				
Wedge Lift Angle		10°			9°				

**Stone Selection - see page 4 for full range of abrasive types available.**

Where there is a choice of mandrels available for a specific diameter, follow the following guidelines:

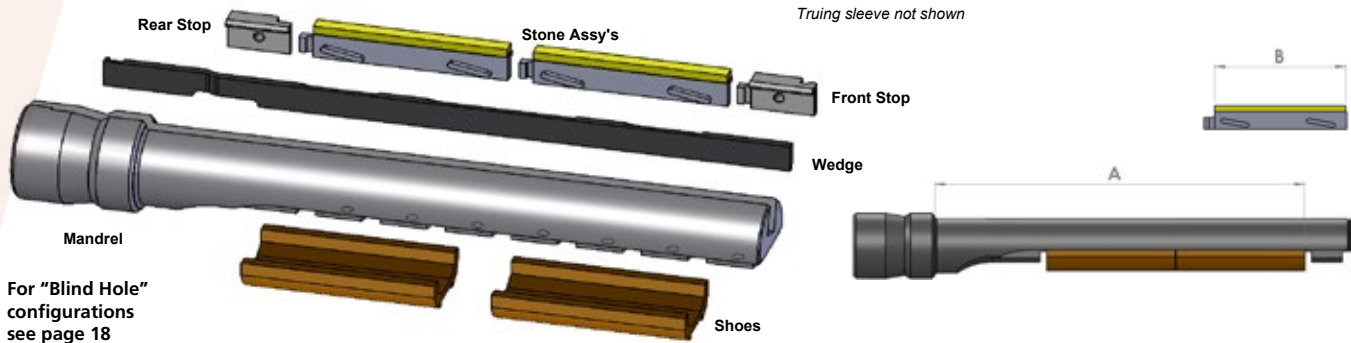
1. Always use the shortest mandrel commensurate with the bore length to be honed.
2. For bores that require straightness or correction of bend use mandrels with the longest stone length.

**REMEMBER - ALWAYS TRUE IN EACH NEW STONE BEFORE USE**

# Permanent Type Mandrels (PT)

**F1 / F2**  
Open / Blind Hole

Diameter Range 1.000 - 2.625" (25.4 - 66.68mm)



		Open Hole	
Mandrel Type	Series	Length A	Stone B
Short (1 stone)	PT1000/6 - PT2500/6	5.98" (152mm)	1 x 3.25" (82.5mm)
Long (2 stones)	PT1000/9 - PT2500/9	9.33" (237mm)	2 x 3.25" (82.5mm)
Extra Long (3 stones)	PT1000/12 - PT2500/12	12.68" (322mm)	3 x 3.25" (82.5mm)

Range		Short Series	Long Series	Extra Long Series	Truing Sleeves	Shoes	
Inch	mm					Brass	Cast Iron
1.000-1.125	25.40-28.57	PT1000/6	PT1000/9	PT1000/12	ST1000	L1059B	L1070C
1.125-1.250	28.57-31.75	PT1125/6	PT1125/9	PT1125/12	ST1125	L1060B	L1071C
1.250-1.375	31.75-34.93	PT1250/6	PT1250/9	PT1250/12	ST1250	L1061B	L1072C
1.375-1.500	34.93-38.10	PT1375/6	PT1375/9	PT1375/12	ST1375	L1062B	L1073C
1.500-1.625	38.10-41.28	PT1500/6	PT1500/9	PT1500/12	ST1500	L1063B	L1074C
1.625-1.750	41.28-44.45	PT1625/6	PT1625/9	PT1625/12	ST1625	L1064B	1075C
1.750-1.875	44.45-47.63	PT1750/6	PT1750/9	PT1750/12	ST1750		
Stone Type for Open Hole		F1	F1	F1			
Open Hole Replacement Wedge		10931	10935	10939			
Stone Type for Blind Hole		F2	F2	F2			
Blind Hole Replacement Wedge		10932	10936	10940			

Range		Short Series	Long Series	Extra Long Series	Truing Sleeves	Shoes	
Inch	mm					Brass	Cast Iron
1.875-2.000	47.63-50.80	PT1875/6	PT1875/9	PT1875/12	ST1875	L1065B	L1076C
2.000-2.125	50.80-53.98	PT2000/6	PT2000/9	PT2000/12	ST2000		
2.125-2.250	53.98-57.15	PT2125/6	PT2125/9	PT2125/12	ST2125		
2.250-2.375	57.15-60.33	PT2250/6	PT2250/9	PT2250/12	ST2250	L1066B	L1077C
2.375-2.500	60.33-63.50	PT2375/6	PT2375/9	PT2375/12	ST2375		
2.500-2.625	63.50-66.68	PT2500/6	PT2500/9	PT2500/12	ST2500		
Stone Type for Open Hole		F1	F1	F1			
Open Hole Replacement Wedge		10933	10937	10941			
Stone Type for Blind Hole		F2	F2	F2			
Blind Hole Replacement Wedge		10934	10938	10942			
Wedge Lift Angle		F1 = 11°		F2 = 22°			

IMPORTANT: Cast iron shoes must be machined to the same diameter as the bore to be honed before use.

Stone Selection - see page 4 for full range of abrasive types available. PT—/12 mandrels are supplied to order only.

Where there is a choice of mandrels available for a specific diameter, follow the following guidelines:

1. Always use the shortest mandrel commensurate with the bore length to be honed.
2. For bores that require straightness or correction of bend use mandrels with the longest stone length.

