INDUSTRIAL PRODUCTS

Superabrasive Finishing Products for Industrial Applications

Engis®

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DIAMOND AND CBN POWDERS

FASTER • MORE EFFICIENT • CLEANER • ENVIRONMENTALLY FRIENDLY

Engis superabrasive powders are available in a wide variety of diamond types, sizes and shapes. There is always one trait that is common to each and every lot of Engis diamond powder – QUALITY!

We process our diamond powder to exacting specifications, selecting only the finest diamond feedstocks. This careful selection of feedstocks, coupled with our special grading process, ensures that you receive diamond powder that meets stringent quality and repeatability criteria. Each lot of diamond powder is individually checked for size, shape and cleanliness. This process ensures consistent quality and superior performance suited to your individual application.

Each micron diamond and CBN product is designed, manufactured & qualified to possess a specific set of chemical & physical properties which ensure its performance.

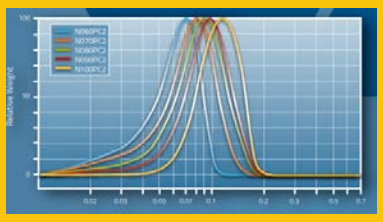
Engis understands how to repeatedly create new breakthroughs for our customers.

We have worked with the world's leading manufacturing companies for decades, engineering surface finishing processes that enable continuous improvements in their specific applications.

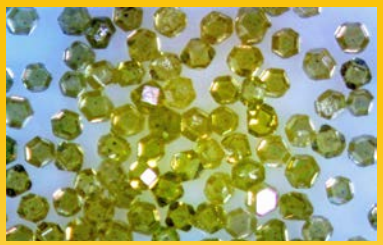
The 5 Keys to Diamond Characterization

- Close monitoring of incoming raw diamond
- Enhanced PSD grading to create standard and custom grades
- Shape of the diamond is closely monitored
- Monitor crushing strength & fracture characteristics
- Remove surface contaminants via proprietary process

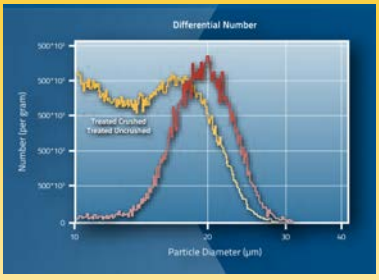
Consistency of Diamond Materials
Assess size, shape, purity, residual crystal growth defects



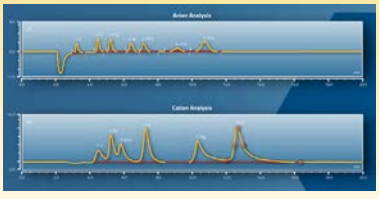
Particle Size Distribution
Ensure consistent PSD from 25 nm to 60 microns



Shape
Dynamic analysis of particle shape characteristics



Mechanical Strength
Monitor crushing strength, fracture characteristics



Surface Cleanliness
Remove surface contaminants via proprietary process

Grinding, Lapping & Polishing Applications

Engis micron diamond and CBN powders can be used in a wide variety of precision grinding, slicing, dicing and lapping & polishing applications, as well as feedstock for the manufacturing of PDC/PCD & PCBN Products. Our superior micronizing capability gives cleaner, more consistent performance results.

METAL BOND DIAMOND POWDERS - Monocrystalline micron and nanometer size diamond that exhibit 3D blocky particle shape. Benefits are aggressive stock removal and superior surface finishing properties.

RESIN BOND DIAMOND POWDERS - Monocrystalline diamond that exhibits typical sharp friable resin bond particles. Micronized from selected industrial grade powders.

POLYCRYSTALLINE DIAMOND POWDERS - Blocky structure with a rough surface texture that microfractures during use. PC powders give you high removal rates while producing excellent surface finishes.

DIAMOND Powders for Abrasive Applications (0.1 - 60 µm)

MA4 - Metal Bond Diamond	Grinding Wheels
RA - Resin Bond Diamond	Lapping & Polishing Slurries & Compounds
PC, PC4 - Polycrystalline Diamond	

DIAMOND Powders for Precision Applications (50nm - 30 µm)

MA4-P - Metal Bond Diamond	Manufacturing of Precision Grinding, Slicing & Dicing Wheels
RA-P - Resin Bond Diamond	Precision Lapping & Polishing Slurries & Compounds
PC-P - Polycrystalline Diamond	

CBN Powders for Abrasive Applications (0.1 - 60 µm)

CBN-A - Cubic Boron Nitride (Amber)	Grinding Wheels
CBN-B - Cubic Boron Nitride (Black)	Honing Tools

DIAMOND Powders for HPHT Sintering of PCD (0.5 - 50 µm)

MA4 PCD-F - Specialty Metal Bond Diamond	High Pressure-High Temperature Sintering of PCD Products, Cutters, Blanks, Dies, etc.

CBN Powders for HPHT Sintering of PCBN (0.5 - 50 µm)

PCBNF-A/B- Specialty Amber/Black CBN Powders	High Pressure-High Temperature Sintering of PCBN Products

LAPPING AND POLISHING SLURRIES

Hyprez® Precision Lapping and Polishing Slurries

As part of our complete solution, Engis manufactures a full line of precision-graded diamond slurries, colloidal silica polishing slurries and aluminum oxide powder with lapping oil for achieving flatness control and excellent surface finish on a wide variety of materials.

Hyprez consumable formulas are the result of Engis' comprehensive understanding of diamond and its application in the lapping process. Our expertise on how to mill, shape and grade diamond of various types and friability is unmatched. Coupled with this experience is our knowledge of chemistry, compounding techniques, carrier formulations and concentrations which provide superior efficiencies and results. Our ISO9001 certified Quality System has made Hyprez the most trusted name in diamond consumable products throughout the world.

Slurry Formulations	Water Based	Oil Based	Emulsion	Low Viscosity (< 10 cP)	Med Viscosity (10-100 cP)	High Viscosity (Permanent Suspension)	Environmentally Friendly Components
S4243	•					•	
S7459-2	•				•		
S4889	•			•			
EcoLAP 2000	•			•			•
S1313-T4		•		•			
EcoLAP 1001		•			•		•
S841			•		•		

WHY DIAMOND FOR LAPPING & POLISHING?

- Reduce lapping times from hours to minutes
- Reduce slurry usage and waste from gallons to pints
- Achieve a reflective finish in a single step, eliminate hand polishing
- Cleaner process, cleaner part
- Process a wide variety of materials

- **Oil Based Slurries –** Our S1313-T4 is recognized as the workhorse slurry for a broad range of lapping applications. It provides superior plate wetting and highly reflective finishes.
- **Water Based Slurries –** When part clean-up is a concern, water based slurries are widely used. Hyprez formulation S4889 is available in a wide range of abrasive sizes and offers superior results in finishing a myriad of materials.
- **EcoLAP™ Slurries –** Our biodegradable EcoLAP slurries provide excellent performance on a wide variety of materials such as hard ceramics, metals and plastics.
- **Emulsion Slurries –** S841 is a good choice for final polishing steps; it maintains good particle dispersion of the diamond without settling for long periods of time. This slurry offers the benefits of oil, while still being easy to clean.
- **Suspensions –** Our S4243 water based slurry requires no stirring to maintain abrasive particle dispersion. This high viscosity suspension is useful when using a polishing pad on double sided applications where it is important to fully wet and cover the lap throughout the work cycle.

Micron Size	S1313-T4 Oil Based	S4889 Water Based	EcoLAP 1001 Oil Based	EcoLAP 2000 Water Based
PINT GLASS BOTTLE PART NUMBERS				
0.5	190.2408	190.2104	190.4155	190.4255
1	190.2411	190.2034	190.4101	190.4201
2	190.2414	190.2120	190.4102	190.4202
3	190.2417	190.2634	190.4103	190.4203
6	190.2420	190.2116	190.4106	190.4206
9	190.2423	190.2133	190.4109	190.4209
15	190.2426	190.2142	190.4115	190.4215
30	190.2429	190.2185	190.4130	190.4230
45	190.2344	190.2285	190.4145	190.4245
60	190.1517	190.2671	190.4160	190.4260

Micron Size	S1313-T4 Oil Based	S4889 Water Based	EcoLAP 1001 Oil Based	EcoLAP 2000 Water Based
GALLON PLASTIC JUG PART NUMBERS				
0.5	190.2909	190.2697	190.4172	109.4272
1	190.2570	190.2236	190.4174	190.4274
2	190.2950	190.2587	190.4175	190.4275
3	190.2577	190.2599	190.4181	190.4276
6	190.2881	190.2537	190.4179	190.4279
9	190.2902	190.2590	190.4181	190.4281
15	190.2576	190.2626	190.4184	190.4284
30	190.2873	190.2929	190.4188	190.4288
45	190.2918	190.2627	190.4192	190.4292
60	N/A	N/A	190.4195	190.4295

DIAMOND COMPOUNDS AND GELS

A comprehensive range of Hyprez® diamond compounds has been developed to meet all the variables involved in lapping and polishing including:

- **Speed of equipment**
- **Hardness of the laps**
- **Material being processed**
- **Working pressure applied to parts**
- **Amount of stock to be removed**
- **Size of area involved**

By using the proper Hyprez compound, in conjunction with the appropriate lapping and polishing machine, lap plates and accessories, you can be assured of consistent, repeatable results of the highest quality.

Engis application engineers and technical sales representatives will gladly assist you in any way possible.

	CHEMISTRY		MATERIALS				PERFORMANCE		
	Oil Based	Water Based	Carbide	Tool Steels	Ceramic	Aluminum	High Luster/ High Performance	Toolroom Application	General Purpose
FIVE-STAR Excellent cutting characteristics. Eliminates polishing steps, resulting in a better quality finish produced in less time.	•		•	•		•	•		
L COMPOUND For use on harder materials, such as tungsten carbide and ceramics. Withstands frictional heat generated during use.	•		•		•	•		•	
W Compound Cleans easily from the work-piece. Suitable for high luster polishing.		•					•	•	•
C-11 Compound For use on harder materials, such as tungsten carbide and ceramics. Cleans easily with mild detergent and water.		•	•				•		

HYPREZ® FIVE-STAR® DIAMOND COMPOUND

Five-Star is a universal compound used in virtually all applications. It is the first diamond compound to combine the excellent cutting ability of natural diamond and the durability of manufactured diamond in a precision blend that assures faster cutting and long service life.

Proven Formulation
One of the world's most widely used diamond compounds, Five-Star is formulated to withstand severe lapping conditions without loss of cutting quality. The use of a stable carrier assures sustained particle suspension throughout the process cycle.

FEATURES & BENEFITS

- **Faster cut rates**
- **Better finishes grit size to grit size**
- **Excellent surface tension**
- **Excellent adhesion to tools and surfaces**
- **Easily cleaned with water or oil based products**
- **Offered in medium, standard and strong concentrations**

Micron	Product Description	5 Gram Syringe Part Number	18 Gram Syringe Part Number	Compound Color
1/10	0.10(FS/US)MED 0.10(FS/US)STD 0.10(FS/US)STR	204.1022 204.1024 204.1026	204.1023 204.1025 204.1027	Gray
1/4	0.25(FS/US)MED 0.25 (FS/US)STD 0.25(FS/US)STR	204.1028 204.1030 204.1032	204.1029 204.1031 204.1033	Gray
1/2	0.5(FS/US)MED 0.5 (FS/US)STD 0.5(FS/US)STR	204.1034 204.1036 204.1038	204.1035 204.1037 204.1039	Gray
1	1(FS/US MED 1(FS/US)STD 1(FS/US)STR	104.1254 104.1256 104.1258	104.1255 104.1257 104.1259	Ivory
3	3(FS/US)MED 3(FS/US)STD 3(FS/US)STR	104.1260 104.1262 104.1264	104.1261 104.1263 104.1265	Yellow
6	6(FS/US)MED 6(FS/US STD 6(FS/US)STR	104.1266 104.1268 104.1270	104.1267 104.1269 104.1271	Orange
9	9(FS/US)MED 9(FS/US)STD 9(FS/US) STR	104.1272 104.1274 104.1276	104.1273 104.1275 104.1277	Green
15	15(FS/US)MED 15(FS/US)STD 15(FS/US)STR	104.1278 104.1280 104.1282	104.1279 104.1281 104.1283	Blue
30	30(FS/US)MED 30(FS/US)STD 30(FS/US)STR	104.1284 104.1286 104.1288	104.1285 104.1287 104.1289	Red
45	45(FS/US)MED 45(FS/US)STD 45(FS/US)STR	104.1290 104.1292 104.1294	104.1291 104.1293 104.1295	Brown
60	60(FS/US)MED 60(FS/US)STD 60(FS/US)STR	104.1296 104.1298 104.1300	104.1297 104.1299 104.1301	Natural

Five-Star is the Mold Polisher's choice! This compound is graded to closer tolerances than normal industry standards which results in faster and more consistent cut rates.

HYPREZ® L DIAMOND COMPOUND AND L GEL

Hyprez L diamond compounds are specially formulated for use with harder materials. Typical applications include finishing tungsten carbide tooling, rolls and balls, ceramics and coarse lapping on Hyprez natural metal and special composite laps.

Proven Formulation
Engis L compound is a uniform diamond particle suspension which is not affected by dilution; it can be thinned to any desired consistency with Hyprez OS Type IV and Hyprelube lubricants. It utilizes a special chemical carrier with increased surface tension to improve lap adhesion and will not be affected by frictional heat generated during use.

FEATURES & BENEFITS

- **Oil based**
- **Formulated for carbide, ceramics and hard metals**
- **Compound offered in medium, standard and strong concentrations**
- **Use with OS-IV Lubricant or Hyprelube® lubricant**

AVAILABLE PACKAGING

- **5 gram syringe**
- **18 gram syringe**
- **5 gram dip jar**
- **100 gram syringe**
- **100 gram jar**

Micron Size	L COMPOUND 18 Gram Part No.	L COMPOUND 100 Gram Part No.	L GEL 18 Gram Part No.	L GEL 100 Gram Part No.	Compound/Gel Color
1/10	101.6071	101.6171	101.6271	101.6371	Gray
1/4	101.6072	101.6172	101.6272	101.6372	Gray
1/2	101.6075	101.6175	101.6275	101.6375	Gray
1	101.6001	101.6101	101.6201	101.6301	Ivory
2	101.6002	101.6102	101.6202	101.6302	Light Yellow
3	101.6003	101.6103	101.6203	101.6303	Yellow
6	101.6006	101.6106	101.6206	101.6306	Orange
9	101.6009	101.6109	101.6209	101.6309	Green
15	101.6015	101.6115	101.6215	101.6315	Dark Blue
30	101.6030	101.6130	101.6230	101.6330	Red
45	101.6045	101.6145	101.6245	101.6345	Brown
60	101.6060	101.6160	101.6260	101.6360	Natural

ALL COMPOUND ITEMS SHOWN ABOVE ARE STANDARD CONCENTRATION, UNBOXED SYRINGES.

Hyprez L Compound is in the form of a thick paste, dispensed from a syringe, commonly used for hand lapping. Hyprez L GEL is also dispensed from a syringe, but with a thinner consistency where drying or caking may be an issue.

HYPREZ® W DIAMOND COMPOUND AND W GEL

Hyprez W diamond compounds are water based and clean easily from the workpiece. This compound is recommended for areas requiring a very high luster that might be adversely affected by an oil based compound.

Proven Formulation
Engis W compound was the first commercially successful diamond compound formulated by Engis. It is still in general use by the mold & die industry and precision hand lapping.

