A comprehensive range of tooling and accessories for the Engis range of multi-stroke honing machines
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 2μ 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. Customers outside the US, please contact your regional Engis office. 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:

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

2. **Affect Performance of Stone**
   - **Surface speed of honing stone**
   - **Surface area of the honing stone**
   - **Stone pressure**
   - **Reciprocation speed**
   - **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:

<table>
<thead>
<tr>
<th>Material Group</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cast Irons</td>
<td>Spun, malleable, meehanite, S.G., etc.</td>
</tr>
<tr>
<td>Soft Steels</td>
<td>Alloy steels below HRC 55, CDS, etc.</td>
</tr>
<tr>
<td>Stainless Steels</td>
<td>Martensitic, austenitic</td>
</tr>
<tr>
<td>Hard Steels</td>
<td>Alloy steels above HRC 55, hard stainless, hard chrome</td>
</tr>
<tr>
<td>Non-Ferrous</td>
<td>Brass, bronze, copper, aluminium</td>
</tr>
</tbody>
</table>

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

Abrasives 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:

<table>
<thead>
<tr>
<th>Engis Code</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>6</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grit Size</td>
<td>60</td>
<td>80</td>
<td>120</td>
<td>180</td>
<td>220</td>
<td>320</td>
<td>500</td>
</tr>
</tbody>
</table>

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

Stoneholder Type  Bond Hardness
Abrasive Type
Abrasives Grit Size
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.

<table>
<thead>
<tr>
<th>Diameter Range</th>
<th>Deburr All Materials</th>
<th>Operation</th>
<th>Cast Iron</th>
<th>Soft Steel</th>
<th>Stainless Steel</th>
<th>Hard Steel</th>
<th>Non-Ferrous</th>
<th>Engis Stone-holder Types</th>
<th>Approx. Speed Range (rpm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>inch/mm</td>
<td></td>
<td></td>
<td></td>
<td>(a)</td>
<td>(b)</td>
<td>(a)</td>
<td>(b)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.045 - 0.120&quot; 1.14 - 3.05mm</td>
<td></td>
<td></td>
<td></td>
<td>not available (see superabrasives on page 6)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.120 - 0.150&quot; 3.05 - 3.81mm</td>
<td>R6J</td>
<td>F</td>
<td>F6F</td>
<td>R6F</td>
<td>R6F</td>
<td>R6F</td>
<td>R6C</td>
<td>F6F</td>
<td>Y Z 2500</td>
</tr>
<tr>
<td></td>
<td>P</td>
<td></td>
<td>F8F</td>
<td>F8F</td>
<td>F8F</td>
<td>F8F</td>
<td>F8F</td>
<td>AA NBB 2500</td>
<td></td>
</tr>
<tr>
<td>0.150 - 0.185&quot; 3.81 - 4.70mm</td>
<td>R6J</td>
<td>F</td>
<td>F6F</td>
<td>R6F</td>
<td>R6F</td>
<td>R6F</td>
<td>R6C</td>
<td>F6F</td>
<td>SH WW 2500</td>
</tr>
<tr>
<td></td>
<td>P</td>
<td></td>
<td>F8F</td>
<td>F8F</td>
<td>F8F</td>
<td>F8F</td>
<td>F8F</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.185 - 0.245&quot; 4.70 - 6.23mm</td>
<td>R6J</td>
<td>R</td>
<td>F4F</td>
<td>R4F</td>
<td>R4E</td>
<td>R4E</td>
<td>R4C</td>
<td>F3F F3C</td>
<td></td>
</tr>
<tr>
<td></td>
<td>F</td>
<td></td>
<td>F6F</td>
<td>R6F</td>
<td>R6F</td>
<td>R6F</td>
<td>R6C</td>
<td>F6F F6C</td>
<td></td>
</tr>
<tr>
<td></td>
<td>P</td>
<td></td>
<td>F8F</td>
<td>F8F</td>
<td>F8F</td>
<td>F8F</td>
<td>F8F</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.245 - 0.365&quot; 6.23 - 9.27mm</td>
<td>R3HS</td>
<td>R</td>
<td>F3F</td>
<td>R4F</td>
<td>R4E</td>
<td>R4E</td>
<td>R4C</td>
<td>F3F F3C</td>
<td>NA NG NEE 2500</td>
</tr>
<tr>
<td></td>
<td>F</td>
<td></td>
<td>F6F</td>
<td>R6F</td>
<td>R6F</td>
<td>R6F</td>
<td>R6C</td>
<td>F6F F6C</td>
<td></td>
</tr>
<tr>
<td></td>
<td>P</td>
<td></td>
<td>F8F</td>
<td>F8F</td>
<td>F8F</td>
<td>F8F</td>
<td>F8F</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.365 - 0.490&quot; 9.27 - 12.45mm</td>
<td>R3HS</td>
<td>R</td>
<td>F3F</td>
<td>R4F</td>
<td>R4E</td>
<td>R3E/S R4C</td>
<td>R4C C3C</td>
<td>F3F F3C</td>
<td>NB NL NEE 1700 K1</td>
</tr>
<tr>
<td></td>
<td>F</td>
<td></td>
<td>F6F</td>
<td>R6F</td>
<td>R6F</td>
<td>C6C</td>
<td>R6C C3C</td>
<td>F6F F6C</td>
<td></td>
</tr>
<tr>
<td></td>
<td>P</td>
<td></td>
<td>F8F</td>
<td>F8F</td>
<td>F8F</td>
<td>F8F C8C</td>
<td>F8F</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.490 - 0.615&quot; 12.45 - 15.62mm</td>
<td>R3HS</td>
<td>R</td>
<td>F3F</td>
<td>R4F</td>
<td>R4E</td>
<td>R3E/S R4C</td>
<td>R4C C3C</td>
<td>F3F F3C</td>
<td>SD NC K4 1300 K3</td>
</tr>
<tr>
<td></td>
<td>F</td>
<td></td>
<td>F6F</td>
<td>R6F</td>
<td>R6F</td>
<td>C6C</td>
<td>R6C C3C</td>
<td>F6F F6C</td>
<td></td>
</tr>
<tr>
<td></td>
<td>P</td>
<td></td>
<td>F8F</td>
<td>F8F</td>
<td>F8F</td>
<td>F8F C8C</td>
<td>F8F</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.615 - 0.770&quot; 15.62 - 19.56mm</td>
<td>R3HS</td>
<td>R</td>
<td>F3F</td>
<td>R4F</td>
<td>R4E</td>
<td>R3E/S R4C</td>
<td>R4C C3C</td>
<td>F3F F3C</td>
<td>ND GG K6 1000 K7</td>
</tr>
<tr>
<td></td>
<td>F</td>
<td></td>
<td>F6F</td>
<td>R6F</td>
<td>R6F</td>
<td>C6C</td>
<td>R6C C3C</td>
<td>F6F F6C</td>
<td></td>
</tr>
<tr>
<td></td>
<td>P</td>
<td></td>
<td>F8F</td>
<td>F8F</td>
<td>F8F</td>
<td>F8F C8C</td>
<td>F8F</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.770 - 1.020&quot; 19.56 - 25.91mm</td>
<td>R3HS</td>
<td>R</td>
<td>F3F</td>
<td>R4F</td>
<td>R4E</td>
<td>R3E/S C3C</td>
<td>R4C C3C</td>
<td>F3F F3C</td>
<td>ND GG K8 800 K9 K10</td>
</tr>
<tr>
<td></td>
<td>F</td>
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<td>F6F</td>
<td>R6F</td>
<td>R6F</td>
<td>C6C</td>
<td>R6C C3C</td>
<td>F6F F6C</td>
<td></td>
</tr>
<tr>
<td></td>
<td>P</td>
<td></td>
<td>F8F</td>
<td>F8F</td>
<td>F8F</td>
<td>F8F C8C</td>
<td>F8F</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.00 - 2.00&quot; 25.4 - 50.8mm</td>
<td>R3HS</td>
<td>R</td>
<td>F2F</td>
<td>R4F</td>
<td>R3E/S C3C</td>
<td>R4C C3C</td>
<td>F2F F3C</td>
<td>F1 F2 F11 600 K12 K13</td>
<td></td>
</tr>
<tr>
<td></td>
<td>F</td>
<td></td>
<td>F6F</td>
<td>R6F</td>
<td>R6F</td>
<td>C6C</td>
<td>R6C C3C</td>
<td>F6F F6C</td>
<td></td>
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<tr>
<td></td>
<td>P</td>
<td></td>
<td>F8F</td>
<td>F8F</td>
<td>F8F</td>
<td>F8F C8C</td>
<td>F8F</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.00 - 3.00&quot; 50.8 - 79.37mm</td>
<td>R3HS</td>
<td>R</td>
<td>F2F</td>
<td>R4F</td>
<td>R3E/S C3C</td>
<td>R4C C3C</td>
<td>F2F F3C</td>
<td>F1 F2 F14 300 K15</td>
<td></td>
</tr>
<tr>
<td></td>
<td>F</td>
<td></td>
<td>F6F</td>
<td>R6F</td>
<td>R6F</td>
<td>C6C</td>
<td>R6C C3C</td>
<td>F6F F6C</td>
<td></td>
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<td></td>
<td>P</td>
<td></td>
<td>F8F</td>
<td>F8F</td>
<td>F8F</td>
<td>F8F C8C</td>
<td>F8F</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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:

<table>
<thead>
<tr>
<th>Engis Code</th>
<th>10</th>
<th>15</th>
<th>22</th>
<th>32</th>
<th>40</th>
<th>60</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grit Size</td>
<td>100</td>
<td>150</td>
<td>220</td>
<td>320</td>
<td>400</td>
<td>600</td>
</tr>
</tbody>
</table>

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).

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).

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

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)**

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

<table>
<thead>
<tr>
<th>Short Series</th>
<th>Mandrel Length A</th>
<th>Stone Length B</th>
</tr>
</thead>
<tbody>
<tr>
<td>CCS045 - CCS055</td>
<td>1.10” (28mm)</td>
<td>0.437” (11mm)</td>
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<tr>
<td>CCS060 - CCS090</td>
<td>1.57” (40mm)</td>
<td>0.437” (11mm)</td>
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<tr>
<td>CCS095 - CCS115</td>
<td>2.08” (53mm)</td>
<td>0.5”(12.7mm)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Diameter Range</th>
<th>Mandrel Length A</th>
<th>Stone Length B</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.045 - 0.050</td>
<td>1.14 - 1.27</td>
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</tr>
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<td>0.050 - 0.055</td>
<td>1.27 - 1.40</td>
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</tr>
<tr>
<td>0.055 - 0.060</td>
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</tr>
<tr>
<td>0.065 - 0.070</td>
<td>1.65 - 1.78</td>
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</tr>
<tr>
<td>0.070 - 0.075</td>
<td>1.78 - 1.90</td>
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</tr>
<tr>
<td>0.075 - 0.080</td>
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</tr>
<tr>
<td>0.085 - 0.090</td>
<td>2.16 - 2.28</td>
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</tr>
<tr>
<td>0.090 - 0.095</td>
<td>2.28 - 2.41</td>
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</tr>
<tr>
<td>0.095 - 0.100</td>
<td>2.41 - 2.54</td>
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</tr>
<tr>
<td>0.100 - 0.105</td>
<td>2.54 - 2.67</td>
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</tr>
<tr>
<td>0.105 - 0.110</td>
<td>2.67 - 2.79</td>
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</tr>
<tr>
<td>0.110 - 0.115</td>
<td>2.79 - 2.92</td>
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</tr>
<tr>
<td>0.115 - 0.120</td>
<td>2.92 - 3.05</td>
<td></td>
</tr>
<tr>
<td>Collet Adaptor</td>
<td>1651</td>
<td></td>
</tr>
<tr>
<td>Adaptor</td>
<td>MA156/4A</td>
<td></td>
</tr>
</tbody>
</table>

**Wedge Lift Angle** 2.5°

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)