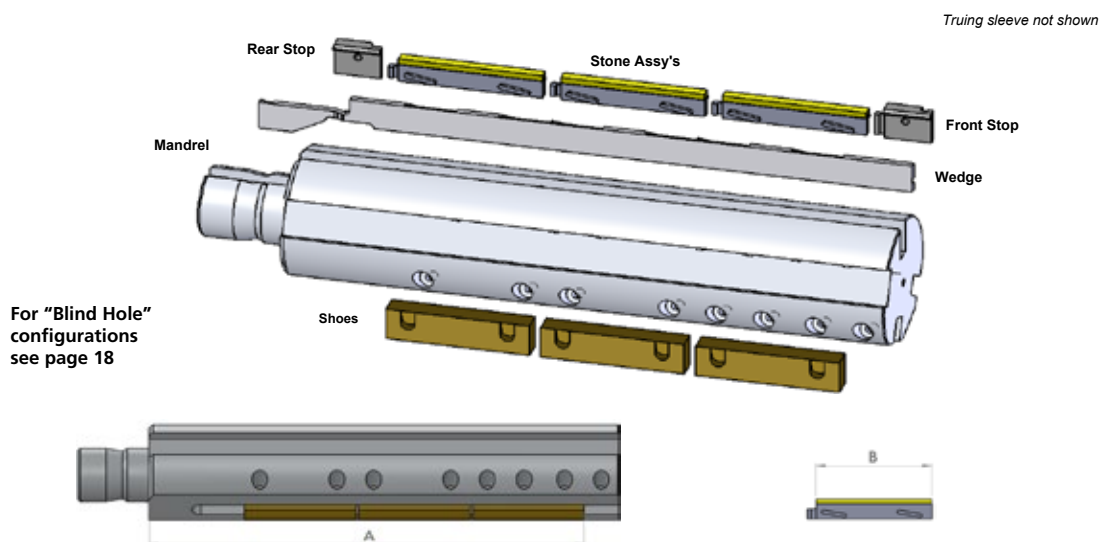
**REMEMBER - ALWAYS TRUE IN EACH NEW STONE BEFORE USE**



# Permanent Type Mandrels (PT)

Diameter Range 2.625 - 3.125" (66.68 - 79.37mm)

**F1 / F2**  
Open / Blind Hole



		Open Hole					
Mandrel Type		Series	Length A	Stone B			
Extra Long (3 stones)		PT2625/12 - PT3000/12	12.68" (322mm)	3 x 3.25" (82.5mm)			
Range		Mandrel (includes Wedge)	Truing Sleeves	Shoes			
Inch	mm			Brass	Cast Iron		
2.625-2.750	66.68-69.85			PT2625/12	ST2625	1705101	MT55630
2.750-2.875	69.85-73.03			PT2750/12	ST2750		
2.875-3.000	73.03-76.20			PT2875/12	ST2875		
3.000-3.125	76.20-79.37	PT3000/12	ST3000				
Stone Type for Open Hole		F1					
Open Hole Replacement Wedge		10943					
Stone Type for Blind Hole		F2					
Blind Hole Replacement Wedge		10944					
Wedge Lift Angle		F1 = 11°		F2 = 22°			

**Stone Selection - see page 4 for full range of abrasive types available.**  
PT—/12 mandrels are supplied to order only.

**IMPORTANT:**  
Shoes must be machined to the same diameter as the bore to be honed before use.

Where there is a choice of mandrels available for a specific diameter, follow the following guidelines:

1. Always use the shortest mandrel commensurate with the bore length to be honed.
2. For bores that require straightness or correction of bend use mandrels with the longest stone length.

**REMEMBER - ALWAYS TRUE IN EACH NEW STONE BEFORE USE**

# Permanent Type Mandrels (PT)

Diameter Range 1.000 - 3.125" (25.4 - 79.37mm)

**F2**  
Open / Blind Hole

Mandrel Type	Series	Blind Hole	
		Length A	Stone B
Short (1 stone)	PT1000/6 - PT2500/6	7.09" (180mm)	3.25" (82.5mm)
Long (1 stone)	PT1000/9 - PT2500/9	10.44" (265mm)	3.25" (82.5mm)
Extra Long (2 stones)	PT1000/12 - PT3000/12	13.79" (350mm)	7.56" (192mm)

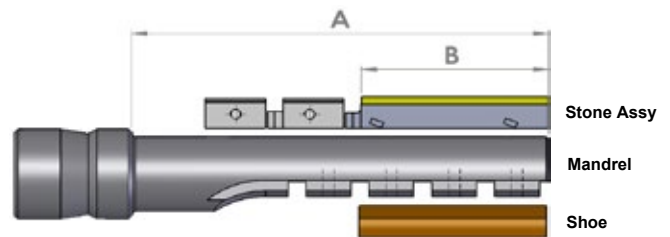
for "Open Hole" configuration  
see pages 16/17

This range of mandrels can be converted for blind hole use as follows:

## PT /6 Series

Change the expansion wedge and stoneholder type and reposition the replaceable shoe, front and rear stops.

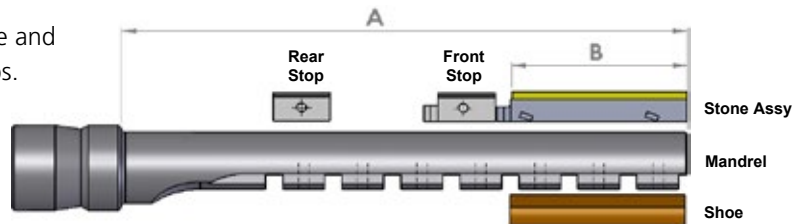
1. Use F2 type stoneholders instead of F1.
2. Move guide shoe forward flush with the end of the mandrel.
3. Move front stop from the first hole to the second hole in the mandrel body.
4. Move the rear stop to last hole in the mandrel body.



## PT /9 Series

Change the expansion wedge and stoneholder type and reposition the replaceable shoe, front and rear stops.

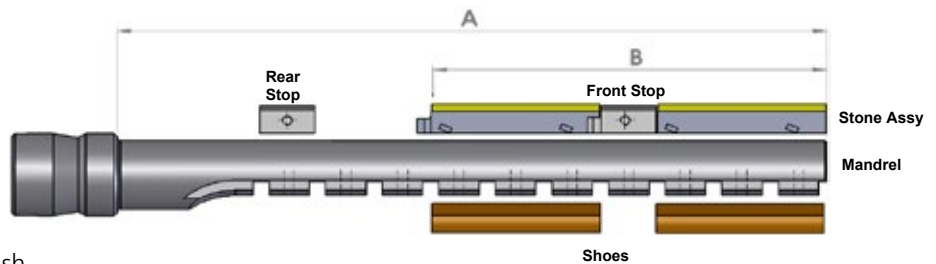
1. Use F2 type stoneholders instead of F1.
2. Move first guide shoe forward flush with the end of the mandrel.
3. Remove the second guide shoe.
4. Move front stop from the first hole to the second hole in the mandrel body.
5. Move the rear stop to last hole in the mandrel body.