FEATURES & BENEFITS

- **Water based**
- **For parts requiring a high luster**
- **Works great on 17-4 stainless**
- **Compound offered in medium, standard and strong concentrations**
- **Use with W or Hyprelube® lubricants**

AVAILABLE PACKAGING

- **5 gram syringe**
- **18 gram syringe**
- **5 gram dip jar**
- **100 gram syringe**
- **100 gram jar**

Micron Size	W COMPOUND 18 Gram Part No.	W COMPOUND 100 Gram Part No.	Compound Color	W GEL (Natural Color) 18 Gram Part No.	W GEL (Natural Color) 100 Gram Part No.
1/10	102.6071	102.6171	Gray	102.6271	102.6371
1/4	102.6072	102.6172	Gray	102.6272	102.6372
1/2	102.6075	102.6175	Gray	102.6275	102.6375
1	102.6001	102.6101	Blue	102.6201	102.6301
2	102.6002	102.6102	Light Green	102.6202	102.6302
3	102.6003	102.6103	Green	102.6203	102.6303
6	102.6006	102.6106	Yellow	102.6206	102.6306
9	102.6009	102.6109	Blush	102.6209	102.6309
15	102.6015	102.6115	Brown	102.6215	102.6315
30	102.6030	102.6130	Mahogany	102.6230	102.6330
45	102.6045	102.6145	Purple	102.6245	102.6345
60	102.6060	102.6160	Orange	102.6260	102.6360

ALL COMPOUND ITEMS SHOWN ABOVE ARE STANDARD CONCENTRATION, UNBOXED SYRINGES.

Hyprez W Compound is in the form of a thick paste, dispensed from a syringe, commonly used for hand lapping. Hyprez W-GEL is also dispensed from a syringe, but with a thinner consistency where drying or caking may be an issue.

HYPREZ® C-11 DIAMOND COMPOUNDS

Hyprez C-11 diamond compounds are designed for the polishing of hard materials such as tungsten carbide or ceramics. Since it is water based, it cleans up nicely with mild detergent and water.

AVAILABLE PACKAGING

- 5 gram syringe
- 18 gram syringe
- Call for other sizes

Micron Size	Product Description	5 Gram Syringe Part No.	18 Gram Syringe Part No.	Compound Color
1/10	0.1(C11)STD-MA	140.1110	140.1120	Gray
1/4	0.25(C11)STD-MA	140.2030	140.1131	Gray
1/2	0.5(C11)STD-MA	140.2151	140.2152	Gray
1	1(C11)MED-MA 1(C11)STD-MA 1(C11)STR-MA	140.2045 140.2047 140.2294	140.1113 140.1107 140.1108	Light Yellow
3	3(C11)MED-MA 3(C11)STD-MA 3(C11)STR-MA	140.2271 140.1103 140.2038	140.2005 140.2006 140.1112	Yellow
6	6(C11)MED-MA 6(C11)STD-MA 6(C11)STR-MA	140.2001 140.2003 140.2039	140.2259 140.2160 140.2156	Orange
9	9(C11)MED-MA 9(C11)STD-MA 9(C11)STR-MA	140.2016 140.1104 140.1111	140.2194 140.2150 140.2285	Green
15	15(C11)MED-MA 15(C11)STD-MA 15(C11)STR-MA	140.2017 140.1106 140.1105	101.2197 140.2185 140.2125	Blue
30	30(C11)MED-MA 30(C11)STD-MA 30(C11)STR-MA	140.2068 140.2251 140.1114	140.2070 140.2257 140.2203	Red
45	45(C11)MED-MA 45(C11)STD-MA 45(C11)STR-MA	140.2077 140.2266 140.2193	140.2076 140.2261 140.2195	Brown
60	60(C11)MED-MA 60(C11)STD-MA 60(C11)STR-MA	140.2204 140.2267 140.2254	140.2201 140.2268 140.2256	Natural

LAPPING CERAMICS WITH DIAMOND

Precision lapping improved mechanical seal quality and reliability for a technical ceramics manufacturer.

OBJECTIVE:

Mechanical seal faces and sliding axial and radial bearings. Sizes ranging from less than 0.035 inches to over 20 inches in diameter for silicon carbide ceramic tile in both personal and vehicle armor.

Mechanical seals require extreme precision in terms of flatness, parallelism and finish. Seal failures in high-pressure or corrosive applications can lead to expensive repairs or result in various environmental, health and safety consequences up to and including loss of life.

SOLUTION:

The advanced materials technologies customer, coupled with Engis' machining expertise, creates the ability to tailor the topography of the seal face to precise levels, making these designs a reality.

RESULTS:

Customer's engineers partnered with Engis to meet the challenge, resulting in several modifications being made to the current Fastlap lapping machine design improving not only the cosmetics, but also the finish of the parts being processed.

HYPREZ® SPECIALTY COMPOUNDS

Engis offers a wide range of standard compounds suitable for most applications in today's manufacturing field, however, new materials or changes in the process environment may require a specialty compound formulation.

Engis' expertise in diamond micronizing, combined with our knowledge of chemistry, compounding techniques and carrier formulations, allows us to serve the ever-changing needs of industry.

When formulating specialty compounds, Engis chemists and process engineers consider all of the aspects of the customer's application that may mandate a change or modification of a compound formulation.

Among the Variables:

- Diamond concentration
- Consistency when diluted
- Diamond type
- Temperature resistance
- Carrier adhesion properties
- Dispensing and handling
- Migration flow
- Chemistry
- Solubility
- Lubricity
- Cleanability

EACH ENGIS SPECIALTY COMPOUND IS A UNIQUE BLEND OF CARRIER CHEMICAL FORMULATION, DIAMOND TYPE, SIZE AND SHAPE. THE CHARACTERISTICS ARE VERIFIED AND RIGIDLY CONTROLLED IN OUR QUALITY LABORATORY.

Scanning Electron Microscopy (SEM) provides qualitative data about diamond type, size and surface.

Optical microscope based image analysis equipment.

HYPREZ® LUBRICANTS

When selecting a lubricant for your application, care should be taken that it is chemically compatible with the compound formulation that you intend to use.

- **Hyprelube®** is a synthetic based lubricant formulated to be used with either our Five-Star® or our Industrial strength diamond compounds. This superior lubricant, with its penetrating qualities and oil/water solubility, not only increases the cutting action, but assures superior lubrication of every diamond particle throughout the polishing cycle.
- **EcoLUBE™ 101**
  This low-viscosity, oil based lubricant is compatible with L compound, L-Gel and other oil based diamond compounds.
- **EcoLUBE 200**
  This water based lubricant is compatible with Five-Star® and other water based compounds.

All Hyprez Lubricants Are Available In The Following Containers:

	Hyprelube®	EcoLUBE 101 Oil Based Lubricant	EcoLUBE 200 Water Based Lubricant
			
4 oz.	510.HL.4OZ	NA	NA
1 pt.	510.HL.1PT	510.4015	510.4080
1 qt.	510.HL.1QT	510.4017	510.4082
1 Gal.	510.HL.1GA	510.4020	510.4085
5 Gal.	510.HL.5GA	510.4022	510.4087
55 Gal.	510.HL.1DR	510.4025	510.4090

HYPREZ® HIGH INTENSITY POLISH

High Intensity Polish (HIP) safely removes haze, plate-out, oxidation and stains from any metal surface.

It's ideal for the final finish on all types of molds and dies resulting in a high luster sheen without any harsh odors.

Being easier to remove than other polishes, HIP wipes off quickly without leaving any residue.

In addition, it is non-corrosive and will clean and remove haze from the mold surface without causing spiral webs, cattails or other types of fine scratches.

FEATURES & BENEFITS

- **No harsh odors**
- **Easy application and removal**
- **Imparts a high polish finish with very little effort**
- **Can be used on typical mold steels as well as brass, bronze, chrome and aluminum**
- **Removes haze, rust, tarnish, dirt and oils**
- **Leaves a protective film which retards oxidation and rust**
- **Non-Diamond Abrasive formulation**

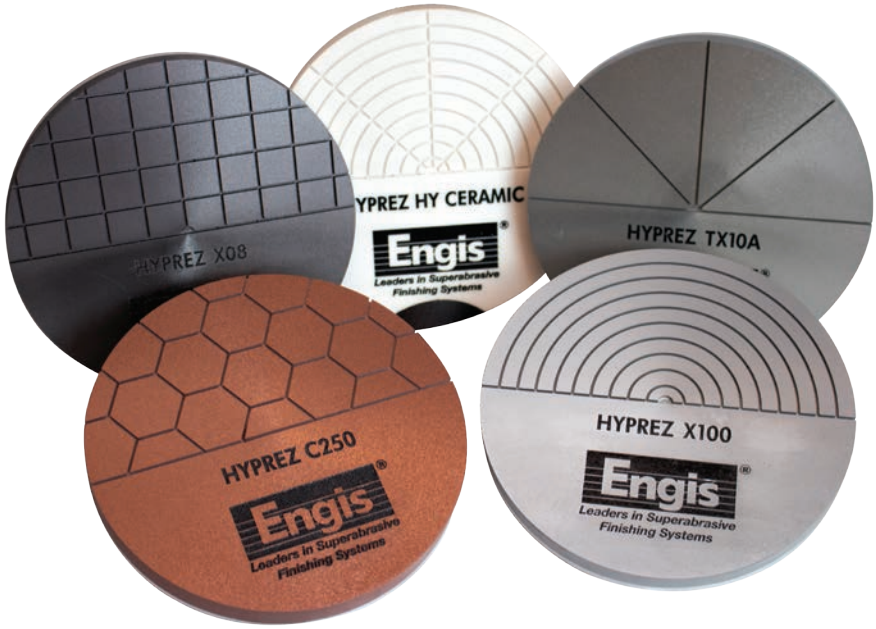
Size	Part Number
5 grams	HIP.5
10 grams	HIP.10
20 grams	HIP.20
50 grams	HIP.50
250 grams	HIP.250
500 grams (1/2 kilo)	HIP.500
1,000 grams (1 kilo)	HIP.1000

HYPREZ® PRECISION LAP PLATES

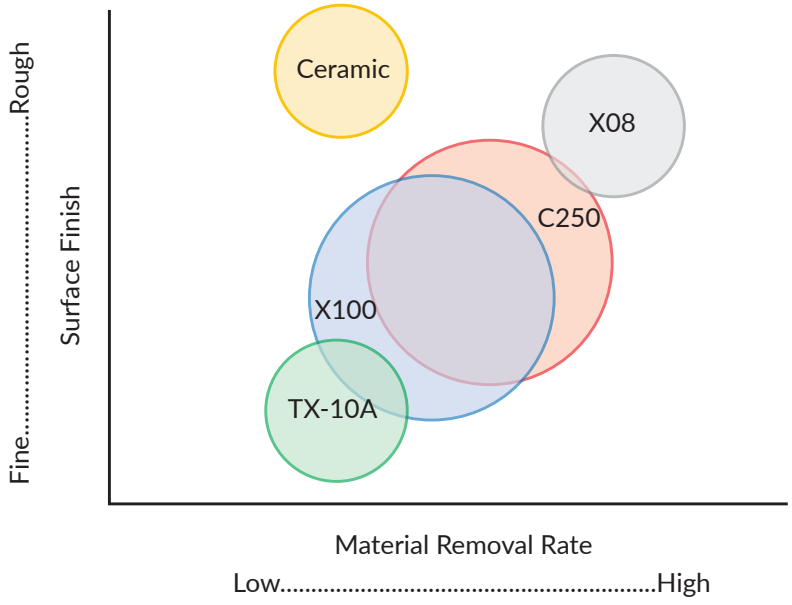
Engis manufactures a complete line of lap plates, including metal composite, solid metal, and fixed abrasive options.

An efficient lapping operation requires the selection of a proper lap plate. This selection is guided by the process objective (stock removal, fine finish), the material being lapped and the diamond size/type used in the lapping slurry.

A composite lap plate is comprised of metal or ceramic particles in a resin matrix, allowing for efficient charging of diamond abrasive particles into the plate. This charged composite plate can significantly reduce process times and achieve a finer surface finish, often in a single step. A composite plate is also well suited for a facing device, taking the guesswork out of flatness and texture control.



COMPOSITE PLATE OFFERING



LAPPING PLATES

All Engis lap plate technologies can be mounted on a customer supplied base. In addition, we can manufacture a base that would fit your machine, regardless of make and mount them with one of our engineered lap plates. Contact Engis Engineering for details.

Hyprez X08

Composite iron plate with the most aggressive stock removal; good alternative to cast iron

Product	Product Code	Description
LAP PLATE MTD ESB-CI LM	703.4737	15 x 0.5 X08 Composite Cast Iron Smooth Face
LAP PLATE MTD ESB-AL LM STD RAD GRV	703.5162	15 x 0.5 X08 Composite Cast Iron With Radial Grooves
LAP PLATE MTD ESB-CI LM STD X-Y GRV	703.4747	15 x 0.5 X08 Composite Cast Iron With Waffle Pattern
LAP PLATE MTD ESB-CI LM2803	703.6118	20 x 0.5 X08 Composite Cast Iron Smooth Face
LAP PLATE MTD ESB-AL LM STD RAD GRV	703.6148	20 x 0.5 X08 Composite Cast Iron With Radial Grooves
LAP PLATE MTD ESB-CI LM STD X-Y GRV	703.6149	20 x 0.5 X08 Composite Cast Iron With Waffle Pattern
LAP PLATE MTD ESB-CI LM0135	703.4685	24 x 0.5 X08 Composite Cast Iron With Waffle Pattern
LAP PLATE MTD ESB-CI LM0135 STD RAD GRV	703.5371	24 x 0.5 X08 Composite Cast Iron With Radial Grooves
LAP PLATE MTD ESB-CI LM0135 STD X-Y GRV	703.5793	24 x 0.5 X08 Composite Cast Iron With Waffle Pattern
LAP PLATE MTD ESB-CI LM0138	703.5882	28 x 0.5 X08 Composite Cast Iron Smooth Face
LAP PLATE MTD ESB-CI LM0138 STD RAD GRV	703.4728	28 x 0.5 X08 Composite Cast Iron With Radial Grooves
LAP PLATE MTD ESB-CI LM0135 STD X-Y GRV	703.6150	28 x 0.5 X08 Composite Cast Iron With Waffle Pattern

Hyprez C250

Composite copper plate; our most universal plate, often used for single step operations

Product	Product Code	Description
LAP PLATE MTD ESB-CI LM	703.6011	15 x 0.5 C250 Composite Copper Smooth Face
LAP PLATE MTD ESB-CI LM STD RAD GRV	703.6010	15 x 0.5 C250 Composite Copper With Radial Grooves
LAP PLATE MTD ESB-CI LM X-Y GRV	703.6151	15 x 0.5 C250 Composite Copper With Waffle Pattern
LAP PLATE MTD ESB-CI LM	703.6007	20 x 0.5 C250 Composite Copper Smooth Face
LAP PLATE MTD ESB-CI LM STD RAD GRV	703.6014	20 x 0.5 C250 Composite Copper With Radial Grooves
LAP PLATE MTD ESB-CI LM X-Y GRV	703.6152	20 x 0.5 C250 Composite Copper With Waffle Pattern
LAP PLATE MTD ESB-CI LM LM0135	703.6051	24 x 0.5 C250 Composite Copper Smooth Face
LAP PLATE MTD ESB-CI LM STD RAD GRV	703.6015	24 x 0.5 C250 Composite Copper With Radial Grooves
LAP PLATE MTD ESB-CI LM X-Y GRV	703.6129	24 x 0.5 C250 Composite Copper With Waffle Pattern
LAP PLATE MTD ESB-CI LM	703.6012	28 x 0.5 C250 Composite Copper Smooth Face
LAP PLATE MTD ESB-CI LM STD RAD GRV	703.6016	28 x 0.5 C250 Composite Copper With Radial Grooves
LAP PLATE MTD ESB-CI LM X-Y GRV	703.6158	28 x 0.5 C250 Composite Copper With Waffle Pattern

Hyprez TX-10A

Composite tin plate; very fine finish, minimizes or replaces pad polishing to maintain flatness