**Diameter Range 0.045 - 0.120” (1.14 - 3.05mm)**

<table>
<thead>
<tr>
<th>Short Series</th>
<th>Y</th>
<th>AA</th>
<th>Long Series</th>
<th>Z</th>
<th>NBB</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mandrel length A</td>
<td>1.5” (38mm)</td>
<td>1.65” (42mm)</td>
<td>Mandrel length A</td>
<td>1.97” (50mm)</td>
<td>2.16”(55mm)</td>
</tr>
<tr>
<td>Stone length B</td>
<td>0.56” (14.5mm)</td>
<td>0.69” (17.5mm)</td>
<td>Stone length B</td>
<td>1.0” (25.4mm)</td>
<td>1.25” (31.7mm)</td>
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</tbody>
</table>

## Diameter Range

<table>
<thead>
<tr>
<th>Inch</th>
<th>mm</th>
</tr>
</thead>
<tbody>
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<td>0.120-0.125</td>
<td>3.05-3.17</td>
</tr>
<tr>
<td>0.125-0.130</td>
<td>3.17-3.30</td>
</tr>
<tr>
<td>0.130-0.135</td>
<td>3.30-3.43</td>
</tr>
<tr>
<td>0.135-0.140</td>
<td>3.43-3.56</td>
</tr>
<tr>
<td>0.140-0.145</td>
<td>3.56-3.68</td>
</tr>
<tr>
<td>0.145-0.150</td>
<td>3.68-3.81</td>
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## Mandrel (includes Wedge)

<table>
<thead>
<tr>
<th>Stone Type</th>
<th>Replacement Wedge</th>
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</thead>
<tbody>
<tr>
<td>Hard</td>
<td>Brass</td>
</tr>
<tr>
<td>HS120/Y</td>
<td>B120/Y</td>
</tr>
<tr>
<td>HS125/Z</td>
<td>B125/Z</td>
</tr>
<tr>
<td>HS130/Z</td>
<td>B130/Z</td>
</tr>
<tr>
<td>HS135/Z</td>
<td>B135/Z</td>
</tr>
<tr>
<td>HS140/Z</td>
<td>B140/Z</td>
</tr>
<tr>
<td>HS145/Z</td>
<td>B145/Z</td>
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## Truing Sleeve

<table>
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<tr>
<th>Hard</th>
<th>Brass</th>
</tr>
</thead>
<tbody>
<tr>
<td>HS120/Z</td>
<td>ST120</td>
</tr>
<tr>
<td>HS125/Z</td>
<td>ST125</td>
</tr>
<tr>
<td>HS130/Z</td>
<td>ST130</td>
</tr>
<tr>
<td>HS135/Z</td>
<td>ST135</td>
</tr>
<tr>
<td>HS140/Z</td>
<td>ST140</td>
</tr>
<tr>
<td>HS145/Z</td>
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### Adaptor

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<td>10906</td>
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### Stone Type

<table>
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<tr>
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<th>NBB</th>
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<tbody>
<tr>
<td>MA156/22</td>
<td>10906</td>
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## Mandrel (includes Wedge)

<table>
<thead>
<tr>
<th>Stone Type</th>
<th>Replacement Wedge</th>
</tr>
</thead>
<tbody>
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<td>Hard</td>
<td>Brass</td>
</tr>
<tr>
<td>HS150/AA</td>
<td>B150/AA</td>
</tr>
<tr>
<td>HS155/AA</td>
<td>B155/AA</td>
</tr>
<tr>
<td>HS160/AA</td>
<td>B160/AA</td>
</tr>
<tr>
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<td>B170/AA</td>
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<td>HS175/AA</td>
<td>B175/AA</td>
</tr>
<tr>
<td>HS180/AA</td>
<td>B180/AA</td>
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</table>

## Truing Sleeve

<table>
<thead>
<tr>
<th>Hard</th>
<th>Brass</th>
</tr>
</thead>
<tbody>
<tr>
<td>HS150/NBB</td>
<td>ST150</td>
</tr>
<tr>
<td>HS155/NBB</td>
<td>ST155</td>
</tr>
<tr>
<td>HS160/NBB</td>
<td>ST160</td>
</tr>
<tr>
<td>HS165/NBB</td>
<td>ST165</td>
</tr>
<tr>
<td>HS170/NBB</td>
<td>ST170</td>
</tr>
<tr>
<td>HS175/NBB</td>
<td>ST175</td>
</tr>
<tr>
<td>HS180/NBB</td>
<td>ST180</td>
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## Replacement Wedge

<table>
<thead>
<tr>
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<th>Z</th>
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</thead>
<tbody>
<tr>
<td>MA156/22</td>
<td>10906</td>
</tr>
</tbody>
</table>

### Wedge Lift Angle

- **18°**
- **10°**

**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)

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

<table>
<thead>
<tr>
<th>Short Series</th>
<th>SH</th>
<th>Long Series</th>
<th>WW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mandrel length A</td>
<td>2.08&quot; (53mm)</td>
<td>Mandrel length A</td>
<td>3.23&quot; (82mm)</td>
</tr>
<tr>
<td>Stone length B</td>
<td>0.75&quot; (19mm)</td>
<td>Stone length B</td>
<td>1.37&quot; (35mm)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Diameter Range</th>
<th>Mandrel (includes Wedge)</th>
<th>Mandrel (includes Wedge)</th>
<th>Truing Sleeve</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Soft</td>
<td>Hard</td>
<td>Hard</td>
</tr>
<tr>
<td>0.185-0.190</td>
<td>HS185/2SH</td>
<td>B185/2SH</td>
<td>HS185/WW</td>
</tr>
<tr>
<td>0.190-0.195</td>
<td>HS190/2SH</td>
<td>B190/2SH</td>
<td>HS190/WW</td>
</tr>
<tr>
<td>0.195-0.200</td>
<td>HS195/2SH</td>
<td>B195/2SH</td>
<td>HS195/WW</td>
</tr>
<tr>
<td>0.200-0.205</td>
<td>HS200/2SH</td>
<td>B200/2SH</td>
<td>HS200/WW</td>
</tr>
<tr>
<td>0.205-0.210</td>
<td>HS205/2SH</td>
<td>B205/2SH</td>
<td>HS205/WW</td>
</tr>
<tr>
<td>0.210-0.215</td>
<td>HS210/2SH</td>
<td>B210/2SH</td>
<td>HS210/WW</td>
</tr>
<tr>
<td>0.215-0.220</td>
<td>HS215/2SH</td>
<td>B215/2SH</td>
<td>HS215/WW</td>
</tr>
<tr>
<td>0.220-0.225</td>
<td>HS220/2SH</td>
<td>B220/2SH</td>
<td>HS220/WW</td>
</tr>
<tr>
<td>0.225-0.230</td>
<td>HS225/2SH</td>
<td>B225/2SH</td>
<td>HS225/WW</td>
</tr>
<tr>
<td>0.230-0.235</td>
<td>HS230/2SH</td>
<td>B230/2SH</td>
<td>HS230/WW</td>
</tr>
<tr>
<td>0.235-0.240</td>
<td>HS235/2SH</td>
<td>B235/2SH</td>
<td>HS235/WW</td>
</tr>
<tr>
<td>0.240-0.245</td>
<td>HS240/2SH</td>
<td>B240/2SH</td>
<td>HS240/WW</td>
</tr>
</tbody>
</table>