## PT /12 Series

Change the expansion wedge and stoneholder type and by repositioning the replaceable shoe and front and rear stops.

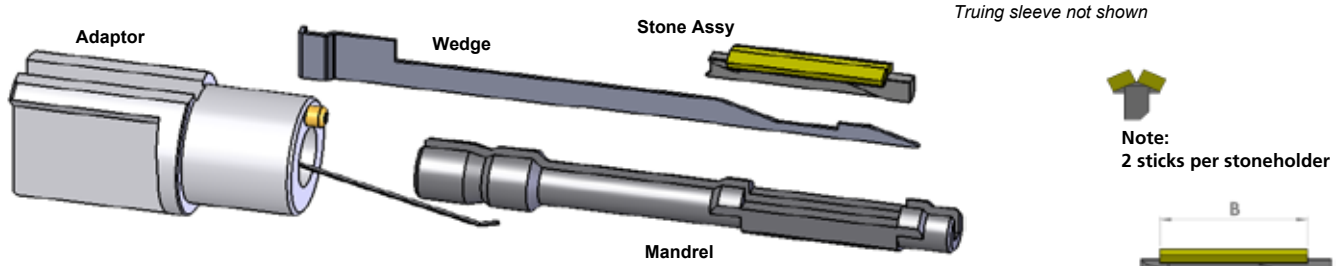
1. Use F2 type stoneholders instead of F1.
2. Move first guide shoe forwards flush with the end of the mandrel.
3. If one stone only is being used, remove the remaining guide shoes, but if two stones are being used, remove the last guide shoe only.
4. Move front stop from the first hole to the second hole in the mandrel body.
5. Move the rear stop to last hole in the mandrel body.



# Hard Steel Keyway Mandrels (HSK)

**K1 - K10**

Diameter Range 0.245 - 1.020" (6.22 - 25.91mm)



Mandrel Type	Length A	Stone B
HSK245/3 - HSK355/3	2.95" (75mm)	.875" (22.2mm)
HSK365/3 - HSK460/3	3.42" (87mm)	1.25" (31.7mm)
HSK490/4 - HSK990/4	3.97" (101mm)	1.75" (44.4mm)



Range		Short Series	Truing Sleeves	Stone Type	Replacement Wedge	Adaptor	ISO Keyway
Inch	mm						
0.245-0.260	6.22-6.60	HSK245/3K1	ST245	K1	10919	MA156/3	0.125" (3.18mm)
0.260-0.275	6.60-6.99	HSK260/3K1	ST260				
0.275-0.290	6.99-7.37	HSK275/3K1	ST275				
0.290-0.305	7.37-7.75	HSK290/3K1	ST290				
0.305-0.325	7.75-8.26	HSK305/3K1	ST305				
0.325-0.335	8.26-8.51	HSK325/3K1	ST325				
0.335-0.355	8.51-9.017	HSK335/3K1	ST335	K2	10920	MA156/4	0.156" (3.96mm)
0.355-0.365	9.017-9.27	HSK355/3K1	ST355				
0.365-0.380	9.27-9.65	HSK365/3K2	ST365				
0.380-0.395	9.65-10.03	HSK380/3K3	ST380				
0.395-0.410	10.03-10.41	HSK395/3K3	ST395				
0.410-0.425	10.41-10.80	HSK410/3K3	ST410				
0.425-0.440	10.80-11.18	HSK425/3K3	ST425	K3	10921	MA156/5	0.1875" (4.76mm)
0.440-0.460	11.18-11.68	HSK440/3K3	ST440				
0.460-0.490	11.68-12.45	HSK460/3K3	ST460				
0.490-0.520	12.45-13.21	HSK490/4K4	ST490				
0.520-0.550	13.21-13.97	HSK520/4K4	ST520				
0.550-0.580	13.97-14.73	HSK550/4K5	ST550				
0.580-0.615	14.73-15.62	HSK580/4K5	ST580	K4	10921	MA156/6	0.25" (6.35mm)
0.615-0.645	15.62-16.38	HSK615/4K6	ST615				
0.645-0.675	16.38-17.15	HSK645/4K6	ST645				
0.675-0.705	17.15-17.91	HSK675/4K6	ST675				
0.705-0.740	17.91-18.80	HSK705/4K7	ST705				
0.740-0.770	18.80-19.56	HSK740/4K7	ST740				
0.770-0.800	19.56-20.32	HSK770/4K8	ST770	K5	10921	MA156/18	0.25" (6.35mm)
0.800-0.830	20.32-21.08	HSK800/4K8	ST800				
0.830-0.865	21.08-21.97	HSK830/4K9	ST830				
0.865-0.895	21.97-22.73	HSK865/4K9	ST865				
0.895-0.925	22.73-23.49	HSK895/4K9	ST895				
0.925-0.955	23.49-24.25	HSK925/4K9	ST925				
0.955-0.990	24.25-25.14	HSK955/4K9	ST955	K6	10921	MA156/18	0.25" (6.35mm)
0.990-1.020	25.14-25.91	HSK990/4K10	ST990				

Wedge Lift Angle	K1 = 5°	K2 - K10 = 18°
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Stone Selection - see page 4 for full range of abrasive types available.