Product	Product Code	Description
LAP PLATE MTD ESB-CI LM	703.4774	15 x 0.5 TX-10A Composite Copper Smooth Face
LAP PLATE MTD ESB-CI LM STD RAD GRV	703.4813	15 x 0.5 TX-10A Composite Copper With Radial Grooves
LAP PLATE MTD ESB-CI LM STD X-Y GRV	703.6153	15 x 0.5 TX-10A Composite Copper With Waffle Pattern
LAP PLATE MTD ESB-AL LM2802	703.6165	20 x 0.5 TX-10A Composite Copper Smooth Face
LAP PLATE MTD ESB-AL LM2802 STD RAD GRV	703.5381	20 x 0.5 TX-10A Composite Copper With Radial Grooves
LAP PLATE MTD ESB-AL LM2802 STD X-Y GRV	703.6154	20 x 0.5 TX-10A Composite Copper With Waffle Pattern
LAP PLATE MTD ESB-CI LM0135	703.5365	24 x 0.5 TX-10A Composite Copper Smooth Face
LAP PLATE MTD ESB-CI LM0135 STD RAD GRV	703.5612	24 x 0.5 TX-10A Composite Copper With Radial Grooves
LAP PLATE MTD ESB-CI LM0135 STD X-Y GRV	703.6155	24 x 0.5 TX-10A Composite Copper With Waffle Pattern
LAP PLATE MTD ESB-CI LM0138	703.5237	28 x 0.5 TX-10A Composite Copper Smooth Face
LAP PLATE MTD ESB-CI LM0138 STD RAD GRV	703.4837	28 x 0.5 TX-10A Composite Copper With Radial Grooves
LAP PLATE MTD ESB-AL LM2802 STD X-Y GRV	703.5919	28 x 0.5 TX-10A Composite Copper With Waffle Pattern

Hyprez Cast Iron

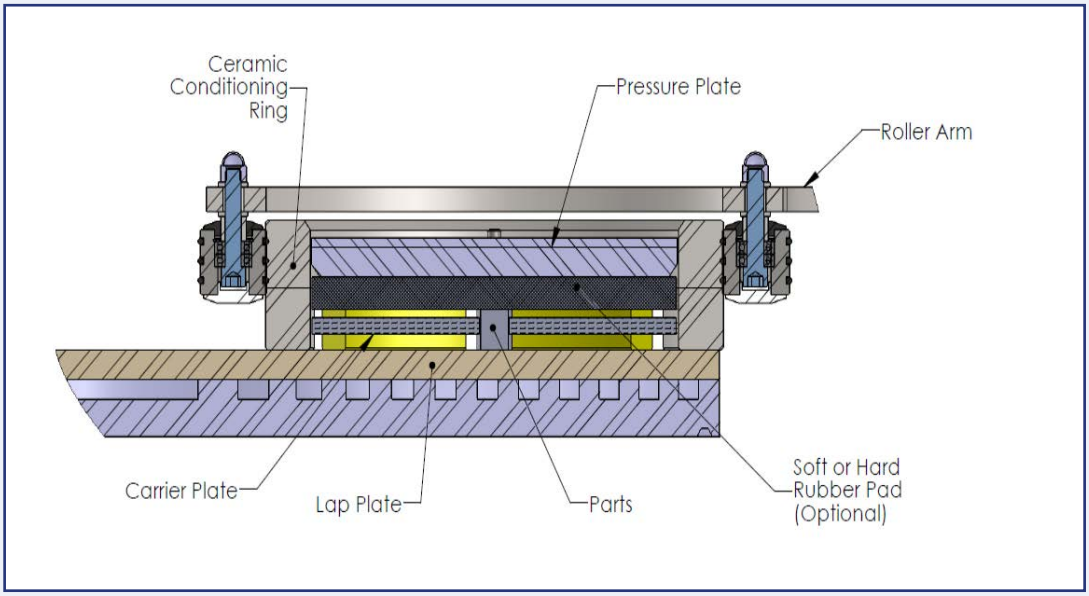
Product	Product Code	Description
LAP PLATE MTD ESB-CI	703.4485	15 x 0.5 Cast Iron Smooth Face
LAP PLATE MTD ESB-CI STD RAD GRV	703.4486	15 x 0.5 Cast Iron With Radial Grooves
LAP PLATE MTD ESB-CI STD X-Y GRV	703.6156	15 x 0.5 Cast Iron With Waffle Pattern
LAP PLATE MTD ESB-CI LM2803	703.6115	20 x 0.5 Cast Iron Smooth Face
LAP PLATE MTD ESB-CI LM2803 STD RAD GRV	703.5622	20 x 0.5 Cast Iron With Radial Grooves
LAP PLATE MTD ESB-CI LM2803 STD X-Y GRV	703.6157	20 x 0.5 Cast Iron With Waffle Pattern
LAP PLATE MTD ESB-CI LM0135	703.4530	24 x 0.5 Cast Iron Smooth Face
LAP PLATE MTD ESB-CI LM0135 STD RAD GRV	703.4408	24 x 0.5 Cast Iron With Radial Grooves
LAP PLATE MTD ESB-CI LM0135 X-Y GRV	703.6101	24 x 0.5 Cast Iron With Waffle Pattern
LAP PLATE MTD ESB-CI LM0138	703.4535	28 x 0.5 Cast Iron Smooth Face
LAP PLATE MTD ESB-CI LM0138 STD RAD GRV	703.4407	28 x 0.5 Cast Iron With Radial Grooves
LAP PLATE MTD ESB-CI LM0138 STD X-Y GRV	703.6102	28 x 0.5 Cast Iron With Waffle Pattern

Hyprez Steel Plate

Product	Product Code	Description
FL-15 STAINLESS STEEL POLISHING PLATE	FLA-15-0007	15 x 0.5 Steel Plate Smooth Face
FL-20 STAINLESS STEEL POLISHING PLATE	FLA-20-0007	20 x 0.5 Steel Plate Smooth Face
FL-24 STAINLESS STEEL POLISHING PLATE	FLA-24-0007	24 x 0.5 Steel Plate Smooth Face
FL-28 STAINLESS STEEL POLISHING PLATE	FLA-28-0007	28 x 0.5 Steel Plate Smooth Face

LAP PLATE CARE

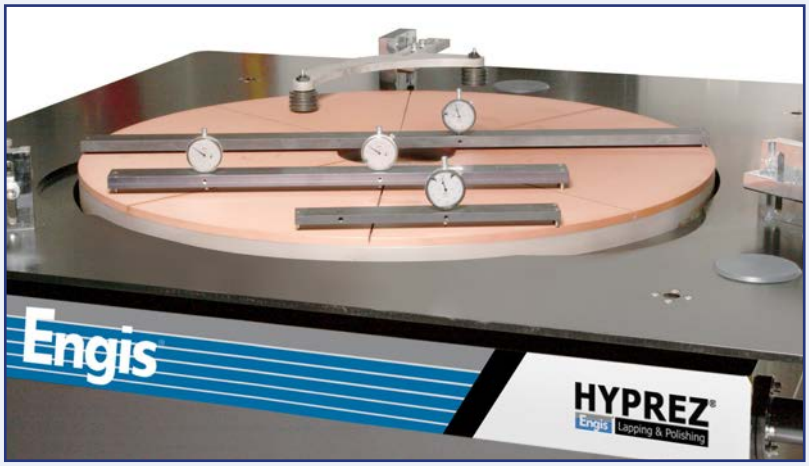
The key to achieving good finish and flatness results is maintaining good plate condition. The flatness, texture, and cleanliness of your lap plate will directly affect your process results.



√ Plate Cleaning

When necessary, clean the lap plate by rinsing and squeegeeing and/or vacuuming the excess residue. We recommend rinsing the plate with DI water and then vacuuming with a wet vac.

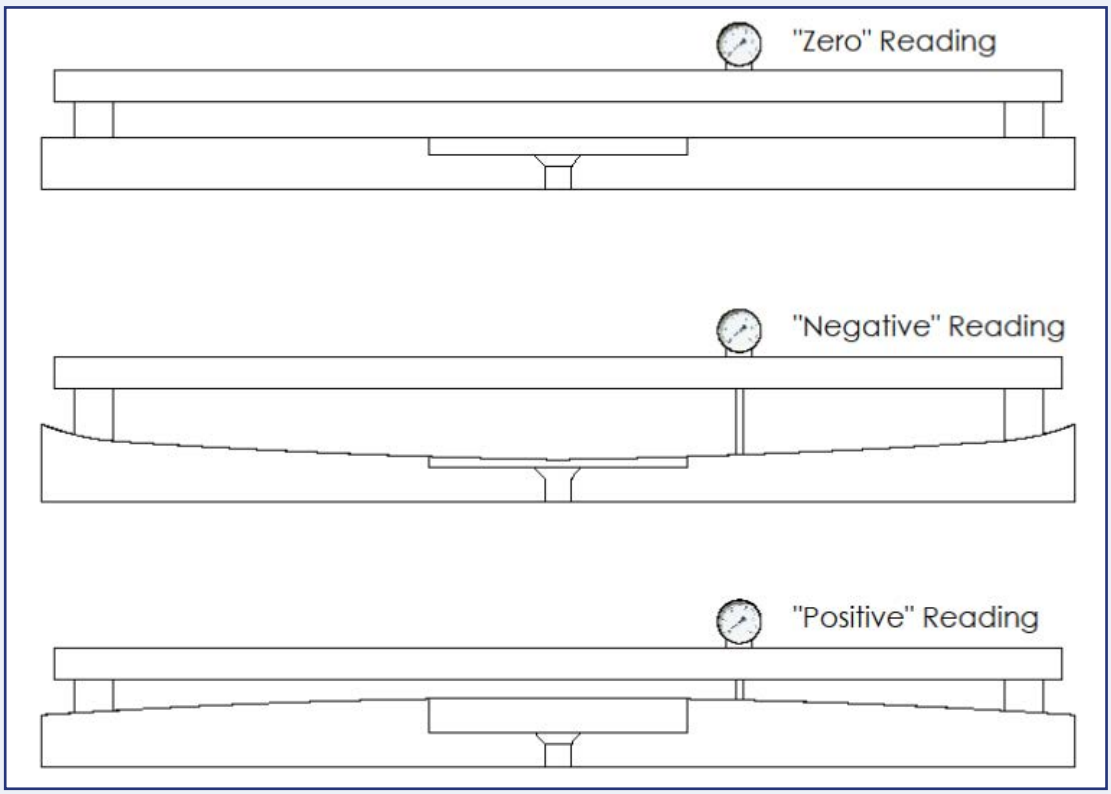
BE CAREFUL NOT TO INTRODUCE CONTAMINATION TO THE PLATE DURING CLEANING.



√ Plate Flatness

Generally, your parts will lap to a mirror image of your lap plate (in respect to flatness), i.e. if your lap plate is excessively concave your parts will turn out convex and vice-versa. It is important to periodically check the plate flatness and make necessary adjustments to maintain the flatness. As a rule, a good starting point is slightly concave (–0.0002" +/- 0.0001").

Place a flatness gauge on the lap plate and read the indicator value. As illustrated below, a "zero" reading would indicate a flat plate, a "negative" reading would indicate a concave plate and a "positive" reading would indicate a convex plate.



√ Re-Conditioning Composite Lap Plates

If the lap plate is out of flat, has lost texture or is glazed from over-charged abrasive particles, then you should re-condition to restore flatness and texture. Two methods of restoring flatness are 1) the use of an on-board plate facing device or 2) use of a diamond plated conditioning ring.

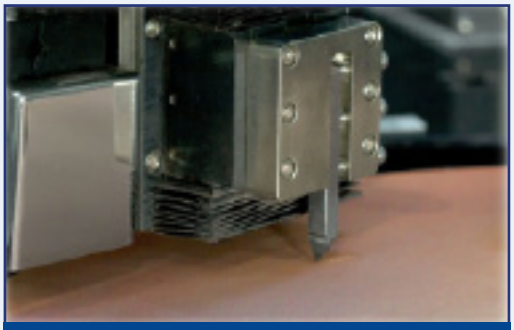


Plate Facing Device

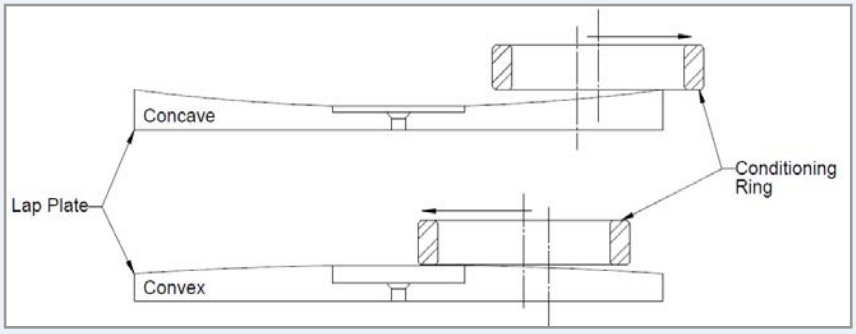
METHOD TO FLATTEN AND TEXTURE A PLATE USING A RING:

Place a PCR (diamond plated conditioning ring) in one of the roller yokes.

- The ring should overlap both the ID and the OD of the lap plate (this will ensure that a ridge is not formed during conditioning).
- Spray enough lubricant on the plate to keep it wet and run the PCR for about 1-2 min at 60 RPM (no load). Note: Use lubricant throughout the re-conditioning cycle, do not use diamond slurry while re-conditioning with a diamond plated ring.
- To correct the flatness of a plate which is too far concave (see top illustration below), position the PCR outward (toward the OD of the plate).
- To correct flatness for a plate which is too far convex (see bottom illustration below), position the PCR inward (toward the ID of the plate). Note: Make small adjustments until you develop a feel for how far to move the ring in or out (usually about 0.25” – 0.50” is adequate).

Plate Conditioning Rings

Important: It is much easier to make the plate go in the positive direction (convex), than to bring it back negative (concave). For this reason, it is important not to let the plate go too far convex.



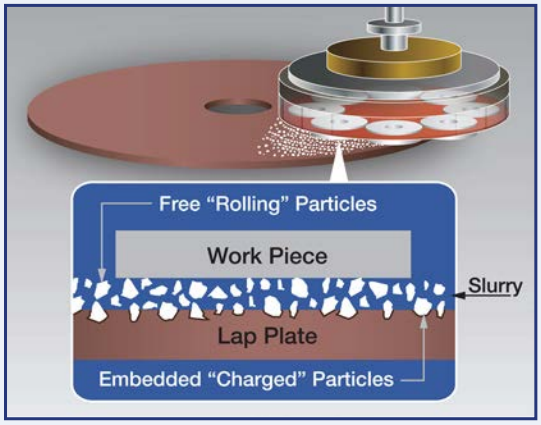
√ Re-Conditioning Cast Iron or Pure Metal Plates

The same basic flatness correction principles apply to cast iron or pure metal plates; a plate facing device or ring are used. However, diamond plated conditioning rings are not used on cast iron. When conditioning a cast iron or pure metal plate you will use a cast iron conditioning ring and a non-diamond abrasive such as aluminum oxide. This is a much slower process, making it that much more important to maintain flatness during the lapping cycle.

Maintaining Plate Flatness

It is important to maintain your plate flatness throughout your processing. The same flattening principles used in correcting flatness apply during the lapping cycle (see Re-Conditioning Composite Lap Plates). During the lapping cycle ceramic conditioning rings are used so the flatness movement will be much slower than when using a PCR.

While running parts if you find the lap plate slowly moves concave, then position the ceramic conditioning rings more outward. Conversely, if while running parts the plate slowly moves convex, then position the ceramic conditioning rings more inward.



√ Charging Lap Plates

Charging is the process of embedding the diamond abrasive into the lap plate surface. Hyprez composite lap plates are specially designed for use with diamond slurry. As such, they require very little, if any, initial charging.