- Adaptor: MA156/1
- Stone Type: SH
- Replacement Wedge: 10909

Wedge Lift Angle: 10°

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)**

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

<table>
<thead>
<tr>
<th>Diameter Range</th>
<th>Mandrel (includes Wedge)</th>
<th>Truing Sleeve</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.245-0.260</td>
<td>SS245/3NA HS245/3NA</td>
<td></td>
</tr>
<tr>
<td>0.260-0.275</td>
<td>SS260/3NA HS260/3NA</td>
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</tr>
<tr>
<td>0.275-0.290</td>
<td>SS275/3NA HS275/3NA</td>
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<td>0.290-0.305</td>
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<tr>
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<td>SS310/3NG</td>
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<tr>
<td>0.320-0.335</td>
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<td>0.335-0.350</td>
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<tr>
<td>0.350-0.365</td>
<td>SS350/3NG HS350/3NG</td>
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</table>

**Adaptor**

- MA156/3
- MA156/45

**Replacement Wedge**

- 10911
- 10912

**Stone Lift Angle**

- 10°

---

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)

### Diameter Range 0.365 - 0.615” (9.27 - 15.62mm)

**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)

### Adaptor, Stone Type, Replacement Wedge

<table>
<thead>
<tr>
<th>Diameter Range</th>
<th>Mandrel (includes Wedge)</th>
<th>Adaptor</th>
<th>Stone Type</th>
<th>Replacement Wedge</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Inch</strong></td>
<td><strong>Soft</strong></td>
<td><strong>Hard</strong></td>
<td><strong>Brass</strong></td>
<td><strong>Hard</strong></td>
</tr>
<tr>
<td><strong>mm</strong></td>
<td><strong>NB</strong></td>
<td><strong>SD</strong></td>
<td><strong>LB</strong></td>
<td><strong>NB</strong></td>
</tr>
<tr>
<td>0.365-0.380</td>
<td>9.27-9.65</td>
<td>SS365/3NB</td>
<td>HS365/3NB</td>
<td>B365/3NB</td>
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<td>0.380-0.395</td>
<td>9.65-10.03</td>
<td>SS380/3NB</td>
<td>HS380/3NB</td>
<td>B380/3NB</td>
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<tr>
<td>0.390-0.413</td>
<td>9.90-10.50</td>
<td>SS390/3NB</td>
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<td>0.395-0.410</td>
<td>10.03-10.41</td>
<td>SS395/3NB</td>
<td>HS395/3NB</td>
<td>B395/3NB</td>
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<td>0.410-0.425</td>
<td>10.41-10.80</td>
<td>SS410/3NB</td>
<td>HS410/3NB</td>
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<td>0.425-0.440</td>
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<tr>
<td>0.440-0.460</td>
<td>11.18-11.68</td>
<td>SS440/3NB</td>
<td>HS440/3NB</td>
<td>B440/3NB</td>
</tr>
<tr>
<td>0.460-0.490</td>
<td>11.68-12.45</td>
<td>SS460/3NB</td>
<td>HS460/3NB</td>
<td>B460/3NB</td>
</tr>
<tr>
<td>0.468-0.492</td>
<td>11.90-12.50</td>
<td>HS468/3NB</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Adaptor**
- MA156/5

**Stone Type**
- NB

**Replacement Wedge**
- 10913

<table>
<thead>
<tr>
<th>Diameter Range</th>
<th>Mandrel (includes Wedge)</th>
<th>Adaptor</th>
<th>Stone Type</th>
<th>Replacement Wedge</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Inch</strong></td>
<td><strong>Soft</strong></td>
<td><strong>Hard</strong></td>
<td><strong>Brass</strong></td>
<td><strong>Hard</strong></td>
</tr>
<tr>
<td><strong>mm</strong></td>
<td><strong>NB</strong></td>
<td><strong>SD</strong></td>
<td><strong>LB</strong></td>
<td><strong>NB</strong></td>
</tr>
<tr>
<td>0.490-0.520</td>
<td>12.45-13.21</td>
<td>SS490/4SD</td>
<td>HS490/4SD</td>
<td>B490/4SD</td>
</tr>
<tr>
<td>0.520-0.550</td>
<td>13.21-13.97</td>
<td>SS520/4SD</td>
<td>HS520/4SD</td>
<td>B520/4SD</td>
</tr>
<tr>
<td>0.543-0.571</td>
<td>13.80-14.50</td>
<td>SS543/4SD</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.550-0.580</td>
<td>13.97-14.73</td>
<td>SS550/4SD</td>
<td>HS550/4SD</td>
<td>B550/4SD</td>
</tr>
<tr>
<td>0.580-0.615</td>
<td>14.73-15.62</td>
<td>SS580/4SD</td>
<td>HS580/4SD</td>
<td>B580/4SD</td>
</tr>
<tr>
<td>0.600-0.615</td>
<td>15.24-15.62</td>
<td>SS600/4SD</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Adaptor**
- MA156/5