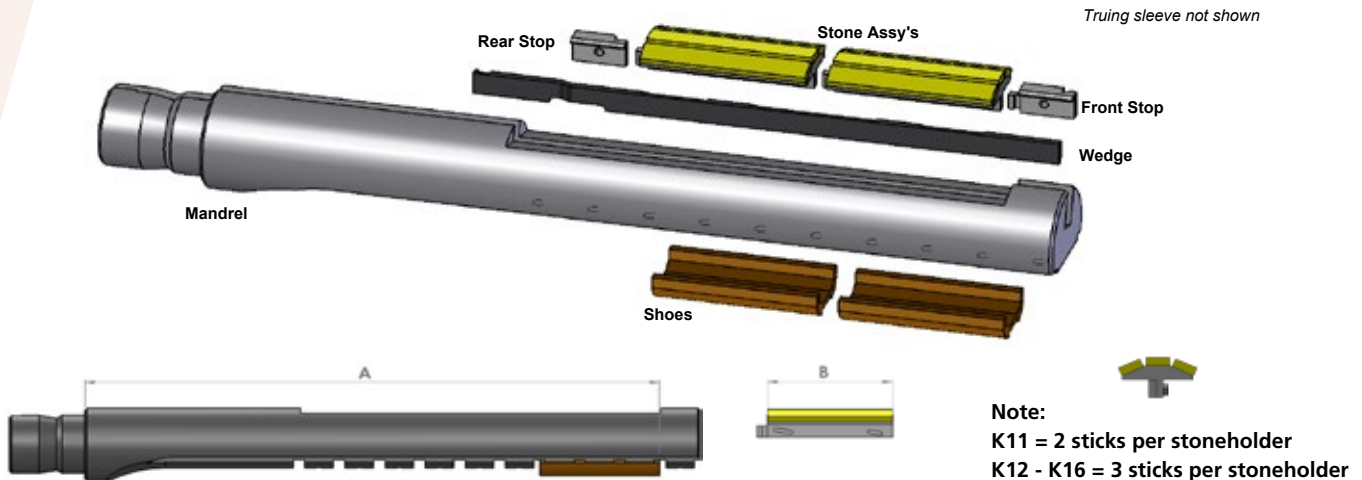
**REMEMBER - ALWAYS TRUE IN EACH NEW STONE BEFORE USE**

# Permanent Type Keyway Mandrels (PTK)

**K11 - K15**

**Diameter Range 1.000 - 2.625" (25.4 - 66.68mm)**

For honing bores containing annular grooves, cross holes, cut outs, etc, use keyway type mandrels. The extra stone width reduces the tendency for the stone to cut faster around these areas.



Mandrel Type	Length A	Stone B
PTK1000/6 - PTK2500/6	6" (152mm)	1 x 3.25" (82.5mm)
PTK1000/9 - PTK2500/9	9.34" (237mm)	2 x 3.25" (82.5mm)
PTK1000/12 - PTK2500/12	12.69" (322mm)	3 x 3.25" (82.5mm)

Range		Short Series	Long Series	Extra Long Series	Truing Sleeves	Stone Type	Cast Iron Shoes	ISO Keyway	
Inch	mm								
1.000-1.125	25.40-28.57	PTK1000/6	PTK1000/9	PTK1000/12	ST1000	K11	L1070C	10mm	
1.125-1.250	28.57-31.75	PTK1125/6	PTK1125/9	PTK1125/12	ST1125		L1071C		
1.250-1.375	31.75-34.93	PTK1250/6	PTK1250/9	PTK1250/12	ST1250		L1072C		
1.375-1.500	34.93-38.10	PTK1375/6	PTK1375/9	PTK1375/12	ST1375		L1073C		
1.500-1.625	38.10-41.28	PTK1500/6	PTK1500/9	PTK1500/12	ST1500	K12	L1074C	12mm	
1.625-1.750	41.28-44.45	PTK1625/6	PTK1625/9	PTK1625/12	ST1625		L1075C		
1.750-1.875	44.45-47.63	PTK1750/6	PTK1750/9	PTK1750/12	ST1750				
Replacement Wedge		10945	10946	10947					

Range		Short Series	Long Series	Extra Long Series	Truing Sleeves	Stone Type	Cast Iron Shoes	ISO Keyway
Inch	mm							
1.875-2.000	47.63-50.80	PTK1875/6	PTK1875/9	PTK1875/12	ST1875	K13	L1076C	14mm
2.000-2.125	50.80-53.98	PTK2000/6	PTK2000/9	PTK2000/12	ST2000	K14		16mm
2.125-2.250	53.98-57.15	PTK2125/6	PTK2125/9	PTK2125/12	ST2125			
2.250-2.375	57.15-60.33	PTK2250/6	PTK2250/9	PTK2250/12	ST2250	K15	L1077C	18mm
2.375-2.500	60.33-63.50	PTK2375/6	PTK2375/9	PTK2375/12	ST2375			
2.500-2.625	63.50-66.68	PTK2500/6	PTK2500/9	PTK2500/12	ST2500			
Replacement Wedge		10948	10949	10950	IMPORTANT: Shoes must be			

Wedge Lift Angle	11°
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IMPORTANT: Shoes must be machined to the same diameter as the bore to be honed before use.

Stone Selection - see page 4 for full range of abrasive types available.

PT—/12 mandrels are supplied to order only.

**REMEMBER - ALWAYS TRUE IN EACH NEW STONE BEFORE USE**

# GHA Tools

## Multi-Stone Honing Tools Using Engis Vertical Stone Sets



### Midget - GHA-281

**Diameter Range 1.00 - 1.50" (25.4 - 38.1mm)**

Head locates in the spindle nose and the linear feed mechanism expands the stones.

#### Stone types

**26** Ø1.00 - 1.25" (25.4 - 31.7mm)

**27** Ø1.25 - 1.50" (31.7 - 38.1mm)



### Minor - GHA-283

**Diameter Range 1.50 - 2.20" (38.1 - 55.8mm)**

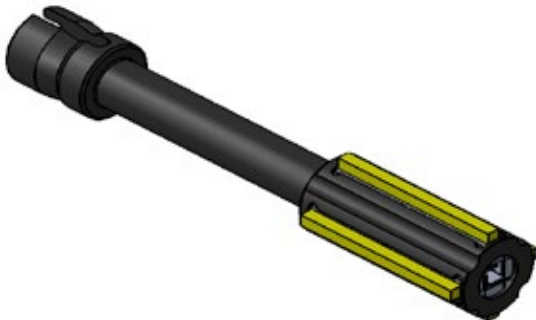
Head locates in the spindle nose and the linear feed mechanism expands the stones.