Charging a Composite Lap Plate

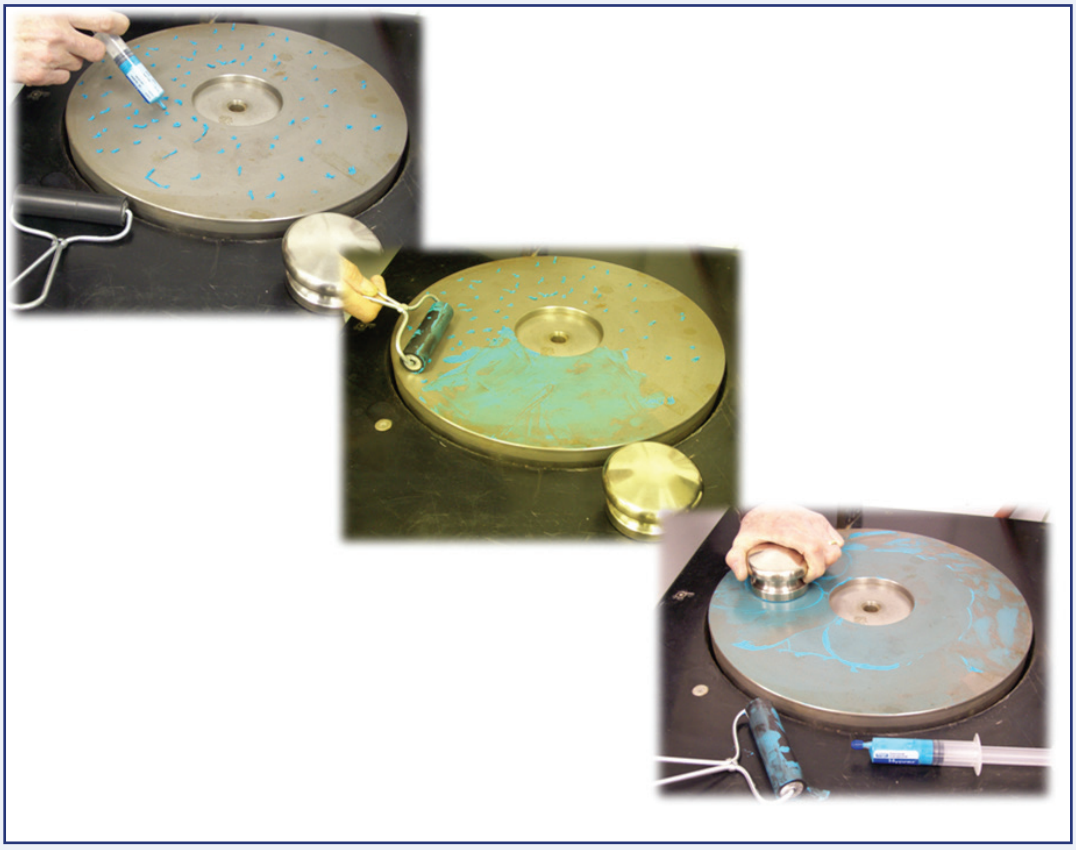
To charge a composite plate, run the machine with the conditioning rings only while applying diamond slurry to the plate. This usually only requires ~1 min. We recommend using ceramic conditioning rings for the diamond lapping processes. This technique will provide an even diamond distribution over the surface of the plate and will prepare the plate for the lapping process.

Charging Cast Iron or Pure Metal Plates

Charging cast iron or pure metal plates is sometimes more involved due to the material's relatively hard nature. These plates can be charged the same way as a composite lap plate, however, the time required can be significantly longer. For this reason pure metal plates, such as cast iron or pure copper, are sometimes hand charged.

Hand Charge a Lap Plate

To hand charge a lap plate, a diamond paste is spread evenly over the surface of the plate (often using a rubber roller). Then a hardened steel charging tool is used to rub the paste into the plate surface (using a tight circular motion). This hand charge can then be followed by running the conditioning rings with the diamond slurry to help provide an even distribution.



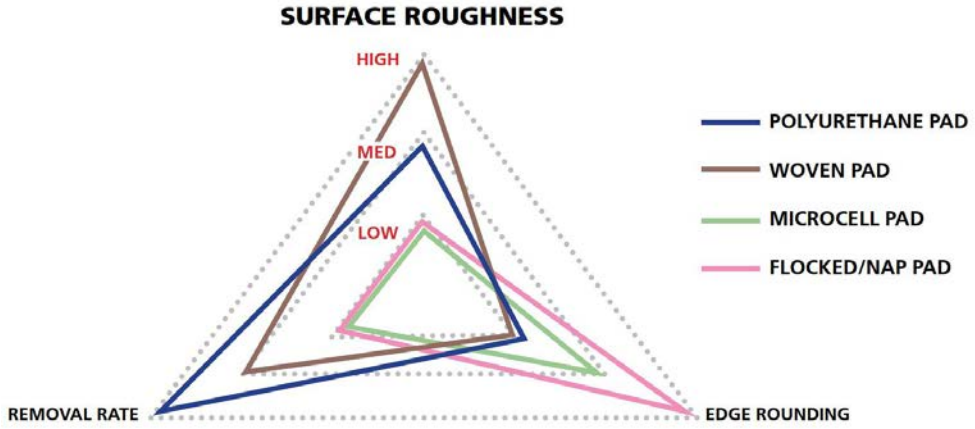
POLISHING PADS

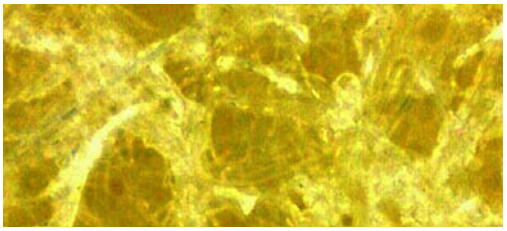
Engis® offers a full selection of polishing pads and cloths to meet demanding polishing and planarization requirements for industrial as well as advanced materials. In addition to industry standard pads, Engis can engineer and supply special pads to meet your needs.

Qualification criteria make our cloths the best available in the industry. Using an array of test materials and slurries, extensive evaluations are performed to ensure these pads meet Engis exacting standards for optimum systems performance.

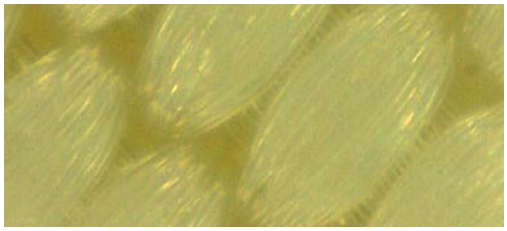
Most offerings are available with or without pressure sensitive adhesive backing. In addition, perforations or grooving are available.

PM-700	Microcell pad made from buffed polyurethane with microscopic voids, laminated to non-woven.
PM-710	Microcell pad made from buffed polyurethane with microscopic voids, laminated to non-woven.
HY NAP700	Nap/flock pad made with long viscose fibers.
HY NAP 730	Nap/flock pad made with long viscose fibers on the woven substrate.
HY NAP 780	Nap/flock pad made with thin, short viscose fibers on the woven substrate.
HY NAP 800	Nap/flock pad made with short viscose fibers on the woven substrate.
ATP 600	Thick non-woven made from polyester/polypropylene fibers with a bu)ed surface.

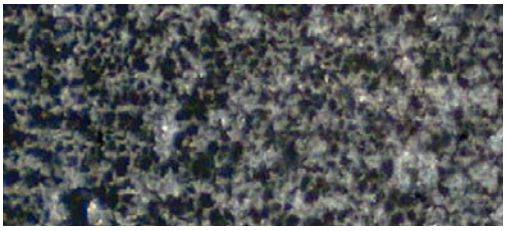




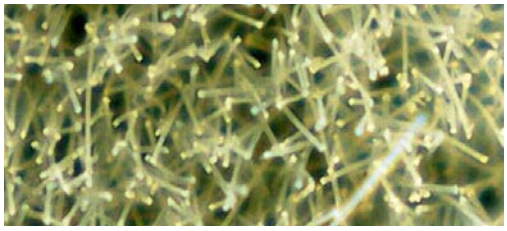
POLYURETHANE PAD



WOVEN PAD



MICROCELL PAD



FLOCKED/NAP PAD

PAD APPLICATIONS

- *Optical components: $LiNbO_3$, CaF_2, MgF_2, Si, Ge, KTP, DKDP, etc.*
- *Planarization of MEMS structures*
- *Semiconductor materials: InP, Sapphire, GaSb, InSb, Si, SiC, GaN, etc.*
- *Polishing of high-grade metal substrates: Titanium, Nickel, Copper, Gold, etc.*
- *Industrial metals: Aluminum, Carbide, Steel, Bronze, etc.*
- *Industrial Ceramics, Glass & Quartz*

Type	Pad Name	Thickness (mm)	Hardness (Shore A)	Surface	Max Diameter (mm)	Material Description	Application
Micro Cell	PM700	1.5	72	Embossed or Perforated	1,360	Microcell pad made from buffed polyurethane with microscopic voids, laminated to non-woven	Final polishing of metals and plastics
	PM710	1.2	74				
Rigid Non Woven	M900	0.7	88	Embossed or Perforated	1,440	Rigid non-woven impregnated with polyurethane	Hard single crystal materials (SiC, Sapphire) of first step stock removal for glass, plastics, metals
	M1000	1.6	98	Embossed		Firm, dense non-woven composed of viscose and polyester	High stock removal on a variety of substrates; hard crystalline materials, ceramic glass, metals, carbides
	ATP720	3.8	72	Embossed		Thick non-woven made from polyester/ polypropylene fibers, buffed surface	Final polishing of glass
Medium Nap	HY-NAP-700	1.1	86	N/A	980	Nap/flock pad made with long viscose fibers	Final polishing of metals and plastics
	HY-NAP-730	1.12	85		1,360	Nap/flock pad made with long viscose fibers on a woven substrate	
	HY-NAP-780	0.7	87		1,440	Nap/flock pad made with thin and short viscose fibers on a woven substrate	
	HY-NAP-800	1	83		1,440	Nap/flock pad made with short viscose fibers on a woven substrate	
Woven	WS920		92	N/A	1,440	Woven	Low-cost option for metal polishing

LAPPING MACHINE ACCESSORIES

Buy genuine heavy industrial grade components to equip your lapping operations and keep your processes running. Engis lapping machine accessories are designed and manufactured to run day in and day out with full time use.

DISPENSERS AND PUMPS

Quantity	Product Code	Description
1	EMC-3	Minimiser Dual Electronic Spray Dispenser, Digital Controls, 2-10" Spray Head Nozzles 115/230v, Includes 2 115v Cables
1	ASPDC	Autostirrer Plastic 115/230vdc
1	P4077	Large Autostirrer W/ Low Level Sensor, 1 Gallon
1	P3861	Stirrer Plate Magnetic 10" X 10" 120 Vac
1	SA0323	3 Station 110v Peristaltic Pumping System
1	509.10M	10m - 10"Long Remote Nozzle Spray Nozzle With Magnetic Base
1	509.15A	15A - 15" Long Nozzle, 24A - 24" Long Nozzle
1	509.1001	Magnets, Large Magnet
1	514.BTL	Pint Jars

CERAMIC CONDITIONING RINGS (FL VERSION)

Quantity	Product Code	Description
1	FLA-15-0002	Ceramic Conditioning Ring 15" 7" X 5.50" X 3-1/2" Center Recess, SS Backed
1	FLA-20-0002	Ceramic Conditioning Ring 20" 9.75" Od X 8.5" Id X 2.125" High SS Backed
1	FLA-24-0002	Ceramic Conditioning Ring 24" W/4-1/2" CTR 11-1/4"OD X 9-3/4" ID X 2-1/8" High SS Backed X 2-1/8" High
1	FLA-28-0002	Ceramic Conditioning Ring 28" 13-7/8" OD. 12" ID 2-1/8" High SS Backed
1	FLA-36-0002	Ceramic Conditioning Ring 36" 16.50" OD x 14.50" ID SS Backed

DIAMOND PLATED CONDITIONING RINGS (PCR)

Quantity	Product Code	Description
1	PCR102-8	15" PCR, 50/60 Grit Plated Conditioning Ring 7" Dia
1	PCR102-2 PCR102-3	15" PCR, 60/80 Grit Plated Conditioning Ring 7" DIA 15" PCR, 100/120 Grit Plated Conditioning Ring 7" DIA
1	PCR104-8 PCR104-4 PCR104-5	24" PCR, 50/60 Grit Plated Conditioning Ring 11.25" DIA 24" PCR, 60/80 Grit Plated Conditioning Ring 11.25" DIA 24" PCR, 100/120 Grit Plated Conditioning Ring 11.25" DIA
1	PCR107-4 PCR107-2 PCR107-3	20" PCR, 50/60 Grit Plated Conditioning Ring 9" DIA 20" PCR, 60/80 Grit Plated Conditioning Ring 9" DIA 20" PCR, 100/120 Grit Plated Conditioning Ring 9" DIA
1	PCR108-5 PCR108-2 PCR108-3	28" PCR, 50/60 Grit Plated Conditioning Ring 13.88" DIA 28" PCR, 60/80 Grit Plated Conditioning Ring 13.88" DIA 28" PCR, 100/120 Grit Plated Conditioning Ring 13.88" DIA
1	PCR106-7 PCR106-3 PCR106-5	36" PCR, 50/60 Grit Plated Conditioning Ring 16.5" DIA 36" PCR, 60/80 Grit Plated Conditioning Ring 16.5" DIA 36" PCR, 100/120 Grit Plated Conditioning Ring 16.5" DIA

FLATNESS GAUGES

Quantity	Product Code	Description
1	SA0049	Gauge, Flatness-15” Long
1	SA0106	Gauge, Flatness-20” Long
1	SA0039	Gauge, Flatness-24” Long
1	SA0039	Gauge, Flatness-28” Long
1	SA0050	Gauge, Flatness-36” Long

POWER ARMS

Quantity	Product Code	Description
1	15FL-0003	15FL Power Arms - Set of 3
1	20FL-0006	20FL Power Arms - Set of 3
1	24FL-0005	24FL Power Arms - Set of 3
1	28FL-0003	28FL Power Arms - Set of 3
1	36FL-0003	36FL Power Arms - Set of 3

PRESSURE BACKING PADS

Quantity	Product Code	Description
1	SRP.15	5” x 1/4” Soft Rubber Pad for 15FL
1	HRP.15	5” x 1/4” Hard Rubber Pad for 15FL
1	SRP.20	7.48” x 1/4” Soft Rubber Pad for 15FL
1	HRP.20	7.48” x 1/4” Hard Rubber Pad for 15FL
1	SRP.24	9.76” x 1/4” Soft Rubber Pad for 15FL
1	HRP.24	9.76” x 1/4” Hard Rubber Pad for 15FL
1	SRP.28	12” x 1/4” Soft Rubber Pad for 15FL
1	HRP.28	12” x 1/4” Hard Rubber Pad for 15FL
1	SRP.36	14-7/16” x 1/2” Soft Rubber Pad for 15FL
1	HRP.36	14-7/16” x 1/8” Hard Rubber Pad for 15FL

HAND WEIGHT ASSEMBLIES

Quantity	Product Code	Description
1	FLA-150004	FL-15 Hand Weight 9 Lbs
1	FLA-20-0004	FL-20 Hand Weight 14.6 Lbs
1	FLA-24-0004	FL-24 Hand Weight 20 Lbs
1	FLA-28-0004	FL-28 Hand Weight 30 Lbs

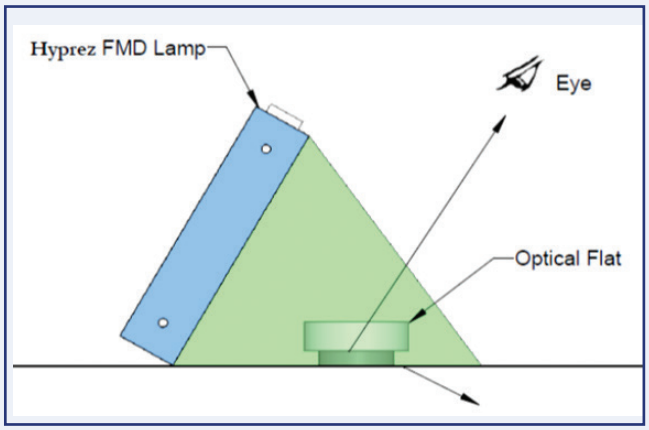
TECHNICAL TIP

AFM, using a scanning probe microscopy technique, is used when precision roughness must be measured over a scan area of several micrometers. Not directly related to roughness by optical profilometry.

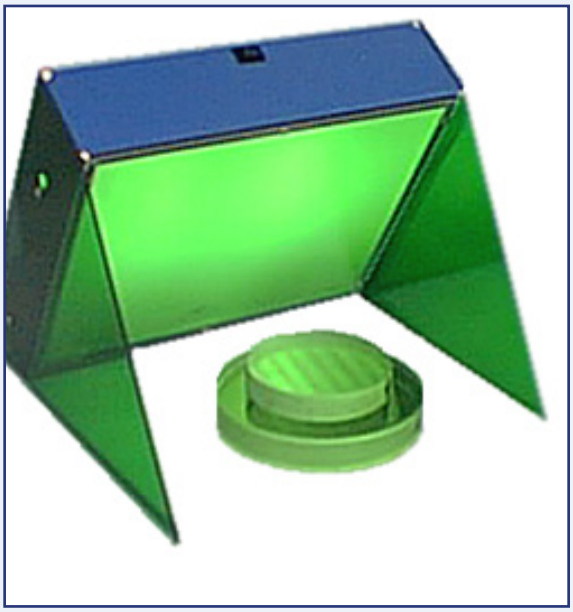
√ Flatness Measurement

Since the flatness achieved in flat lapping is typically in the range of millionths of an inch, the preferred method of measurement is by means of optical instruments. For the most demanding applications an Interferometer with data output is best, but in most cases, the more economical approach utilizes an optical flat under a monochromatic light source.