**Stone Type**
- SD

**Replacement Wedge**
- 10915

**Wedge Lift Angle**
- 10°

---

### 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)

### Diameter Range 0.615 - 1.020” (15.62 - 25.91mm)

<table>
<thead>
<tr>
<th>Short Series</th>
<th>ND</th>
<th>Long Series</th>
<th>GG</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diameter Range</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inch</td>
<td>mm</td>
<td>In</td>
<td>Out</td>
</tr>
<tr>
<td>0.615-0.645</td>
<td>15.62-16.38</td>
<td>Hard</td>
<td>PT615/4ND</td>
</tr>
<tr>
<td>0.622-0.650</td>
<td>15.80-16.50</td>
<td>Hard</td>
<td>PT622</td>
</tr>
<tr>
<td>0.645-0.675</td>
<td>16.38-17.15</td>
<td>Hard</td>
<td>PT645/4ND</td>
</tr>
<tr>
<td>0.675-0.705</td>
<td>17.15-17.91</td>
<td>Hard</td>
<td>PT705</td>
</tr>
<tr>
<td>0.705-0.740</td>
<td>17.91-18.80</td>
<td>Hard</td>
<td>PT740/4ND</td>
</tr>
</tbody>
</table>

### 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

<table>
<thead>
<tr>
<th>Diameter Range</th>
<th>Mandrel (includes Wedge)</th>
<th>Truing Sleeve</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inch</td>
<td>mm</td>
<td>Hard</td>
</tr>
<tr>
<td>0.770-0.800</td>
<td>19.56-20.32</td>
<td>HS770/4ND</td>
</tr>
<tr>
<td>0.800-0.830</td>
<td>20.32-21.08</td>
<td>HS800/4ND</td>
</tr>
<tr>
<td>0.830-0.865</td>
<td>21.08-21.97</td>
<td>HS830/4ND</td>
</tr>
<tr>
<td>0.865-0.895</td>
<td>21.97-22.73</td>
<td>HS865/4ND</td>
</tr>
<tr>
<td>0.895-0.925</td>
<td>22.73-23.49</td>
<td>HS895/4ND</td>
</tr>
<tr>
<td>0.925-0.955</td>
<td>23.49-24.25</td>
<td>HS925/4ND</td>
</tr>
<tr>
<td>0.955-0.990</td>
<td>24.25-25.14</td>
<td>HS955/4ND</td>
</tr>
<tr>
<td>0.976-1.004</td>
<td>24.80-25.50</td>
<td>HS976/4ND</td>
</tr>
<tr>
<td>0.990-1.020</td>
<td>25.14-25.91</td>
<td>HS990/4ND</td>
</tr>
</tbody>
</table>

| Replacement Wedge | 10915 | 10917 |

**Wedge Lift Angle**

| Angle | 10° | 9° |

Engis® Multi-stroke Honing
Permanent Type Mandrels (PT)
Diameter Range 1.000 - 2.625” (25.4 - 66.68mm)

For “Blind Hole” configurations see page 18

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

<table>
<thead>
<tr>
<th>Range</th>
<th>Short Series</th>
<th>Long Series</th>
<th>Extra Long Series</th>
<th>Truing Sleeves</th>
<th>Shoes</th>
<th>Cast Iron</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.000-1.125</td>
<td>PT1000/6</td>
<td>PT1000/9</td>
<td>PT1000/12</td>
<td>ST1000</td>
<td>L1059B</td>
<td>L1070C</td>
</tr>
<tr>
<td>1.125-1.250</td>
<td>PT1125/6</td>
<td>PT1125/9</td>
<td>PT1125/12</td>
<td>ST1125</td>
<td>L1060B</td>
<td>L1071C</td>
</tr>
<tr>
<td>1.250-1.375</td>
<td>PT1250/6</td>
<td>PT1250/9</td>
<td>PT1250/12</td>
<td>ST1250</td>
<td>L1061B</td>
<td>L1072C</td>
</tr>
<tr>
<td>1.375-1.500</td>
<td>PT1375/6</td>
<td>PT1375/9</td>
<td>PT1375/12</td>
<td>ST1375</td>
<td>L1062B</td>
<td>L1073C</td>
</tr>
<tr>
<td>1.500-1.625</td>
<td>PT1500/6</td>
<td>PT1500/9</td>
<td>PT1500/12</td>
<td>ST1500</td>
<td>L1063B</td>
<td>L1074C</td>
</tr>
<tr>
<td>1.625-1.750</td>
<td>PT1625/6</td>
<td>PT1625/9</td>
<td>PT1625/12</td>
<td>ST1625</td>
<td>L1064B</td>
<td>L1075C</td>
</tr>
<tr>
<td>1.750-1.875</td>
<td>PT1750/6</td>
<td>PT1750/9</td>
<td>PT1750/12</td>
<td>ST1750</td>
<td>L1065B</td>
<td>L1076C</td>
</tr>
</tbody>
</table>

Stone Type for Open Hole
- F1
- F2
- F2

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)

### Open Hole

<table>
<thead>
<tr>
<th>Mandrel Type</th>
<th>Series</th>
<th>Length A</th>
<th>Stone B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extra Long (3 stones)</td>
<td>PT2625/12 - PT3000/12</td>
<td>12.68” (322mm)</td>
<td>3 x 3.25” (82.5mm)</td>
</tr>
</tbody>
</table>

### Range Mandrel (includes Wedge) Truing Sleeves Shoes

<table>
<thead>
<tr>
<th>Inch</th>
<th>mm</th>
<th>Mandrel (includes Wedge)</th>
<th>Truing Sleeves</th>
<th>Shoes</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.625-2.750</td>
<td>66.68-69.85</td>
<td>PT2625/12</td>
<td>ST2625</td>
<td>1705101</td>
</tr>
<tr>
<td>2.750-2.875</td>
<td>69.85-73.03</td>
<td>PT2750/12</td>
<td>ST2750</td>
<td></td>
</tr>
<tr>
<td>2.875-3.000</td>
<td>73.03-76.20</td>
<td>PT2875/12</td>
<td>ST2875</td>
<td></td>
</tr>
<tr>
<td>3.000-3.125</td>
<td>76.20-79.37</td>
<td>PT3000/12</td>
<td>ST3000</td>
<td></td>
</tr>
</tbody>
</table>