#### Stone types

**28** Ø1.50 - 1.75" (38.1 - 44.4mm)

**29** Ø1.75 - 2.00" (44.4 - 50.8mm)

**30** Ø2.00 - 2.20" (50.8 - 55.8mm)



### Junior - GHA-285

**Diameter Range 2.00 - 2.69" (50.8 - 68.3mm)**

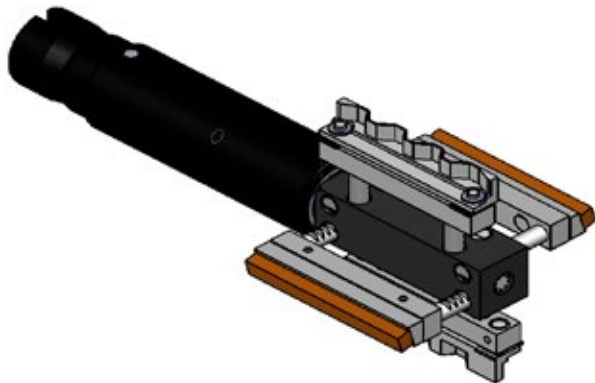
Head locates in the spindle nose and the linear feed mechanism expands the stones.

#### Stone types

**T** Ø2.00 - 2.20" (50.8 - 55.8mm)

**U** Ø2.20 - 2.40" (55.8 - 60.9mm)

**V** Ø2.40 - 2.69" (60.9 - 68.3mm)



### Standard - GHA-287

**Diameter Range > 2.56" (>65.0mm)**

Head locates in the spindle nose and the linear feed mechanism is converted via a helical adaptor to rotational feed movement in the hone head to expand the stones. When fitting new stone sets the square hone body must be removed from the assembly.

#### Stone types

**G** Ø2.56 - 3.90" (65.0 - 99.0mm)

**M** Ø2.68 - 4.21" (68.0 - 107.0mm)

Please note that the maximum honing diameter will depend on the application.



# Special Design Tools

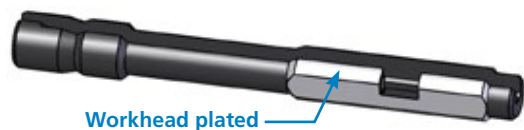
All mandrels in this catalog can be supplied to suit individual customer requirements such as increased length and coatings. As well as mandrel variants, other types of tools can be supplied, such as multi stone tools. These can also be adapted to fit any honing system.

All special tools are made to order. Please contact Engis for advice and details of your requirements.

**Below are some examples of special tools:**

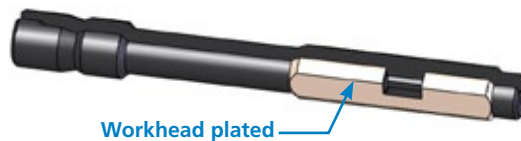
## Chrome Plated Mandrels

All HS type mandrels within the range Ø0.120-1.02" (3.05 – 25.91mm) can be supplied with the workhead hard chrome plated for increased strength and wear resistance.



## Diamond Plated Mandrels

All HS type mandrels within the range Ø0.120-1.02" (3.05 – 25.91mm) can be supplied with the workhead diamond plated for increased strength and wear resistance.



## Carbide Backed Mandrels

All HS type mandrels within the range Ø0.245-1.02" (6.22 – 25.91mm) and bronze and cast iron mandrel guide shoes can be supplied with carbide guides for wear resistance.

The carbide strips are glued in position and ground to the appropriate diameter.



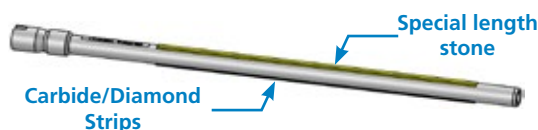
## Diamond Backed Mandrels

All HS type mandrels within the range Ø0.245-1.02" (6.22 – 25.91mm) and bronze and cast iron mandrel guide shoes can be supplied with diamond guides for wear resistance. The diamond strips are glued in position and ground to the appropriate diameter.



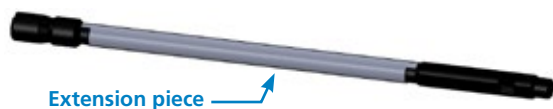
## Special Single Stone Mandrels

Designed for special applications such as correction of bend and when standard long series do not offer sufficient stone length. These tubular mandrels can be made for bores over Ø1.02" (3.05mm), have limited stone expansion and the mandrel workhead is hard chrome plated or has carbide guides for wear resistance, depending on diameter.



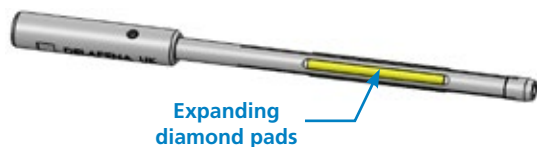
## Extended Length Mandrels

All mandrels within the range Ø.395-1.02" (10.0-25.91mm) can be supplied with extended lengths. The extension is achieved by cutting and sleeving the mandrel shank to achieve the required length. Typical applications include extruder barrel and gun barrel honing.



## Expanding Diamond Hones

A range of cone expanded diamond honing tools available for bores within the range Ø2.0 – 30mm. These tools can be used with any suitable power source in conjunction with the corresponding micrometer adjustment device and with Engis honing machines with an appropriate adaptor.



## Multi-Stone Honing Tools

These cone expanded tools are designed for specific components and are generally used for production honing. Available for bores from Ø0.160" (4.0mm). These tools can be supplied with 3, 4, 5, 6 or 8 compact super abrasive hones (depending on diameter). Tools can be designed to fit any honing chuck system and have "spring return" or "positive retract" cone systems.

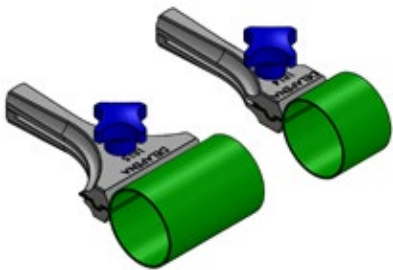


## Accessories - 1



### 1826 Hinged Stroking Fixture

The hinged fixture is an alternative to the standard universal fixtures. It can accommodate components as the universal fixtures but has a hinged plate for easy load / unload of parts. It allows the component to be removed while it is on the honing mandrel. Includes three pairs of fingers with longwearing, adjustable carbide pads, one pair mounted on an extension piece allowing the honing of two parts in line (not shown).