Equipment Setup



- Place the part below the light source (Hyprez FMD Lamp).
- Carefully place the optical flat on top of the part.
- Viewing down through the optical flat you will see light and dark bands at the interface of the part and the optical flat.
- These light bands are used in determining the part flatness.



ENGIS OFFERS A WIDE VARIETY OF MONOCHROMATIC OPTICAL FLATS – CONTACT US FOR FURTHER INFORMATION

√ Reading Light Bands

The full topography of the contacted surface is revealed in a single reading, showing whether your part surface is convex, concave or wavy, while also showing the direction and amount of contour. Absolutely straight, parallel, equally spaced bands indicate a true surface. Interference bands can measure the flatness of parts that have contours up to 0.0002" convex, through flat to 0.0002" concave.

The number of bands does not indicate flatness, only steepness of the wedge. There is always a film of air separating the two surfaces (optical flat and part). To make bands fewer and further apart, press on the optical flat to make the air film thinner; band spacing of approximately ¼" is recommended. Bands too close together make it difficult to interpret a true picture of band curvature. This is clearly illustrated in Figures (A), (B) and (C).

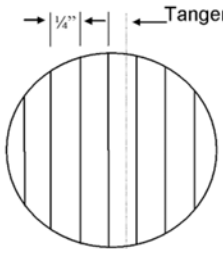


Figure A
Thinner air film produces good light band interpretation
Band curvature = 0
Flatness error = 0

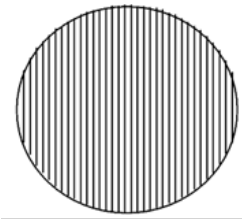


Figure B
Air film too thick makes it difficult to interpret true curvature.

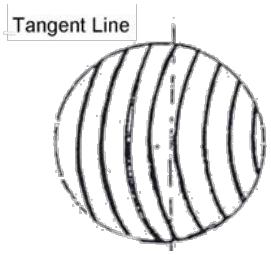


Figure C
Curvature well defined when bands are spaced ¼" apart.

√ Example of Flatness Variations

If an imaginary tangent line connecting the ends of any dark band intersects the next band, the error in flatness is one light band (Figure D). If the line cuts the second band, the error is two light bands (Figure E).

An error of one light band represents 0.0000116" (11.6 millionths of an inch), using helium light source. In other words, between the center of one dark band and the center of the adjacent dark band, the level of the lapped surface has risen or fallen by that amount.

Figure D

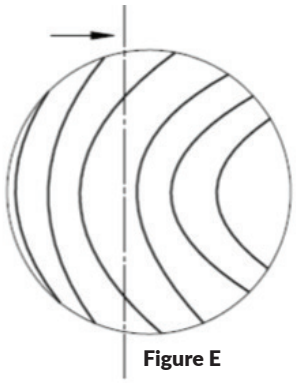


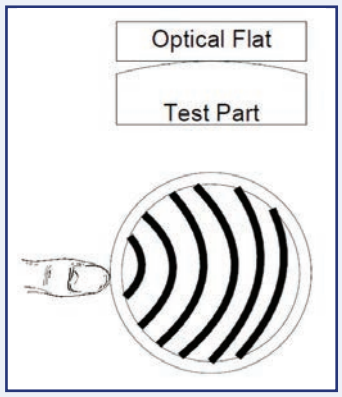
Figure E

The dark bands viewed beneath the optical flat are not light waves - they simply show where interference is produced by deflection from two surfaces. The number of dark bands crossing the tangent line indicate the level that the work has risen or fallen (by 11.6 millionths of an inch) in relation to the optical flat.

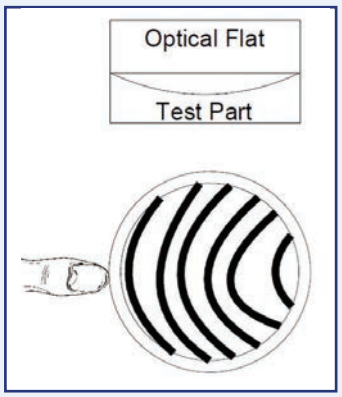
TECHNICAL TIP

√ Determining Concave or Convex Flatness

To determine if your part is concave or convex the optical flat is placed on the test part, then slight finger pressure applied at the outer edge of the optical flat establishing the contact point.



- When the light bands curve around the finger the part is convex. The lap plate may be too far concave.
- The part is two light bands convex.



- When the light bands curve away from the finger the part is concave The lap plate may be too far convex.
- This part is two light bands concave.

√ Light Band to Flatness Conversion Chart for Helium Monochromatic Lights

The helium wave length is 23.2 microinches (0.59 micrometers). The unit displacement observed between the center of one dark band and the center of the next dark band is equal to 1/2 wavelength or 11.6 microinches (0.29 µm).

Number of Bands	Microinches (millionths of an inch)	Inches	Micrometers
.1	1.2	.0000012	0.029
.2	2.3	.0000023	0.059
.3	3.5	.0000035	0.088
.4	4.6	.0000046	0.118
.5	5.8	.0000058	0.147
.6	6.9	.0000069	0.176
.7	8.1	.0000081	0.206
.8	9.3	.0000093	0.235
.9	10.4	.0000104	0.264
1.	11.6	.0000116	0.294
2.	23.1	.0000231	0.588
3.	34.7	.0000347	1.175
4.	46.3	.0000463	1.469
5.	57.8	.0000578	1.763
6.	69.4	.0000694	2.056

Number of Bands	Microinches (millionths of an inch)	Inches	Micrometers
7.	81.0	.0000810	2.056
8.	92.5	.0000925	2.350
9.	104.1	.0001041	2.644
10.	115.7	.0001157	2.938
11.	127.2	.0001272	3.232
12.	138.8	.0001388	3.525
13.	150.4	.0001504	3.819
14.	161.9	.0001619	4.113
15.	173.5	.0001735	4.407
16.	185.1	.0001851	4.700
17.	196.6	.0001966	4.994
18.	208.2	.0002082	5.228
19.	219.8	.0002198	5.582
20.	231.3	.0002318	5.876

HYPREZ® LAPPING MACHINES

The FastLap™ Series of Lapping & Polishing Machines are built for versatility and speed. These machines can be customized from a basic tabletop model to a large floor-standing model with advanced process controls.

Built with heavy duty spindle bearings, they are designed to withstand the high loads necessary for diamond processing of hard materials.

Model FL-15VPF (with Plate Facing and Main Bearing Grease Pump)

Model FL-15VP (Pneumatic)

Model FL-15V (Hand Weight)

Standard Models	FL15	FL20	FL24	FL28
Lap Plate Diameter	15” 381 mm	20” 508 mm	24” 610 mm	28” 711 mm
Maximum Part Diameter (Inside Work Ring)	5-7/16” 138 mm	7-7/16” 188 mm	9-11/16” 246 mm	11-15/16” 303 mm
Work Stations/Rings	3	3	3	3
Maximum Plate Speed	90 rpm	90 rpm	90 rpm	90 rpm
Maximum Pnumatic Pressure (Per Spindle, All Spindels engaged)	100 lbs 45 kg	200 lbs 90 kg	300 lbs 136 kg	500 lbs 227 kg

DIAMOND LAPPING CONVERSION KITS

Flat lapping is often the process of choice when finishing a ceramic surface to precise dimensions. As advanced ceramics evolve and ever harder and more stable materials are introduced into the market, the challenge to finish parts to precise dimensions grows. Flat lapping is often the process of choice when it is necessary to achieve dimensional flatness and finish requirements.

Unless the proper tools are applied, however, flat lapping can be a time-consuming process. Lapping with diamond can pay off in lower cycle times and lower slurry consumption. Lapping with diamond also results in lower slurry cost per hour, lower sludge generation, lower reject rates and fewer process steps.

Common applications for the flat lapping of precision ceramics include mechanical seals, seal rings, pump parts, vacuum chucks, fixture components, wafers for microelectromechanical devices (MEMs), and flat glass or mirror substrates.

Almost any application of engineered ceramics with high flatness and/or surface finish requirements may benefit from the diamond lapping process.

Advantages Over Conventional Lapping:

- Aggressive material removal for equal or better productivity
- Uniform edge-to-edge flatness; sub light band (11 millionths of an inch) results are routine and up to 1/20 wavelength is achievable under specific conditions
- Better than sub-micron surface finish (< 0.5 Ra) is routine; subnanometer surface finishes are achievable
- High potential to develop a one-step lapping and polishing solution for reduced cycle times
- Reduced waste supports green initiatives

DIAMOND LAPPING VS. CONVENTIONAL SILICON CARBIDE FOR AN ALUMINUM WAFER

	Silicon Carbide	Diamond
Number of process steps	2	1
Removal rate/cycle time	.0013 in/hr 45 min cycle	.004 in/hr 15 min cycle
Slurry consumption	.5 gal/8hr	1 pint/8hr
Slurry generation	4 gal/8hr	.125 gal/8hr
Part finish	Matte Finish	Reflective
Part cleanliness	Dark, Dirty: two cleaning steps	Relatively clean: one-step light cleaning
Slurry cost/8hr shift	$166.00	$47.00

DIAMOND LAPPING EXAMPLES

	Seal Ring	Pump Slider	Seal Ring	Seal Ring
Ceramic Material	99.7% Alumina	Alumina	Alumina	Alumina Nitride
Surface Area	49 In^2	.035 In^2	1.5 In^2	104 In^2
Removal Rate	.0018 In/hr	.0024 In/hr	.0038 In/hr	.0005 In/hr
Diamond Size	6 Microns	3 Microns	15 Microns	3 Microns
Slurry Type	Water Based	Water Based	Water Based	Water Based
Plate Type	HY Iron Composite	HY Iron Copper	HY Iron Copper	HY Iron Ceramic
Surface Finish	5.7µin	1.7µin	6.5µin	6µin

CONVERT TO DIAMOND LAPPING

Lap table conversion kits are available from Engis. These kits will convert your conventional lapping table to qualify its use with Engis diamond lapping and polishing technology. Kits are available for Kemet, Lapmaster-Wolters, Speedfam, Stahli, PR Hoffman and many more. Please contact our sales department to determine if your machine will qualify.

CONVERSION KITS

Surface Pattern	Composite Copper Plate	Composite Iron Plate	Composite Tin Plate	Cast Iron Plate	Steel Plate
15" Lapping Table Conversion Kit					
Smooth Face	15.CVKT.C250.S	15.CVKT.X08.S	15.CVKT.TX10A.S	15.CVKT.CI.S	15.CVKT.S.S
Radial Grooves	15.CVKT.C250.R	15.CVKT.X08.R	15.CVKT.TX10A.R	15.CVKT.CI.R	
Waffle Pattern	15.CVKT.C250.W	15.CVKT.X08.W	15.CVKT.TX10A.W	15.CVKT.CI.W	
20" Lapping Table Conversion Kit					
Smooth Face	20.CVKT.C250.S	20.CVKT.X08.S	20.CVKT.TX10A.S	20.CVKT.CI.S	20.CVKT.S.S
Radial Grooves	20.CVKT.C250.R	20.CVKT.X08.R	20.CVKT.TX10A.R	20.CVKT.CI.R	
Waffle Pattern	20.CVKT.C250.W	20.CVKT.X08.W	20.CVKT.TX10A.W	20.CVKT.CI.W	
24" Lapping Table Conversion Kit					
Smooth Face	24.CVKT.C250.S	24.CVKT.X08.S	24.CVKT.TX10A.S	24.CVKT.CI.S	24.CVKT.S.S
Radial Grooves	24.CVKT.C250.R	24.CVKT.X08.R	24.CVKT.TX10A.R	24.CVKT.CI.R	
Waffle Pattern	24.CVKT.C250.W	24.CVKT.X08.W	24.CVKT.TX10A.W	24.CVKT.CI.W	
28" Lapping Table Conversion Kit					
Smooth Face	28.CVKT.C250.S	28.CVKT.X08.S	28.CVKT.TX10A.S	28.CVKT.CI.S	28.CVKT.S.S
Radial Grooves	28.CVKT.C250.R	28.CVKT.X08.R	28.CVKT.TX10A.R	28.CVKT.CI.R	
Waffle Pattern	28.CVKT.C250.W	28.CVKT.X08.W	28.CVKT.TX10A.W	28.CVKT.CI.W	

ALL KITS INCLUDE:

- Lap Plate Mounted on a Custom Drive Plate
- Conditioning Rings, Per Recommended Lap Plate
- PCR, Per Recommended Lap Plate
- Pressure Plate Weight Assembly or Hand Weight depending on Machine Model
- Flatness Gauge depending on Machine Model
- EMC-3 MiniMiser Dual Electronic Spray Dispenser
- 2-10” Spray Head Nozzels incl 2 115V Cables
- ASP DC Autostirrer Plastic

HELICAL LAPPING TOOLS

Lapping tools from Helical Lap & Manufacturing Co., a subsidiary of Engis Corporation, provide a simple and economical solution for producing extremely fine tolerances and accuracies in bores and cylindrical parts.

- Helical Laps can adapt to be used on almost any machine with a rotating spindle, such as a lathe, drill, or honing machine.
- Helical Laps are highly versatile tools that can be used in a wide range of materials and applications.
- Helical ID and OD Laps are manufactured from a proprietary grade of annealed grey cast iron with a grain structure designed to optimize the abrasive charging of the tool. The lap incorporates a helical slot to allow for expansion and contraction of the tool.
- Helical Laps are primarily finishing tools to bring parts to size, reduce the rough peaks of a surface and correct common imperfections in bore and cylinder geometry such as roundness, bellmouth and barrel shape. The tools are used with a lapping compound (diamond, aluminum oxide, silicon carbide, boron carbide, garnet) and typically, only a small amount of material is removed. The tools should always be ordered to the true ID or OD of the part to be worked, and then they are manufactured with the correct starting size.

INTERNAL HELICAL SLOT LAPS, ARBORS AND EXPANDERS

Internal laps mount on a tapered arbor or mandrel. The tool expands as the lap is moved up the tapered arbor. Because the internal taper of the lap is closely matched to the taper of the arbor, unlike barrel laps which only expand in the middle, Helical Laps expand uniformly across the entire length of the lap. This is a unique and key feature for achieving precise bore roundness and straightness. As stock is removed, simply tap the lap up the arbor.

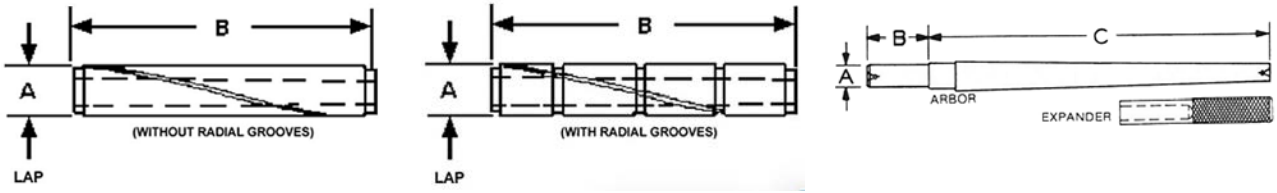
When Helical Laps are used in combination with our tightly graded, high quality lapping and polishing abrasives, exceptional bore surface finishes can be obtained. Standard lap diameters range from 3/64" up to 3". Other diameters (including metric) and lengths are available upon request. Standard size tools are generally in stock.

Expanding Internal Laps should be longer than the length of the bore being lapped.

Standard Internal Laps are manufactured undersize to allow for stock removal and abrasive clearance. Order a 1/4″ lap to finish a .2500 dia. bore.

Radial Grooves are recommended for most lapping applications; however, there are instances when non-grooved laps are recommended, such as when lapping interrupted bores.