Stone Type for Open Hole F1
Open Hole Replacement Wedge 10943
Stone Type for Blind Hole F2
Blind Hole Replacement Wedge 10944

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

### Stone Selection
- For full range of abrasive types available, see page 4.

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 1.000 - 3.125” (25.4 - 79.37mm)

<table>
<thead>
<tr>
<th>Mandrel Type</th>
<th>Series</th>
<th>Length A</th>
<th>Stone B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Short (1 stone)</td>
<td>PT1000/6 - PT2500/6</td>
<td>7.09” (180mm)</td>
<td>3.25” (82.5mm)</td>
</tr>
<tr>
<td>Long (1 stone)</td>
<td>PT1000/9 - PT2500/9</td>
<td>10.44” (265mm)</td>
<td>3.25” (82.5mm)</td>
</tr>
<tr>
<td>Extra Long (2 stones)</td>
<td>PT1000/12 - PT3000/12</td>
<td>13.79” (350mm)</td>
<td>7.56” (192mm)</td>
</tr>
</tbody>
</table>

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.

<table>
<thead>
<tr>
<th>Blind Hole</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
</tr>
<tr>
<td>B</td>
</tr>
</tbody>
</table>

for “Open Hole” configuration see pages 16/17
# Hard Steel Keyway Mandrels (HSK)

**Diameter Range 0.245 - 1.020” (6.22 - 25.91mm)**

**Mandrel Type**

<table>
<thead>
<tr>
<th>Diameter Range</th>
<th>Mandrel Type</th>
<th>Length A</th>
<th>Stone B</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.245 - 0.260</td>
<td>HSK245/3 - HSK355/3</td>
<td>2.95” (75mm)</td>
<td>.875” (22.2mm)</td>
</tr>
<tr>
<td>0.260 - 0.275</td>
<td>HSK260/3 - HSK460/3</td>
<td>3.42” (87mm)</td>
<td>1.25” (31.7mm)</td>
</tr>
<tr>
<td>0.275 - 0.305</td>
<td>HSK325/3 - HSK990/4</td>
<td>3.97” (101mm)</td>
<td>1.75” (44.4mm)</td>
</tr>
</tbody>
</table>