### 1813 - 1815 Loop Grip Holders

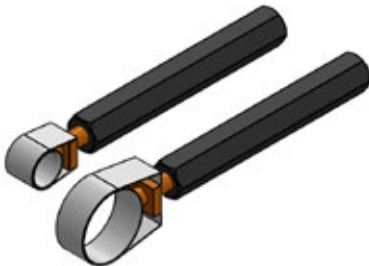
A range of heavy-duty holders used to prevent rotation of the workpiece when using the above fixtures or honing manually. A webbing loop is placed around the component and held secure by tightening a thumb screw.

#### Available in three sizes

**1813** = 0.748" (19mm wide)

**1814** = 1.496" (38mm wide)

**1815** = 2.952" (75mm wide)



### 1850 - 1858 Hone Grip Holders

A range of holders used to prevent rotation of the workpiece when using the above fixtures or honing manually. A loop is placed around the component and held secure by tightening a thumb screw.

**1850** = No.10 - 0.311-0.374"

**1855** = No.21 - 0.657-0.803"

**1851** = No.12 - 0.366-0.468"

**1856** = No.22 - 0.736-0.874"

**1852** = No.14 - 0.394-0.539"

**1857** = No.25 - 0.866-0.933"

**1853** = No.17 - 0.492-0.638"

**1858** = No.27 - 0.846-1.0"

**1854** = No.19 - 0.602-0.748"



### 1840/1841 Gauge Assembly

Unit used for ensuring the component runs concentrically when mounted on the honing mandrel. This is a requirement when using the Engis multi-plain chuck.

**1840** is used on PH-2000 and SH-1000

**1841** is used on PH-1000



## Accessories - 2



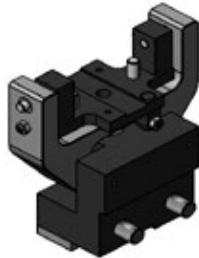
### 1806 Basic Die Honing Fixture

Suitable for large bodied, small bore components. The fixture comprises of two fully floating workholders to take cylindrical components up to 3" (76mm) diameter and 5" (125mm) long. The workholders are located into a base unit which incorporates a spring counterbalance to counteract the weight of the component.

Gimbal Ring Sizes:

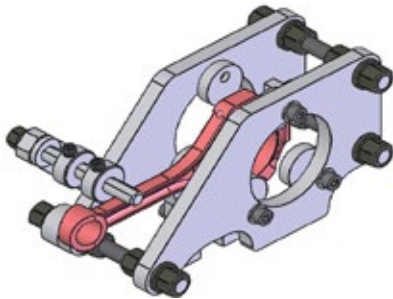
**1807** = 1.968" (50mm) capacity

**1808** = 2.953" (75mm) capacity



### 1809 Floating Gimbal Fixture

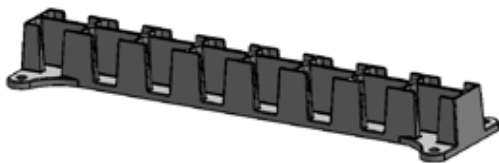
Designed for small, lightweight components that are not suited to the 1810 universal fixture. The fixture has a fully floating platform onto which component holding sub-fixtures are located. Designed with a weight compensating mechanism this fixture is ideal for automatic honing of bores less than 0.120" (3.05mm) diameter.



### SF45009 Connecting Rod Fixture

An adjustable fixture to suit a wide range of connecting rods sizes. The fixture ensures squareness of face to bore and can be used for both big and small ends.

The basic fixture design can also be supplied to suit a specific rod size which is particularly suited for large volume work.



### SL29 Mandrel Rack

Designed to accommodate 16 complete honing units for bores up to 1" (25.4mm), the Engis Mandrel Rack is an invaluable accessory enabling the operator to keep assembled honing units readily available.



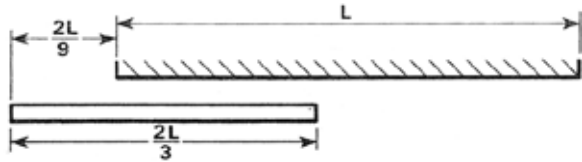
### CG100 Mandrel Adaptor

A simple adaptor for use with any external power source such as portable drill, pillar drill, radial arm drill, etc. The CG100 will accept all mandrels from Ø0.393-3.11" (10 – 79mm) and is used when it is not practical to use the hand operated horizontal honing machine. The mandrel is expanded/retracted by turning the knurled knob.

# Technical Information 1

## Ideal Stone Length

The relationship between the length of the bore, honing stone and stroke length have a direct effect on the parallelism of the honed hole.



If the bore length is  $L$  then the stone length should not exceed  $2L/3$ . To produce a parallel hole the stone must pass out of each end of the bore by one third of its own length. The tool offering the longest stone in accordance with this formula should always be used.

## Stack Honing

When the bore length is much shorter than the diameter (over square) then consideration should be given to stacking several parts together to create a suitable honing length.

## Stone Dressing (Truing)

Each new stone should be dressed parallel with the tool to prevent shape errors being introduced into the bore. This operation should be performed DRY at relatively low speed and light pressure. Ideally the truing sleeve should be the same diameter as the bore to be honed. Never use a truing sleeve when its diameter exceeds the maximum range of the tool being dressed in.

## Wedge Wear

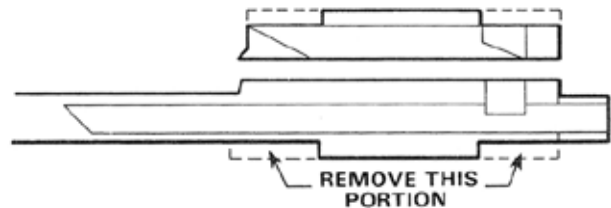
Because of the very nature of the honing process, wedges are subject to wear which causes loss of accuracy and performance. Wedges should be inspected prior to use and replaced when worn or damaged.

## Modifying Mandrels & Stones

Sometimes it is necessary to shorten the stone length to achieve specific requirements. Generally both the stone and the mandrel workhead should be shortened the same amount.

## Short Open Bores

When the bore length is short and stack honing is not possible, the stone and mandrel workhead should be reduced at each end to leave a central section  $1\frac{1}{2}$  times the bore length.