INTERNAL LAPS & LAP PULLERS



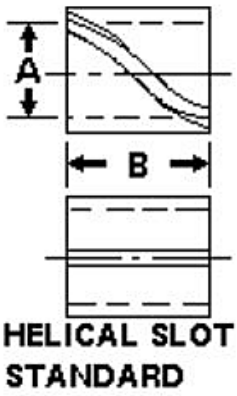
SPECIAL SIZE AND/OR LENGTH LAPS AND ARBORS CAN BE MADE TO SUIT YOUR APPLICATION

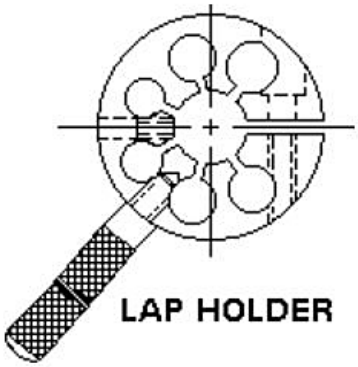
View Helical Lap Standard Tool List at
www.helicallap.com/internal-helical-slot-laps-arbors-and-expanders/

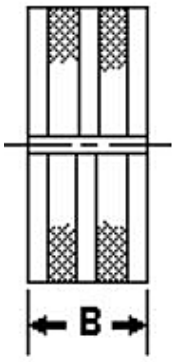
EXTERNAL EXPANDING CAST IRON LAPS & LAP HOLDERS

External lap insert sleeves are made slightly oversized to allow for starting clearance and are also designed to uniformly contract as the external lap holder is tightened. Worn lap inserts can be quickly replaced.

External lapping tools should be shorter than the length of the part being lapped. When lapping a cylindrical part with lands, the external lap should be long enough to span as many lands as possible to prevent rolling edges. Standard external laps are manufactured slightly over size to allow for clearance and can be tightened to the appropriate diameter with the external lap holder.







SPECIAL SIZE EXTERNAL LAPS AND HOLDERS CAN BE MADE TO SUIT YOUR APPLICATION

View Helical Lap Standard Tool List a
www.helicallap.com/external-laps-lap-holders/

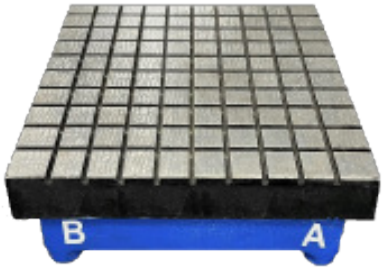
CAST IRON HAND LAPPING PLATES

Cast Iron Lapping Plates are extensively used for accurate hand lapping of ferrous and non-ferrous parts to obtain a perfect surface form & flatness.

All Helical close-grained gray cast iron lap plates are heat treated to relieve internal stresses before being finished. The plates are heavily ribbed below the top surface for rigidity. The top surfaces of all lap plates have 3×3 mm grooves at a pitch of 25-30 mm. Handles are provided for lifting and handling.

Plates are manufactured in accordance with ISO standards for cast iron surface plates.

Part Number	Description	Grade	Material	Flatness (µ)
200x200LP-P	200 x 200 mm Lapping Plate	0	Heavily Ribbed Cast Iron	3.5
450x300LP-G	450 x 300 mm Lapping Plate	1	Heavily Ribbed Cast Iron	8
600x450LP-G	600 X 450 mm Lapping Plate	1	Heavily Ribbed Cast Iron	10



ABRASIVES

In order to achieve superior finishes it is important to use lapping tools with only high quality abrasives. Our range of abrasive products is made to our exacting specifications for consistency. Stringent controls are in place to eliminate stray coarse particles that will cause scratching. Fine particles are also minimized providing you with faster stock removal and finishes better than other products in the same nominal micron size.

50/50 Series Diamond Lapping Compound can be used for many applications as it is both water and oil soluble and is formulated to withstand severe lapping conditions without loss of cutting quality. The use of a stable carrier assures sustained particle suspension throughout the process cycle. 50/50 compound's unique blend of natural and manufactured diamonds also provides more surface coverage and improved impregnation of lapping tools.

OS is an oil based formula that provides superior lubrication and will not evaporate during the lapping process even when exposed to elevated temperatures.

A special note about abrasives. It is possible to use Helical Laps to produce desired finishes easily and quickly; however, if more than one abrasive size is used in order to achieve the desired finish in the least amount of time, it is highly recommended to keep separate laps dedicated to each abrasive size used. By following this recommendation, you will avoid having to go back to remove scratches produced by larger size abrasive particles.

DIAMOND LAPPING COMPOUND (5 Gram Gun)

Part Number	Micron	Description	Color
3-5050-45	3	3-5050-45 Diamond Compound	Green
6-5050-42	6	6-5050-42 Diamond Compound	Yellow
8-5050-35	8	8-5050-35 Diamond Compound	Red
14-5050-35	14	14-5050-35 Diamond Compound	Brown
OS0.5-2MA	1	OS 0.5-2 MA Diamond Compound	Blue
OS2-4MA	3	OS 2-4 MA Diamond Compound	Green
OS4-8MA	6	OS 4-8 MA Diamond Compound	Yellow
OS6-12MA	9	OS 6-12 MA Diamond Compound	Red
OS10-20MA	15	OS 10-20 MA Diamond Compound	Brown
OS22-36MA	30	OS 22-36 MA Diamond Compound	Mahogany
OS36-54MA	45	OS 36-54 MA Diamond Compound	Purple
OS40-80MA	60	OS 40-80 MA Diamond Compound	Orange

Additional grades and packaging in 10 and 18 gram guns or dip jars available upon request.

SILICON CARBIDE (1/2 Pint)

Part Number	Grade	Description
SO220	220	220 Grit Paste
SO320	320	320 Grit Paste
SO600	600	600 Grit Paste

WHITE ALUMINUM OXIDE (1/2 Pint)

Part Number	Grade	Description
500WA	500	500 Grit Paste
900WA	900	900 Grit Paste
1200WA	1500	1500 Grit Paste

ALUMINUM OXIDE (1/2 Pint)

Part Number	Grade	Description
AO220	220	220 Grit Paste
AO320	320	320 Grit Paste
AO600	600	600 Grit Paste
AO800	800	800 Grit Paste

BORON CARBIDE (4 oz.)

Part Number	Grade	Description
BCC220	220	220 Grit Paste
BCC320	320	320 Grit Paste
BCC400	400	400 Grit Paste
BCC600	600	600 Grit Paste
BCC800	800	800 Grit Paste
BCC1000	1000	1000 Grit Paste
BCC1200	1200	1200 Grit Paste

GARNET (1/2 Pint)

Part Number	Grade	Description
GN400	400	400 Grit Paste
GN800	800	800 Grit Paste

SPECIAL APPLICATION LAPPING TOOLS

We maintain an inventory of standard tools and often can ship the same day. If you are looking for a tool that is not shown in our standard tool list and would like to have us develop and quote a special tool for your application please contact us. Standard tools can often be modified to meet fast delivery requirements. Helical Lap is capable of making tools with special diameters, multiple diameters, extra-long lengths, and various groove designs. Our engineers can design tools to meet and exceed precise tolerance requirements for geometry and surface finishes.

Step Laps: Multiple diameter internal laps for lapping concentric bores.

Tandem Laps: Internal laps for lapping in-line bores (same or different diameters).

Long Length Tools: Internal and external laps, arbors, and lap holders are available in longer than standard lengths.

Adjustable Arbors: Available with threaded adjusters, eliminating expanders and pullers.

Reverse Tapered Arbors: Including for lapping blind holes. All available with threaded adjustment.

DIPROFIL CLASSIC RANGE OF RECIPROCATING POLISHING/FILING TOOLS

The Classic Series is the original reciprocating filing tool designed as an efficient, fast and precise tooling system to replace tedious hand operations. Each tool is lightweight with sturdy construction, enabling operators to perform even delicate work on intricate parts with ease.

The Classic Series is easy to operate and performs operations such as filing, honing, polishing and lapping of both straight and curved surfaces.

Classic tools have been the benchmark of quality tooling for mold and die making for many, many years.

Each model is fit with an ergonomic rubber sleeve for maximum operator comfort

	FPS/R	FPH/R	FPL/R
Motor	Flexible Shaft with ball joint	Flexible Shaft with ball joint	Air
Driver	Key Hole	Square Hole	Lubricated Compressed Air
Tool Holder	Ø 6.4 mm	Ø 6.4 mm	Ø 6.4 mm
Stroke Length - Maximum	0 - 6mm	0 - 6mm	0 - 6mm
Stroke Length - Recommended	0.5 - 3mm	0.5 - 3mm	0.5 - 3mm
Speed - Maximum	8,000 rpm	8,000 rpm	8,000 rpm
Speed - Recommended	5,000-7,000 rpm	5,000-7,000 rpm	5,000-7,000 rpm
Weight	585 - 615 g	585 - 615 g	585 - 615 g
Noise	<70 dbA @ 6,000 rpm	<70 dbA @ 6,000 rpm	<70 dbA @ 6,000 rpm
Vibration	4 - 12 m/s^2	4 - 12 m/s^2	4 - 12 m/s^2

Frequency weighed hand/arm vibration principally in accordance with ISO 28927-8. For further details refer to the Operation Guide.

DI-PRO™ MARK II - RANGE OF LOW VIBRATION RECIPROCATING TOOLS

The Di-Pro™ polishing/filing machines represent a commitment from Diprofil® to greater operator comfort and safety. The Di-Pro™ series has been engineered with an enhanced ergonomic design to greatly reduce vibration while, at the same time, providing adequate torque and reciprocation levels to get the job done right. With Di-Pro, you don't need to sacrifice performance in order to improve comfort and safety!

	FXS-N	FXL-N
Motor	**Electric:** • Driven by electrical motor with speed control, ie Diprofil® type DSE-47 & flexible shaft with ball joint connection. • Corresponding motors of other brands may also be used.	**Air:** • Should be driven by compressed air & oil mist lubricated air. • The built-in air motor may be damaged if operated with unlubricated air.
Tool Holder	Ø 6.4 mm	Ø 6.4 mm
Stroke Length - Maximum	0 - 6mm	0 - 6mm
Stroke Length - Recommended	0.5 - 3mm	0.5 - 3mm
Speed - Maximum	7,000 rpm	7,000 rpm
Speed - Recommended	5,000-6,000 rpm	5,000 rpm
Weight	700 g	920 g
Noise	<75 dbA @ 7,000 rpm	<75 dbA @ 7,000 rpm
Vibration	<2.5 m/s^2	<2.5 m/s^2
Spare Parts List	http://diprofil.com/wp-content/uploads/2015/03/FXS-N-complete.pdf	http://diprofil.com/wp-content/uploads/2015/ 03/FXL-N-complete.pdf

It is important not to exceed the maximum tool input speed specified by the manufacturer.

Tools have been designed in accordance with ISO 28927-8 to minimize hand/arm vibration. For further details see diagram and other information in the Operation Guide.

Please note, the air-driven tool requires a quick coupling (HSL-M) as well as an MFB Dipro-Fog lubricator. The air motor is manufactured to a precise level of accuracy and requires lubrication & filtered air (to 5 microns) to assure trouble-free operation.

MFB

HSL-M

ACCESSORIES FOR CLASSIC AND DI-PRO™ TOOLS

UNIVERSAL TOOL HOLDER FMR/VH

Designed for Diprofil® polishing/filing machines. Great choice for holding DiaMold® polishing stones.

FEATURES

- Stainless steel hardened shank - 3mm (1/8”)
- Shank length - approximately 35mm (1.375”)
- Maximum tool thickness - 6mm (.236”)

LIGHTWEIGHT TOOL HOLDER THPS-3

The reduced mass design of this tool holder suppresses potentially harmful vibrations from the stoning operation. Designed to be used with Diprofil reciprocating machines and polishing stones with a thickness of 3mm (1/8”).

FEATURES

- Stone thickness capacity - 3mm (1/8”)
- Steel hardened shank - 3mm (1/8”)
- Shank length - approximately 18mm (11/16”)
- Total tool holder length - 31.5mm (1-1/4”)
- Jaw width - 8mm (5/16”)
- Weight - 3.9g

LIGHTWEIGHT TOOL HOLDER THFS-1

The reduced mass design of this tool holder suppresses potentially harmful vibrations from the stoning operation. Designed to be used with Diprofil and other high frequency ultrasonic machines using ceramic stones with a thickness of 1mm (.039”).

FEATURES

- Ceramic stone thickness capacity - 1mm (.039”)
- Steel hardened shank - 3mm (1/8”)
- Shank length - approximately 18mm (11/16”)
- Total tool holder length - 31.5mm (1-1/4”)
- Jaw width - 8mm (5/16”)
- Weight - 4.3g

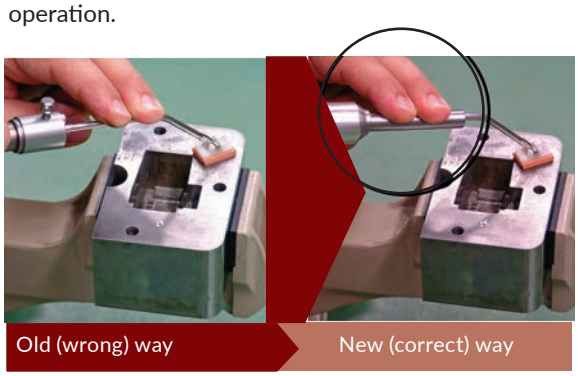
PROTECTIVE FINGER SLEEVES PFS-3.5 AND PFS-6.4

The PFS-3.5 and PFS-6.4 Protective Finger Sleeves are designed to fit your existing Diprofil Classic and Di-Pro Series machines.

This attachment covers the reciprocating tool rods and greatly reduces hand injuries during sustained tool operation.

FEATURES

- **PFS-3.5 fits machines with a 3.5mm tool capacity**
- **PFS-6.4 fits machines with a 6.4mm tool capacity**



FNAK LUBRICATING OIL FOR DIPROFIL® TOOLS

FNAK Lubricant is specially formulated for use on external oil points on Diprofil hand tools. When used properly this oil will reduce wear and prolong the life of your Diprofil reciprocating polishing/filing machines.

Part Number	Container Size	MSDS
FNAK	20 ml / .67 oz.	659
FNAK - 0.5	1/2 liter / 16.9 oz.	659

Please note: It is recommended that you read and follow the procedures outlined in the manufacturer's Operation Guide sent with each tool as they may require daily, as well as hourly lubrication.

MFB DIPRO-FOG IN-LINE AIR FILTER/ LUBRICATOR/ REGULATOR/ MANOMETER

When using any Diprofil air operated tool, the MFB In-Line Air Lubricator is a MUST. The MFB not only serves as a micro particle air filter, but keeps the pressure constant and the unit lubricated. The MFB set includes tubing and a bottle of MFAK tool lubricant. We also recommend ordering the HSL-M quick release hose connector when using Diprofil air operated tools.

TECHNICAL DATA

- **Max. primary pressure: 16 bar / 232 psi**
- **Max. capacity at 7 bar: 1200 l/min**
- **Hose connection: 7mm / .275"**
- **Secondary pressure: 0.5 – 10 bar / 7 - 145 lbs**

Please note: If your shop air has heavy contamination of dirt, oil, or water, it is advisable to add a larger pre-filter to reduce contamination to 5 micron.