**Range Short Series Truing Sleeves Stone Type Replacement Wedge Adaptor ISO Keyway**

<table>
<thead>
<tr>
<th>Inch</th>
<th>mm</th>
<th>HSK245/3K1 ST245</th>
<th>K1</th>
<th>10919</th>
<th>MA156/3</th>
<th>0.125” (3.18mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.245-0.260</td>
<td>6.22-6.60</td>
<td>HSK245/3K1 ST245</td>
<td>K1</td>
<td>10919</td>
<td>MA156/3</td>
<td>0.125” (3.18mm)</td>
</tr>
<tr>
<td>0.260-0.275</td>
<td>6.60-6.99</td>
<td>HSK260/3K1 ST260</td>
<td>K1</td>
<td>10919</td>
<td>MA156/3</td>
<td>0.125” (3.18mm)</td>
</tr>
<tr>
<td>0.275-0.305</td>
<td>6.99-7.37</td>
<td>HSK275/3K1 ST275</td>
<td>K1</td>
<td>10919</td>
<td>MA156/3</td>
<td>0.125” (3.18mm)</td>
</tr>
<tr>
<td>0.290-0.305</td>
<td>7.37-7.75</td>
<td>HSK290/3K1 ST290</td>
<td>K1</td>
<td>10919</td>
<td>MA156/3</td>
<td>0.125” (3.18mm)</td>
</tr>
<tr>
<td>0.305-0.325</td>
<td>7.75-8.26</td>
<td>HSK305/3K1 ST305</td>
<td>K2</td>
<td>10920</td>
<td>MA156/4</td>
<td>0.156” (3.96mm)</td>
</tr>
<tr>
<td>0.325-0.355</td>
<td>8.26-8.51</td>
<td>HSK325/3K1 ST325</td>
<td>K3</td>
<td>10920</td>
<td>MA156/4</td>
<td>0.156” (3.96mm)</td>
</tr>
<tr>
<td>0.355-0.365</td>
<td>8.97-9.27</td>
<td>HSK355/3K1 ST355</td>
<td>K4</td>
<td>10920</td>
<td>MA156/5</td>
<td>0.1875” (4.76mm)</td>
</tr>
<tr>
<td>0.365-0.380</td>
<td>9.27-9.65</td>
<td>HSK365/3K1 ST365</td>
<td>K5</td>
<td>10920</td>
<td>MA156/5</td>
<td>0.1875” (4.76mm)</td>
</tr>
<tr>
<td>0.380-0.395</td>
<td>9.65-10.03</td>
<td>HSK380/3K1 ST380</td>
<td>K5</td>
<td>10920</td>
<td>MA156/5</td>
<td>0.1875” (4.76mm)</td>
</tr>
<tr>
<td>0.395-0.410</td>
<td>10.03-10.41</td>
<td>HSK395/3K1 ST395</td>
<td>K5</td>
<td>10920</td>
<td>MA156/5</td>
<td>0.1875” (4.76mm)</td>
</tr>
<tr>
<td>0.410-0.425</td>
<td>10.41-10.80</td>
<td>HSK410/3K1 ST410</td>
<td>K5</td>
<td>10920</td>
<td>MA156/5</td>
<td>0.1875” (4.76mm)</td>
</tr>
<tr>
<td>0.425-0.440</td>
<td>10.80-11.18</td>
<td>HSK425/3K1 ST425</td>
<td>K5</td>
<td>10920</td>
<td>MA156/5</td>
<td>0.1875” (4.76mm)</td>
</tr>
<tr>
<td>0.440-0.460</td>
<td>11.18-11.68</td>
<td>HSK440/3K1 ST440</td>
<td>K5</td>
<td>10920</td>
<td>MA156/5</td>
<td>0.1875” (4.76mm)</td>
</tr>
<tr>
<td>0.460-0.490</td>
<td>11.68-12.45</td>
<td>HSK460/3K1 ST460</td>
<td>K6</td>
<td>10921</td>
<td>MA156/6</td>
<td>0.1875” (4.76mm)</td>
</tr>
<tr>
<td>0.490-0.520</td>
<td>12.45-13.21</td>
<td>HSK490/4K4 ST490</td>
<td>K6</td>
<td>10921</td>
<td>MA156/6</td>
<td>0.1875” (4.76mm)</td>
</tr>
<tr>
<td>0.520-0.550</td>
<td>13.21-13.97</td>
<td>HSK520/4K4 ST520</td>
<td>K6</td>
<td>10921</td>
<td>MA156/6</td>
<td>0.1875” (4.76mm)</td>
</tr>
<tr>
<td>0.550-0.580</td>
<td>13.97-14.73</td>
<td>HSK550/4K5 ST550</td>
<td>K6</td>
<td>10921</td>
<td>MA156/6</td>
<td>0.1875” (4.76mm)</td>
</tr>
<tr>
<td>0.580-0.615</td>
<td>14.73-15.62</td>
<td>HSK580/4K5 ST580</td>
<td>K6</td>
<td>10921</td>
<td>MA156/6</td>
<td>0.1875” (4.76mm)</td>
</tr>
<tr>
<td>0.615-0.645</td>
<td>15.62-16.38</td>
<td>HSK615/4K6 ST615</td>
<td>K6</td>
<td>10921</td>
<td>MA156/6</td>
<td>0.1875” (4.76mm)</td>
</tr>
<tr>
<td>0.645-0.675</td>
<td>16.38-17.15</td>
<td>HSK645/4K6 ST645</td>
<td>K6</td>
<td>10921</td>
<td>MA156/6</td>
<td>0.1875” (4.76mm)</td>
</tr>
<tr>
<td>0.675-0.705</td>
<td>17.15-17.91</td>
<td>HSK675/4K6 ST675</td>
<td>K6</td>
<td>10921</td>
<td>MA156/6</td>
<td>0.1875” (4.76mm)</td>
</tr>
<tr>
<td>0.705-0.740</td>
<td>17.91-18.60</td>
<td>HSK705/4K7 ST705</td>
<td>K7</td>
<td>10921</td>
<td>MA156/6</td>
<td>0.1875” (4.76mm)</td>
</tr>
<tr>
<td>0.740-0.770</td>
<td>18.60-19.56</td>
<td>HSK740/4K7 ST740</td>
<td>K7</td>
<td>10921</td>
<td>MA156/6</td>
<td>0.1875” (4.76mm)</td>
</tr>
<tr>
<td>0.770-0.800</td>
<td>19.56-20.32</td>
<td>HSK770/4K8 ST770</td>
<td>K8</td>
<td>10921</td>
<td>MA156/18</td>
<td>0.25” (6.35mm)</td>
</tr>
<tr>
<td>0.800-0.830</td>
<td>20.32-21.08</td>
<td>HSK800/4K8 ST800</td>
<td>K8</td>
<td>10921</td>
<td>MA156/18</td>
<td>0.25” (6.35mm)</td>
</tr>
<tr>
<td>0.830-0.865</td>
<td>21.08-21.97</td>
<td>HSK830/4K9 ST830</td>
<td>K8</td>
<td>10921</td>
<td>MA156/18</td>
<td>0.25” (6.35mm)</td>
</tr>
<tr>
<td>0.865-0.895</td>
<td>21.97-22.73</td>
<td>HSK865/4K9 ST865</td>
<td>K8</td>
<td>10921</td>
<td>MA156/18</td>
<td>0.25” (6.35mm)</td>
</tr>
<tr>
<td>0.895-0.925</td>
<td>22.73-23.49</td>
<td>HSK895/4K9 ST895</td>
<td>K8</td>
<td>10921</td>
<td>MA156/18</td>
<td>0.25” (6.35mm)</td>
</tr>
<tr>
<td>0.925-0.955</td>
<td>23.49-24.25</td>
<td>HSK925/4K9 ST925</td>
<td>K8</td>
<td>10921</td>
<td>MA156/18</td>
<td>0.25” (6.35mm)</td>
</tr>
<tr>
<td>0.955-0.990</td>
<td>24.25-25.14</td>
<td>HSK955/4K9 ST955</td>
<td>K8</td>
<td>10921</td>
<td>MA156/18</td>
<td>0.25” (6.35mm)</td>
</tr>
<tr>
<td>0.990-1.020</td>
<td>25.14-25.91</td>
<td>HSK990/4K10 ST990</td>
<td>K8</td>
<td>10921</td>
<td>MA156/18</td>
<td>0.25” (6.35mm)</td>
</tr>
</tbody>
</table>

**Wedge Lift Angle**

| K1 | 5° |
| K2 - K10 | 18° |

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

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

Engis® Multi-stroke Honing 19
Permanent Type Keyway Mandrels (PTK)

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**

<table>
<thead>
<tr>
<th></th>
<th>Length A</th>
<th>Stone B</th>
</tr>
</thead>
<tbody>
<tr>
<td>PTK1000/6 - PTK2500/6</td>
<td>6” (152mm)</td>
<td>1 x 3.25” (82.5mm)</td>
</tr>
<tr>
<td>PTK1000/9 - PTK2500/9</td>
<td>9.34” (237mm)</td>
<td>2 x 3.25” (82.5mm)</td>
</tr>
<tr>
<td>PTK1000/12 - PTK2500/12</td>
<td>12.69” (322mm)</td>
<td>3 x 3.25” (82.5mm)</td>
</tr>
</tbody>
</table>