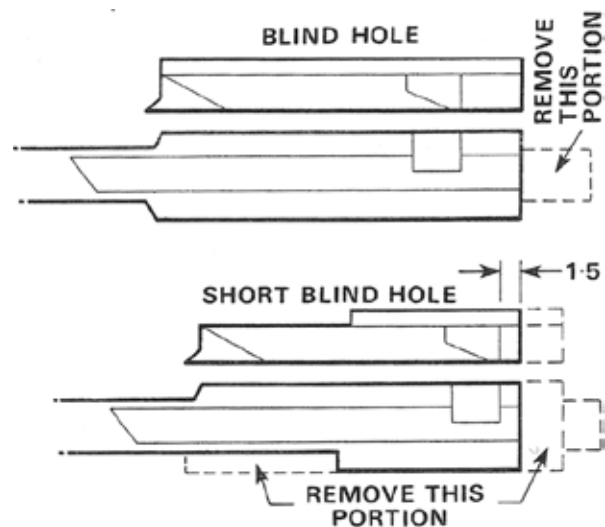
## Blind Bores

The range of "CCS" mandrels are NOT suitable for blind hole use.

### SS, HS, B & PT ~ $\varnothing 0.12'' - 1.02''$ (3.05 - 25.4mm)

The range of mandrels listed in this catalog can be converted for blind hole use as follows;

1. Remove pilot end so that end of stone is flush with end of mandrel.
2. If necessary, reduce the stone and mandrel workhead length to  $2/3$  of the bore length and that at least  $1/2$  the stone length is behind the front lift point to prevent tipping.  
*Note, when honing short blind bores, it may be necessary to modify the stoneholder as well as the mandrel to ensure that at least half the stone length is behind the front lift point.*



### PT ~ $\varnothing 1.0'' - 3.125''$ (25.4 - 79.37mm)

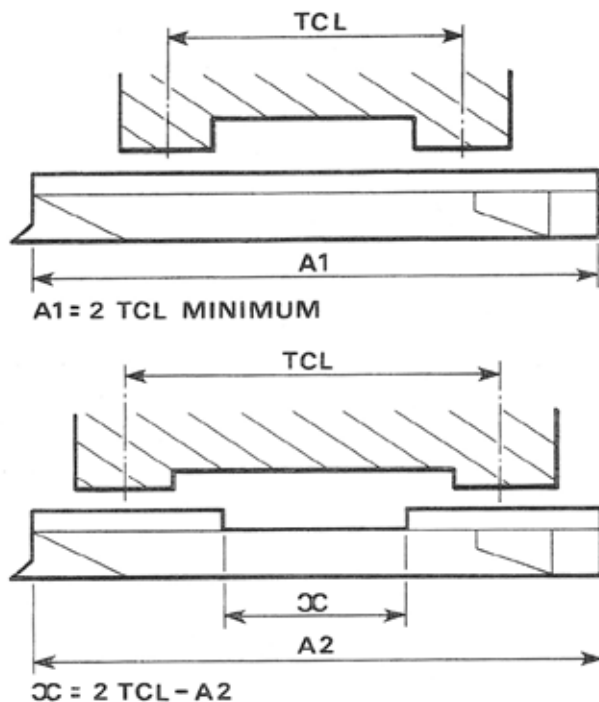
For details on converting PT mandrels for "Blind Hole" use, refer to page 15.

## Technical Information 2

### Tandem Bores

When honing tandem bores the stone should be of sufficient length to ensure that the entire stone surface contacts one or the other of the tandem bores during the honing stroke, and to achieve this, the stone length must be at least twice the center distance of the tandem bores.

If the stone is less than twice the tandem center distance, then the center portion of the stone must be removed, the amount being equal to amount that the stone length is less than twice the center distance of the tandem bores.



TCL = Tandem Center Line

### Keyway Bores

It is essential that keyway tooling is dressed to the exact bore diameter to be honed.

Keyway mandrels must have a full form on both the stone and mandrel workhead to prevent the tool from jamming in the slot.

All PTK mandrels are fitted with cast iron shoes that must be machined to the correct diameter before use.

Special stone platforms for use with the 1208 Standard head can be made to hone bores from  $\varnothing 1.102"$  (75.00mm).

### Replacement Shoes

All PT mandrels are fitted with bronze shoes as standard and are ready for immediate use.

PTK mandrels are fitted with cast iron shoes that must be machined to the correct diameter before use.

All mandrels over  $\varnothing 1.02"$  (28.00mm) are supplied with packing strips that should be placed between the mandrel body and shoe if the diameter to be honed is in the upper half of the range of the mandrel.



# Trouble Shooting 1



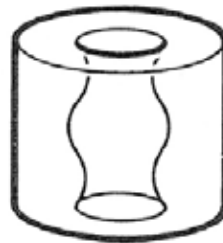
Oval



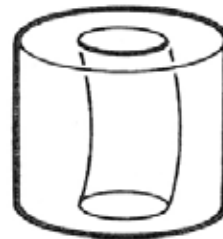
Bellmouthed



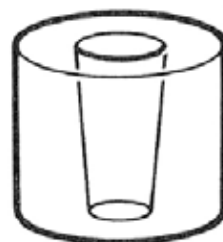
Barrelled



Combined  
Bellmouthed/Barrel



Rainbow



Tapered

## Oval Bores

Ensure the tool is the correct size for the bore to be honed. Thoroughly true in the stones, preferably to the exact bore diameter. If the part to be honed is thin walled, reduce the cutting pressure. If the stone stops cutting at reduced pressure, use a softer stone. For bores containing cut outs, large cross holes, etc., use keyway-type tooling.

## Bellmouthed Bores

Thoroughly true in the stones, preferably to the exact bore diameter. Reduce the stroke length and use tool with shorter stone length if available. If the bore length is less than 1/2 of the stone length, reduce the stone length to 1½ times the bore length. If bellmouth persists, continue to shorten stone or use a softer stone. Overcorrection will cause barreling.

## Barrelled Bores

Thoroughly true in the stones, preferably to the exact bore diameter. Increase stroke length and use tool with longer stone length if available. If barreling persists, shorten stone at both ends. Overcorrection will cause bellmouthing.