ELECTRIC MOTORS AND FOOT PEDALS

M.TX-SXR Kit	M.LXH-TXR Kit	M.TX-TXR Kit
High Torque / Low Speed Key Drive Type 1/3 HP 15,000 maximum rpm Ball Bearing Design 115V Electrical Plug	**High Torque / Low Speed** Square Drive Type 1/10 HP 5,000 maximum rpm Ball Bearing Design 115V Electrical Plug	**High Torque / Low Speed** Square Drive Type 1/3 HP 15,000 maximum rpm Ball Bearing Design 115V Electrical Plug
Includes: • M.TX Hang Up Style Motor • C.SXR-1 Cast Iron Foot Pedal • Outer Sheath #S-77 (36-1/4" long) • Inner Key Drive Shaft S-93 (39" long)	**Includes:** • M.LX Hang Up Style Motor • C.TXR-1 Plastic Foot Pedal • Heavy Duty Outer Sheath #S-10801TX (63" long) • Inner Shaft #S-10823 (63-3/4" long)	**Includes:** • M.TX Hang Up Style Motor • C.TXR-1 Plastic Foot Pedal • Outer Sheath #S-77 (36-1/4" long) • Inner Key Drive Shaft S-93 (39" long)
Replacement Parts: • C.SXR-1 Speed Control (foot pedal) • Outer Sheath #S-77 (36-1/4" long) • Inner Key Drive Shaft #S-93 (39" long) • MP319P Motor Brushes & Brush Caps	**Replacement Parts:** • C.TXR-1 Speed Control (foot pedal) • Heavy Duty Outer Sheath #S-10801TX (63" long) • Inner Shaft #S-10823 (63-3/4" long) • MP319P Motor Brushes & Brush Caps	**Replacement Parts:** • C.SXR-1 Speed Control (foot pedal) • Outer Sheath #S-77 (36-1/4" long) • Inner Key Drive Shaft #S-93 (39" long) • MP319P Motor Brushes & Brush Caps
Hand Tools That Use M.TX-SXR: • FXS-N Di-Pro Machine (page 11) • FPS/R Classic Machine (page 10)	**Hand Tools That Use M.LX:** • H.30H, H.44T	**Hand Tools That Use M.TX-TXR:** • FPS/R

C.EMX-1 RHEOSTAT DIAL SPEED CONTROL

Solid state motor speed control offers precise adjustment of motor speed and maintains speed for the operator, unlike a foot pedal that requires constant foot pressure.

BENCH MOUNT MOTOR HANGERS

MAMH-2 BENCH TOP SCREW MOUNT

The Telescoping Motor Hanger is designed for fast and easy height and swivel adjustment by way of pole screws.

The pole base flange mounts permanently to your work bench top by three screws providing secure stable mounting.(Motor not included.)

Swivel Motor and adjust height

Screws onto desk iop

MAMH-1 BENCH TOP CLAMP MOUNT

This motor hanger allows you the flexibility to move the hanger assembly easily to any bench location by way of its screw clamp (2 1/4") capacity.

It also includes rest for #30 or #44 handpieces. (Motor and handpieces not included.)

Handpiece rest

Adjust height

MAHH-30 BENCH HANDPIECE HOLDER CLAMP

The MAHH-30 provides a secure bench top mounting of handpieces #30 and #44.

With the handpiece firmly held to the bench top, the operator has both hands free to hold and control the workpiece during grinding or polishing operations. (Handpiece not included.)

Adjust height

CLASSIC DIPROFIL TOOL KITS

DS4 - FPS/R Classic Tool With Key Drive Kit (39” Cable)

Set Includes

- FPS/R: Classic Diprofil Tool with Key Drive
- M.TX-TXR: Drive motor with key drive flex shaft & foot control
- MAMH-1: Bench clamp motor hanger
- C.TXR-1: Foot pedal
- S-77: Outer sheath
- S-93: Inner key drive shaft
- MP319P: Motor brushes & caps

FEATURES

- Tool holder: 6.4 mm / 1/4”
- Stroke length: 0-6 mm / 0-.235”
- Motor: 5,000 rpm

DS5 - FPH/R Classic Tool With Square Drive Kit (Heavy Duty 63” Cable)

Set Includes

- FPH/R: Classic Diprofil Tool with Square Drive
- M.LXH-TXR: Drive motor with square drive flex shaft and foot control
- MAMH-1: Bench clamp motor hanger
- C.TXR-1: Foot pedal
- S-10801TX: Outer sheath
- S-10823: Inner square drive shaft
- MP319P: Motor brushes & caps

FEATURES

- Tool holder: 6.4 mm / 1/4”
- Stroke length: 0-6 mm / 0-.235”
- Motor: 5,000 rpm

All Tool Kits are packed in a sturdy plastic case and come with operating wrenches.

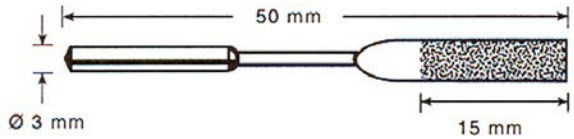
DIPROFIL® DIAMOND AND STEEL FILES

Diprofil diamond files are made from carefully selected quality diamonds, precisely bonded to obtain the best physical properties for added strength and resistance to wear. Diamond files are excellent for EDM scale removal and for use on carbide, hardened steel, ceramics and other hard materials.

Page	Type	Intended Use
46	DLA	Short machining files for general use. Designed with a semi-flexible shank to obtain a good contact with the work piece. These precision files are the basic type for use with the Diprofil Polishing Machines. Different shapes and grain sizes are available as well as safe-sided types. Medium to high stroke (3-5 mm).
47	DLE	Long precision machine files for general use. Low to medium stroke (2-4 mm). Different shapes and grain sizes are available as well as two safe-sided types. Low to medium stroke (2-4 mm).
48	DLH	Precision hand files for general use. Different shapes available as well as safe-sided types.
49	DLS	Conical hand files for general use. Specially recommended for EDM scale removal and other preparation of thin slots, e.g. after wire-EDM machining. Different sizes and grain sizes are available.
50	DBH	Hand files for general use.
51	DLD	One sided riffle type hand files. Specially recommended for use on shaped surfaces.
52	DLX	Hand files for general use. This file type can be comfortably used without a fitted handle.
53	DLQ	Extra long (200 mm) hand files for general use. Different shapes are available.
54	DLM	Short conical machine files for general use. Specially recommended for EDM scale removal and other preparation of thin slots, e.g. after wire-EDM machining. Different shapes and grain sizes are available
55	DBE	Long machine files for general use. Low to medium stroke (2-4 mm). Different shapes and grain sizes are available.
56	STL-1 – STL-6	Standard steel files for use in Diprofil polishing machines. Low to medium stroke (2-4 mm). Available in both medium (-00) and fine (-1) cut as well as in different shapes.
56	STL-11 – STL-14	Precision riffle type machine files. Especially recommended for use on shaped surfaces. Low to medium stroke (2-4 mm). Available in both medium (-00) and fine (-1) cut as well as in different shapes.
57	STL-21 – STL-26	Mini steel files for use in Diprofil polishing machines. Low to medium stroke (2-4 mm). Available in both medium (-00) and fine (-1) cut as well as in different shapes.
57	STL-101	Medium sized steel files especially recommended for deburring of cast aluminum goods. Low to medium stroke (2-4 mm). Available in both medium (-00) and fine (-1) cut.

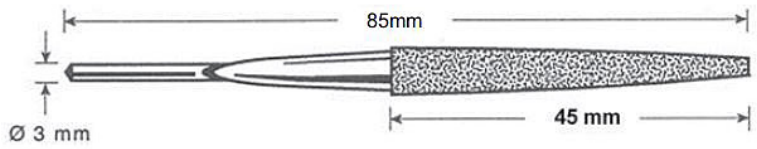
Diprofil Precision Steel Files are great for use on soft and semi-hard steel as well as other materials of low and medium hardness.

DLA PRECISION FILES FOR DIPROFIL FILING MACHINES



Shape	Size mm	Diamond D64* • 50 (fine)	Diamond D151* • 100 (medium)	Diamond D181* • 150 (coarse)
Standard Files				
	2 x 1	DLA-2x1S-D64	DLA2x1S-D151	DLA2x1S-D181
	3 x 1	DLA-3x1S-D64	DLA3x1S-D151	DLA3x1S-D181
	4 x 1	DLA-4x1S-D64	DLA4x1S-D151	DLA4x1S-D181
	4 x 2	DLA-4x2S-D64	DLA4x2S-D151	DLA4x3S-D181
	5 x 2	DLA-5x2S-D64	DLA5x2S-D151	DLA5x3S-D181
	Ø1	DLA-1-64	DLA-1-D151	DLA-1-D181
	Ø2	DLA-2-64	DLA-2-D151	DLA-2-D181
	Ø3	DLA-3-64	DLA-3-D151	DLA-3-D181
	Ø4	DLA-4-64	DLA-4-D151	DLA-4-D181
	2 x 2 x 2		DLA-T2S-D151	
	3 x 3 x 3		DLA-T3S-D151	
	4 x 4 x 4		DLA-T4S-D151	
	r = 1		DLA-R1S-D151	
	r = 1.5		DLA-R1.5S-D151	
	r = 2		DLA-R2S-D151	
	r = 5	DLA-R2.5xR5-D64	DLA-R2.5xR5-D151	DLA-R2.5xR5-D181
Safe-Sided Files				
	2 x 1	DLA-2x1-D64	DLA2x1 -D151	DLA2x1-D181
	3 x 1	DLA-3x1-D64	DLA3x1-D151	DLA3x1-D181
	4 x 1	DLA-4x1-D64	DLA4x1-D151	DLA4x1-D181
	5 x 2	DLA-5x2-D64	DLA5x2-D151	DLA5x3-D181
	0.5 x 4		DLA-0.5 x 4-D151	
	1 x 4		DLA-1 x 4-D151	
	2 x 2 x 2	DLA-T2-D64	DLA-T2-D151	DLA-T2-D181
	3 x 3 x 3	DLA-T3-D64	DLA-T3-D151	DLA-T3-D181
	4 x 4 x 4		DLA-T4-D151	DLA-T4-D181
	r = 1		DLA-R1-D151	
	r = 1.5		DLA-R1.5-D151	
	r = 2		DLA-R2-D151	

DLE PRECISION FILES FOR DIPROFIL FILING MACHINES



Shape	Size mm	Diamond D151* ● 100 (medium)
Standard Files		
	5 x 2	DLE-11-D151
	Ø3	DLE-2-D151
	5 x 2	DLE-30-D151
	5 x 2	DLE-4-D151
	3.5 X 3.5 X 3.5	DLE-5 -D151
	2.5 x 2.5	DLE-6-D151
Safe-Sided Files		
	5 x 1	DLE-1-D151
	5 X 2	DLE-3-D151

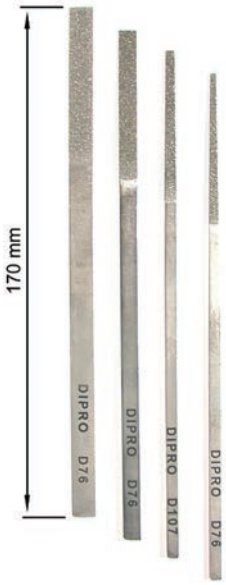
DLH PRECISION FILES FOR HAND FILING

Shape	Size mm	Diamond D151* • 100 (medium)
Standard Files		
	5.3 x 1.4	DLH-11-D151
	Ø3	DLH-2-D151
	5.1 x 2.2	DLH-4-D151
	3.8 x3.8 x 3.8	DLH-5-D151
	2.6 x 2.6	DLH-6-D151
	5.2 x 1.6	DLH-8-D151
	5.0 x 1.6	DLH-9-D151
	5.0 x 2.4	DLH-30-D151
Safe-Sided Files		
	4.8 x 1.1	DLH-1-D151
	5.5 x 1.7	DLH-3-D151
	4.9 x 2.1	DLH-7-D151
File set containing 7 diamond files, one each of DLH-1 through DLH-7		DLH/D151

DLS DI-PRO CONICAL DIAMOND FILES FOR HAND FILING

Shape	Size mm	Item Number Diamond D46	Item Number Diamond D76	Item Number Diamond D107
Standard Files				
	4 x 2		DLS-1-D76	
	4 x 3	DLS-2-D46	DLS-2-D76	DLS-2-D107
	6 x 6	DLS-3-D46	DLS-3-D76	DLS-3-D107
	8 x 8	DLS-4-D46	DLS-4-D76	DLS-4-D107

DLS Set: Set consisting of the above 10 different DLS Hand Files



Item Number: DLS/1

*Grain Sizes according to FEPA

DBH DI-PRO DIAMOND FILES FOR HAND FILING

Total file length approx 140mm
Shaft diameter 3mm

Shape	Size mm	Item Number Diamond D46	Item Number Diamond D76	Item Number Diamond D107
Standard Files				
	6 x 1.5	DBH-1-D46	DBH-1-D76	
	Ø3	DBH-2-D46	DBH-2-D76	DBH-2-D126
	5 x 2	DBH-3-D46	DBH-3-D76	DBH-3-D126
	5 x 2	DBH-4-D46	DBH-4-D76	DBH-4-D126
	3.5	DBH-5-D46	DBH-5-D76	DBH-5-D126
	2.5 x 2.5	DBH-6-D46	DBH-6-D76	DBH-6-D126
	6 x 2	DBH-7-D46	DBH-7-D76	DBH-7-D126
	5.4 x 1.5	DBH-8-D46	DBH-8-D76	DBH-8-D126
	1.7 x 6	DBH-9-D46	DBH-9-D76	DBH-9-D126
	6 x 1.5	DBH-10-D46	DBH-10-D76	DBH-10-D126
	Set of 10	DBH-SET-D46	DBH-SET-D76	DBH-SET-D126

DLD DI-PRO DIAMOND FILES FOR HAND FILING

Total file length
approx 140mm
Shaft diameter 3mm

Total file length approx 200mm

	Shape	Size mm	Item Number Diamond D107
		6 x 1.2	DLD-1-D107
		2.5 x 2.5	DLD-2-D107
		3 x 1.5	DLD-3-D107
		3 x 3 x 3	DLD-4-D107
		5 x 2	DLD-5-D107
		3.5 x 1.5	DLD-6-D107
		4 x 2.2	DLD-7-D107
		Ø2.5	DLD-8-D107
		5 x 1.5	DLD-9-D107
		Ø2.5	DLD-10-D107

*Grain Sizes according to FEPA

DLD SET: SET CONSISTING OF THE ABOVE 10 DIFFERENT DLD HAND FILES

Item Number: DLD-SET-D107

DLX DI-PRO DIAMOND FILES FOR HAND FILING

Total file length approx 200mm	Shape	Size mm	Item Number Diamond D151
		11 x 3.5	DLX-1-D151
		Ø5	DLX-2-D151
		10.5 x 4.4	DLX-3-D151
		7.7 x 7.7 x 7.7	DLX-4-D151
		6.3 x 6.3	DLX-5-D151

*Grain Sizes according to FEPA

DLX SET: SET CONSISTING OF THE ABOVE 5 DIFFERENT DLX HAND FILES.

Item Number: DLX-SET-D151

DLQ DIPRO DIAMOND FILES FOR HAND FILING

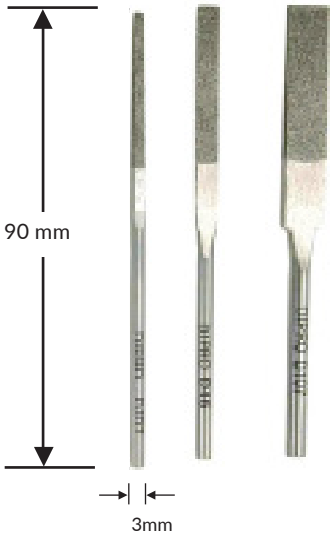
Shape	Size mm	Item Number Diamond D126
	8.5 x 1.6	DLQ-1-D126
	Ø4	DLQ-2-D126
	7 x 2.5	DLQ-3-D126
	3.5 x 3.5 x 3.5	DLQ-4-D126
	4.5 x 4.5	DLQ-5-D126

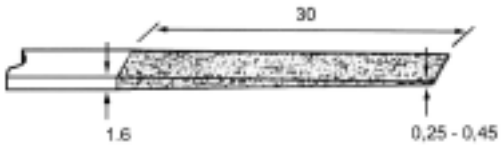
Total file length
approx 200mm
Shaft diameter 4mm

DLQ SET: SET CONSISTING OF THE ABOVE 10 DIFFERENT DLQ HAND FILES

Item Number: DLQ-SET-D126

DLM DI-PRO CONICAL DIAMOND FILES FOR DIPROFIL FILING MACHINES





Shape	Size mm	Item Number Diamond D46	Item Number Diamond D107
Standard Files			
	2.5 x 1.6	DLM-1-D46	DLM-1-D107
	4 x 1.6	DLM-2-D46	DLM-2-D107
	6 x 1.6	DLM-3-D46	DLM-3-D107

*Grain Sizes according to FEPA

DLM SET: SET CONSISTING OF THE 6 DIFFERENT DLM FILES

Item Number: DLM/1

DBE DI-PRO DIAMOND FILES FOR DIPROFIL FILING MACHINES

Shape	Size mm	Item Number Diamond D46	Item Number Diamond D76	Item Number Diamond D107
Standard Files				
	4 x 2	DBE-1-D46	DBE-1-D76	DBE-1-D107
	Ø3	DBE-2-D46	DBE-2-D76	DBE-2-D107
	5 x 2	DBE-3-D46	DBE-3-D76	DBE-3-D107
	5 x 2	DBE-4-D46	DBE-4-D76	DBE-4-D107
	3.5 x 3.5 x 3.5	DBE-5-D46	DBE-5-D76	DBE-5-D107
	2.5 x 2.5	DBE-6-D46	DBE-6-D76	DBE-6-D107

Total File Length Approx 90mm

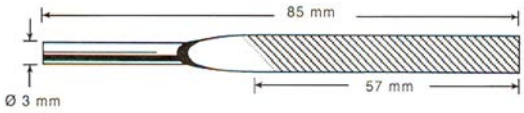
DBE SET: SET CONSISTING OF THE ABOVE 6 DIFFERENT DBE MACHINE FILES

Item Numbers:
DBE-SET-D46, DBE-SET-D76, DBE-SET-D107

DIPROFIL PRECISION STEEL FILES

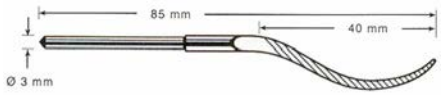
Steel Files are for use on soft and semi-hardened steel as well as other materials of low and medium hardness.