**Range**

**Inch** | **mm** | **Short Series** | **Long Series** | **Extra Long Series** | **Truing Sleeves** | **Stone Type** | **Cast Iron Shoes** | **ISO Keyway** |
<table>
<thead>
<tr>
<th></th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1.000-1.125</td>
<td>25.40-28.57</td>
<td>PTK1000/6</td>
<td>PTK1000/9</td>
<td>PTK1000/12</td>
<td>ST1000</td>
<td>K11</td>
<td>L1070C</td>
<td>10mm</td>
</tr>
<tr>
<td>1.125-1.250</td>
<td>28.57-31.75</td>
<td>PTK1125/6</td>
<td>PTK1125/9</td>
<td>PTK1125/12</td>
<td>ST1125</td>
<td>K11</td>
<td>L1071C</td>
<td>10mm</td>
</tr>
<tr>
<td>1.250-1.375</td>
<td>31.75-34.93</td>
<td>PTK1250/6</td>
<td>PTK1250/9</td>
<td>PTK1250/12</td>
<td>ST1250</td>
<td>K12</td>
<td>L1072C</td>
<td>12mm</td>
</tr>
<tr>
<td>1.375-1.500</td>
<td>34.93-38.10</td>
<td>PTK1375/6</td>
<td>PTK1375/9</td>
<td>PTK1375/12</td>
<td>ST1375</td>
<td>K12</td>
<td>L1073C</td>
<td>12mm</td>
</tr>
<tr>
<td>1.500-1.625</td>
<td>38.10-41.28</td>
<td>PTK1500/6</td>
<td>PTK1500/9</td>
<td>PTK1500/12</td>
<td>ST1500</td>
<td>K12</td>
<td>L1074C</td>
<td>12mm</td>
</tr>
<tr>
<td>1.625-1.750</td>
<td>41.28-44.45</td>
<td>PTK1625/6</td>
<td>PTK1625/9</td>
<td>PTK1625/12</td>
<td>ST1625</td>
<td>K12</td>
<td>L1075C</td>
<td>12mm</td>
</tr>
<tr>
<td>1.750-1.875</td>
<td>44.45-47.63</td>
<td>PTK1750/6</td>
<td>PTK1750/9</td>
<td>PTK1750/12</td>
<td>ST1750</td>
<td>K12</td>
<td>L1075C</td>
<td>12mm</td>
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</tbody>
</table>

**Replacement Wedge**

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>10945</td>
<td>10946</td>
<td>10947</td>
</tr>
</tbody>
</table>

**Range**

**Inch** | **mm** | **Short Series** | **Long Series** | **Extra Long Series** | **Truing Sleeves** | **Stone Type** | **Cast Iron Shoes** | **ISO Keyway** |
<table>
<thead>
<tr>
<th></th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1.875-2.000</td>
<td>47.63-50.80</td>
<td>PTK1875/6</td>
<td>PTK1875/9</td>
<td>PTK1875/12</td>
<td>ST1875</td>
<td>K13</td>
<td>L1076C</td>
<td>14mm</td>
</tr>
<tr>
<td>2.000-2.125</td>
<td>50.80-53.98</td>
<td>PTK2000/6</td>
<td>PTK2000/9</td>
<td>PTK2000/12</td>
<td>ST2000</td>
<td>K14</td>
<td>L1076C</td>
<td>16mm</td>
</tr>
<tr>
<td>2.125-2.250</td>
<td>53.98-57.15</td>
<td>PTK2125/6</td>
<td>PTK2125/9</td>
<td>PTK2125/12</td>
<td>ST2125</td>
<td>K14</td>
<td>L1076C</td>
<td>16mm</td>
</tr>
<tr>
<td>2.250-2.375</td>
<td>57.15-60.33</td>
<td>PTK2250/6</td>
<td>PTK2250/9</td>
<td>PTK2250/12</td>
<td>ST2250</td>
<td>K15</td>
<td>L1077C</td>
<td>18mm</td>
</tr>
<tr>
<td>2.375-2.500</td>
<td>60.33-63.50</td>
<td>PTK2375/6</td>
<td>PTK2375/9</td>
<td>PTK2375/12</td>
<td>ST2375</td>
<td>K15</td>
<td>L1077C</td>
<td>18mm</td>
</tr>
<tr>
<td>2.500-2.625</td>
<td>63.50-66.68</td>
<td>PTK2500/6</td>
<td>PTK2500/9</td>
<td>PTK2500/12</td>
<td>ST2500</td>
<td>K15</td>
<td>L1077C</td>
<td>18mm</td>
</tr>
</tbody>
</table>

**Replacement Wedge**

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>10948</td>
<td>10949</td>
<td>10950</td>
</tr>
</tbody>
</table>

**Stone Lift Angle**

11°

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

<table>
<thead>
<tr>
<th>Stone Type</th>
<th>Diameter Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>26</td>
<td>Ø1.00 - 1.25”</td>
</tr>
<tr>
<td>27</td>
<td>Ø1.25 - 1.50”</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Stone Type</th>
<th>Diameter Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>28</td>
<td>Ø1.50 - 1.75”</td>
</tr>
<tr>
<td>29</td>
<td>Ø1.75 - 2.00”</td>
</tr>
<tr>
<td>30</td>
<td>Ø2.00 - 2.20”</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Stone Type</th>
<th>Diameter Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>T</td>
<td>Ø2.00 - 2.20”</td>
</tr>
<tr>
<td>U</td>
<td>Ø2.20 - 2.40”</td>
</tr>
<tr>
<td>V</td>
<td>Ø2.40 - 2.69”</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Stone Type</th>
<th>Diameter Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>G</td>
<td>Ø2.56 - 3.90”</td>
</tr>
<tr>
<td>M</td>
<td>Ø2.68 - 4.21”</td>
</tr>
</tbody>
</table>

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 Ø0.395-1.02” (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.

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”
1851 = No.12 - 0.366-0.468”
1852 = No.14 - 0.394-0.539”
1853 = No.17 - 0.492-0.638”
1854 = No.19 - 0.602-0.748”

1855 = No.21 - 0.657-0.803”
1856 = No.22 - 0.736-0.874”
1857 = No.25 - 0.866-0.933”
1858 = No.27 - 0.846-1.0”

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
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 1/2 times the bore length.

Blind Bores
The range of “CCS” mandrels are NOT suitable for blind hole use.

SS, HS, B & PT - Ø0.12”-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 - Ø1.0”-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 than twice the center distance of the tandem bores.

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 Ø1.102” (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 Ø1.02” (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 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 1 1/2 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.

---

**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
Leaders in Superabrasive Finishing Systems

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