## Combined Bellmouthed/ Barrel Bores

Typical in bores containing many cross holes, e.g. valve spool. Shorten stone length AND increase stroke length. If problem persists, use softer stone

## Rainbow Bores (and Waviness)

Use long series tooling. Stone length should be at least 1 1/2 times the bore length. Correction of bent bores may result in bellmouthing. When bend has been corrected, any bellmouthing can be corrected as described above.

## Tapered Bores

Thoroughly true in the stones, preferably to the exact bore diameter. When honing manually, reverse the component frequently. When honing automatically, adjust stroke position to allow more stone to pass through the tight end of the bore.

# Trouble Shooting 2

## Taper-in Blind Bores

Thoroughly true in the stones, preferably to the exact bore diameter and reduce the stone length to 2/3 bore length.

If the bore has insufficient or no relief at the blind end, use short stone first to hone bottom of the bore. Use stone with hard tip. Ensure adequate supply of honing to blind bore.

## Bent Bores

Use longest stone length available. Stone length should be at least 1½ times bore length.

Correction of bent bores may result in bellmouthing. When bend has been corrected any bellmouth can be corrected as described above.

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## Stone Glazed

- Stone does not cut
- Open surface of stone with dressing stick
- Increase stroking speed
- Reduce rotation speed
- Increase pressure
- Use softer stone

## Slow Stock Removal

- If slow stock removal is not the result of stone glazed or loaded
- Increase rotation speed
- Increase pressure
- Use softer stone
- Use coarser stone

## Pick Up

- Reduce pressure
- Reduce rotation speed
- Use softer stone
- Use finer stone
- Change HS type mandrel to bronze or PT type
- Ensure good flow of honing fluid
- Check quality of honing fluid

## Finish Too Fine

- Open surface of stone with dressing stick
- Increase stroking speed
- Reduce rotation speed
- Increase pressure
- Use coarser stone
- Use softer stone

## Stone Loaded

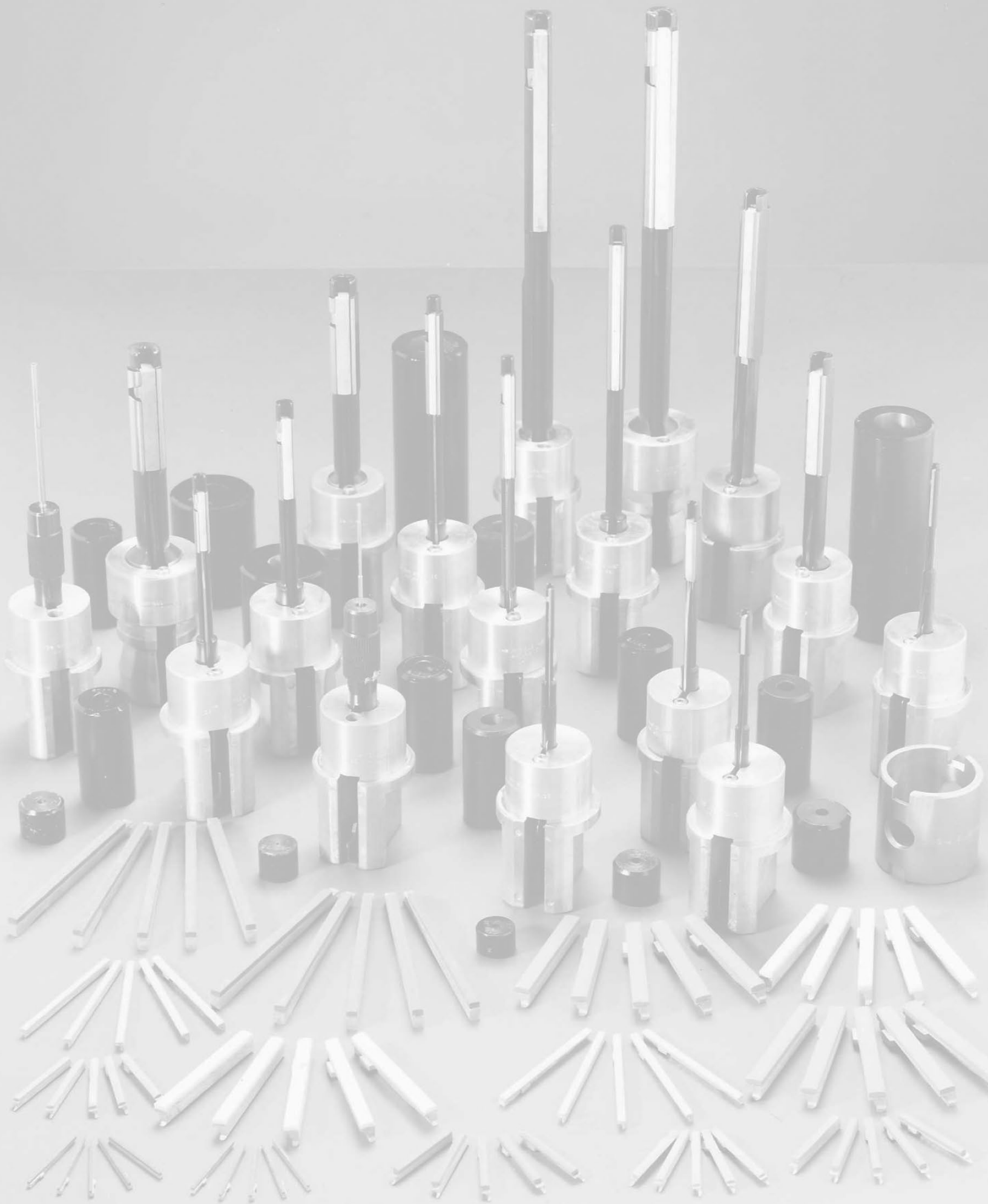
- Stone surface becomes clogged with material
- Clean stone surface with dressing stick
- Increase stroking speed
- Use softer stone
- Use coarser stone

## Excessive Stone Wear

- Reduce pressure
- Increase rotation speed
- Use harder stone
- Use finer stone

## Finish Too Rough

- Thoroughly dress stone and shoe preferably to exact bore diameter
- Increase rotation speed
- Reduce pressure
- Use finer stone
- Change HS type mandrel to bronze or PT type
- Check quality of honing fluid



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