STL 1 - STL 6 PRECISION STEEL FILES



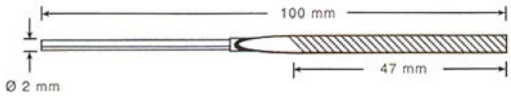
Shape	Size mm	Medium Cut - 00	Fine Cut - 1
	5 x 1.5	STL-1-00	STL-1-1
	Ø3	STL-2-00	STL-2-1
	5 x 2	STL-3-00	STL-3-1
	5 x 2	STL-4-00	STL-4-1
	3.5 x 3.5 x 3.5	STL-5-00	STL-5-1
	2.5 x 2.5	STL-6-00	STL-6-1

STL 11 - STL 14 PRECISION STEEL FILES



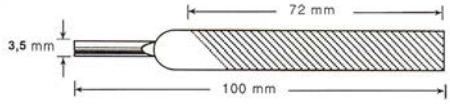
Shape	Size mm	Medium Cut - 00	Fine Cut - 1
	4 X 2	STL-11-00	STL-11-1
	Ø3	STL-12-00	STL-12-1
	4.7 X 2.5	STL-13-00	STL-13-1
	3 x 3	STL-14-00	STL-14-1

STL 21 - STL 26 PRECISION STEEL FILES



Shape	Size mm	Medium Cut - 00	Fine Cut - 1
	3.3 x 1	STL-21-00	STL-21-1
	Ø2	STL-22-00	STL-22-1
	3.2 x 1.1	STL-23-00	STL-23-1
	3 x 3.12	STL-24-00	STL-24-1
	2.2 x 2.2 x 2.2	STL-25-00	STL-25-1
	1.7 x 1.7	STL-26-00	STL-26-1

STL 101 PRECISION STEEL FILES



Shape	Size mm	Medium Cut - 00	Fine Cut - 1
	10 x 2.5	STL-101-00	STL-101-1

*Grain Sizes according to FEPA

MOUNTED WOOD BOBS (1 PER BOX)

Engis Wood Bobs are available in Hydulignum, a highly-compressed hard wood laminated in layers with plastic. The grain direction is perpendicular to the circumference to assure uniform lapping surface and efficient charging. They are recommended for fast stock removal or where exact contour or shaping is required - use 15 micron or coarser Engis Diamond Compounds for these applications.

Bobs are also available in selected soft pine for pre-finish before final felt polishing. Diamond Compounds grade of 15 micron or finer are recommended for use with these bobs.

501.HYD.1/SFT

501.HYD.4/SFT.4

501.HYD.2/SFT.2

501.HYD.5/SFT.5

501.HYD.3/SFT.3

501.HYD.6/SFT.6

1/8” Mandrel Mounted Cones and Cylinders:

Hydulignum (Hard Wood)	Pine (Soft Wood)	Size	Shape
501.HYD.1	501.SFT.1	3/4” x 1-3/16”	Cone
501.HYD.2	501.SFT.2	7/16” x 1-3/16”	Cone
501.HYD.3	501.SFT.3	9/32” x 5/8”	Cone
501.HYD.4	501.SFT.4	3/4” x 1-1/8”	Cylinder
501.HYD.5	501.SFT.5	7/16” x 3/4”	Cylinder
501.HYD.6	1501.SFT.6	9/32” x 1/2”	Cylinder

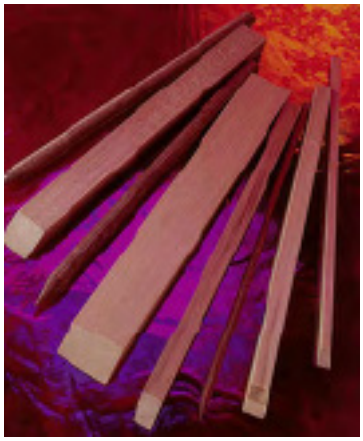
Max. RPM 10,000

Hard Wood Lapping Sticks:

Laminated 6” lapping sticks are designed especially for fast stock removal using Engis diamond compounds. Made of highly compressed wood layers with alternating grain direction, saturated and bonded with synthetic resin, they are dense, easily formed, shape retaining, and perform like a cast iron lap of top quality such as Meehanite. The many shapes available include square and rectangular with 45° bevels or round with conical points.

Soft Wood Lapping Sticks:

Designed for immediate and final polishing. Square and rectangular shapes are beveled to 45°; round sticks are pointed. All shapes are 6” long.



Hard Wood	Soft Wood	In Each Pack	Size	Shape
502.D	502.SD	1	1/8” x 1/8” x 6”	Square
502.E	502.SE	1	1/8” x 1/4” x 6”	Rectangle
502.F	502.SF	1	1/4” x 1/4” x 6”	Square
502.G	502.SG	1	3/16” x 3/16” x 6”	Square
502.H	502.SH	1	5/16” x 1/2” x 6”	Rectangle
502.I	502.SI	1	5/16” x 3/4” x 6”	Rectangle
502.J	502.SJ	1	1/8” x 6”	Round
502.K	502.SK	1	3/16” x 6”	Round
502.L	502.SL	1	1/4 x 6”	Round

All One Size and Wood Hardness Contained in Each Package

SPECIAL GROUP COMBINATIONS OF LAPPING STICKS

Hard Wood	Soft Wood	In Each Pack	Size	Shape
Group 502.A	Group 502.SA	6	1/8” x 1/8” x 6”	Square
		6	1/8” x 1/4” x 6”	Rectangle
		4	1/4” x 1/4” x 6”	Square
		4	3/16” x 3/16” x 6”	Square
		2	5/16” x 1/2” x 6”	Rectangle
		2	5/16” x 3/4” x 6”	Rectangle
Group 502.B	Group 502.SB	12	1/8” x 1/8” x 6”	Square
		12	1/8” x 1/4” x 6”	Rectangle
		12	1/4” x 1/4” x 6”	Square
Group 502.C	Group 502.SC	5	5/16” x 1/2” x 6”	Rectangle
		5	5/16” x 3/4” x 6”	Rectangle
Group 502.M	Group 502.SM	10	1/8” x 6”	Round
		8	3/16” x 6”	Round
		4	1/4 x 6”	Round

POLISHING BRUSHES (12 PER BOX)

These top quality brushes will hold diamond compounds longer and provide more cutting action at lower production costs. They are made of natural stiff bristle for long life. Available in three shapes with long shank for straight handpieces and in three shapes with short shank for contra-angle handpieces.

End Shape

Cup Shape

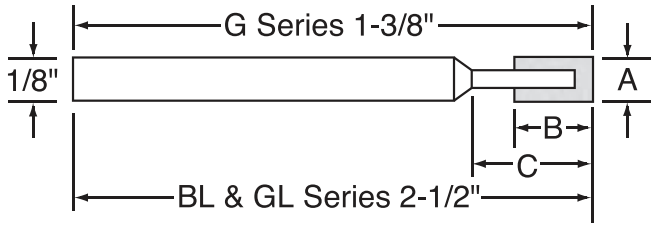
Wheel Shape

Brush Number	Shank Diameter	Shape	Description
Use these brushes with any Straight Handpiece			
504 7HL	**1/8”**	**End Shape**	**Plast Ferrule**
504.7HS	**3/32”**	**End Shape**	**Metal Ferrule**
504.2HL	**1/8”**	**Wheel Shape**	**Firm, natural bristles hold shape**
504.2HS	**3/32”**	**Wheel Shape**	**Firm, natural bristles hold shape**
504.12HL	**1/8”**	**Cup Shape**	**More bristles for longer life**
504.12HS	**3/32”**	**Cup Shape**	**More bristles for longer life**
Use these brushes with Contra-Angle Handpiece only - for hard-to-get-at places			
504.73RC	**3/32”**	**End Shape**	
504.123RC	**3/32”**	**Cup Shape**	

Max. RPM 15,000

PRECISION PLUS ELECTROPLATED DIAMOND & CBN GRINDING PINS

Featuring hardened steel shanks and bonded diamond or CBN particles, these precision grinding pins are ideal for use on jig and internal grinding machines and/or hand tools. Through our Electrogrip process, particle exposure is maximized, assuring a free cutting action that greatly reduces heat and wear.



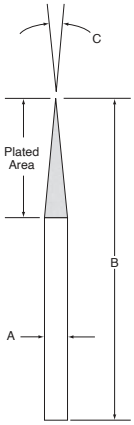
BL (CBN) & GL (Diamond) Series Pins - Specifications

CBN Grit Size	CBN Part Number	Diamond Grit Size	Diamond Part Number	A	B	C
140/170	BL.20	Coarse (140/170) or Fine (200/230)	GL.20	.020	1/16”	1/8”
	BL.25		GL.25	.025	3/32”	1/4”
	BL.30		GL.30	.030	3/32”	1/4”
	BL.35		GL.35	.035	3/32”	1/4”
80/100	BL.40	Coarse (140/170) or Fine (200/230)	GL.40	.040	1/8”	3/8”
	BL.45		GL45	.045	1/8”	3/8”
	BL.50		GL.50	.050	1/8”	3/8”
	BL.50-1		GL.50.1	.050	1/8”	1”
	BL.55		GL.55	.055	1/8”	3/8”
80/100	BL.60	Coarse (140/170) or Fine (200/230)	GL.60	.060	1/8”	3/8”
	BL.60-1		GL60.1	.060	1/8”	1”
	BL.70		GL70	.070	5/32”	1/2”
	BL.70-1		GL.70.1	.070	5/32”	1”
	BL.80		GL.80	.080	5/32”	1/2”
	BL.80-1		GL.80.1	.080	5/32”	1”
80/100	BL.90	Coarse (100/170) or Fine (200/230)	GL.90	.090	5/32”	1/2”
	BL.90-1		GL90.1	.090	5/32”	1”
	BL.100		GL100	.100	5/32”	1/2”
	BL.100-1		GL.100.1	.100	5/32”	1”
	BL.110		GL.110	-110	5/32”	1/2”
	BL.110-1		GL.110.1	.110	5/32”	1”
	BL.125		GL.125	.125	5/32”	1/2”
	BL.125-1		GL.125.1	.125	5/32”	1”
80/100	BL.141	Coarse (100/120) or Fine (200/230)	GL.141	.141	1/4”	-
	B.L156		GL.156	.156	1/4”	-
	BL.188		Gl.188	.188	1/4”	-
	BL.218		GL.218	.218	1/4”	-
	BL.250/2		GL.250.2	.250	1/4”	-
	BL.250/3		GL.250.4	.250	1/4”	-

PLEASE SPECIFY GRIT SIZE WHEN ORDERING

DIAMOND TAPER PINS AND MANDRELS

These diamond-plated taper pins are ideal for grinding or ripping tungsten carbide drawing dies for the wire and tube industries, and for cold heading dies. You get fast, efficient and precise grinding, with long wear. Eye protection is recommended.



G (DIAMOND) SERIES PINS - SPECIFICATIONS

Diamond Grit Size	Part Number	A	B	C
Coarse (140/170) or Fine (200/230)	G.20	.020	1/16”	1/8”
	G.25	.025	3/32”	1/4”
	G.30	.030	3/32”	1/4”
	G.35	.035	3/32”	1/4”
Coarse (140/170) or Fine (200/230)	G.40	.040	1/8”	3/8”
	G.45	.045	1/8”	3/8”
	G.50	.050	1/8”	3/8”
	G.55	.055	1/8”	3/8”
	G.60	.060	1/8”	3/8”
Coarse (140/170) or Fine (200/230)	G.70	.070	5/32”	1/2”
	G.80	.080	5/32”	1/2”
	G.90	.090	5/32”	1/2”
	G.100	.100	5/32”	1/2”
	G.110	.110	5/32”	1/2”
	G.125	.125	5/32”	1/2”

Part Number	A	B	C
GLT.125.10	1/8”	2-1/2”	10”
GLT.125.12	1/8”	2-1/2”	12”
GLT.125.16	1/8”	2-1/2”	16”
GLT.125.26	1/8”	2-1/2”	26”
GLT.250.10	1/4”	2-1/2”	10”
GLT.250.12	1/4”	3”	12”
GLT.250.16	1/4”	3”	16”
GLT.250.26	1/4”	3”	26”

BX (CBN) & GX (DIAMOND) SERIES PINS - SPECIFICATIONS

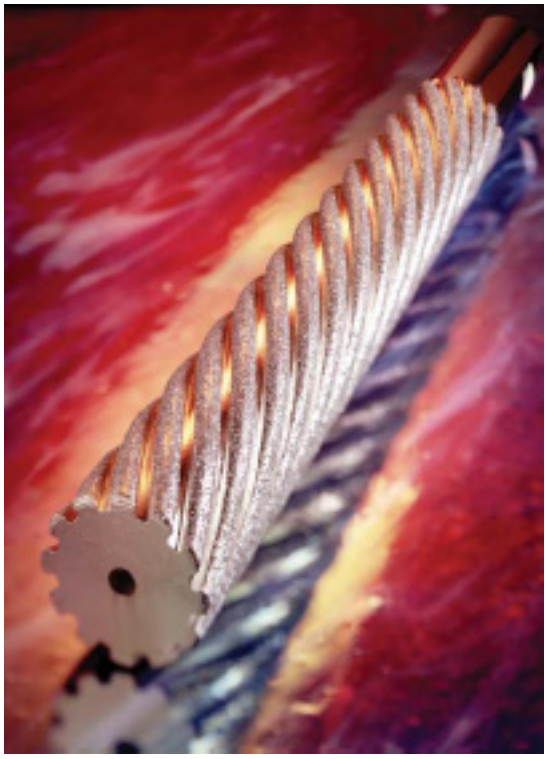
CBN Grit Size	Part Number	Diamond Grit Size	Part Number	B	C
80/100	BX.141	Coarse (100/120) or Fine (140/170)	GX.141	9/64”	1/4”
	BX.156		GX.156	5/32”	1/4”
	BX.188		GX.188	3/16”	1/4”
	BX.218		GX.218	7/32”	1/4”
	BX.250.2		GX.250.2	1/4”	1/8”
	BX.250.4		GX.250.4	1/4”	1/4”
	BX.312.2		BX.312.2	5/16”	1/8”
	BX.312.4		GX.312.4	5/16”	1/4”
	BX.312.6		GX.312.6	5/16”	3/8”
80/100	BX.375.2	Coarse (100/120) or Fine (140/170)	GX.375.2	3/8”	1/8”
	BX.375.4		GX.375.4	3/8”	1/4”
	BX.375.6		GX.375.6	3/8”	3/8”
	BX.500,4		GX.500.4	1/2”	1/4”
	BX.500.6		GX.500.6	1/2”	3/8”
	BX.500.8		GX.500.8	1/2”	1/2”
	BX.750.4		GX.750.4	3/4”	1/4”
	BX.750.8		GX.750.8	3/4”	1/2”

PLEASE SPECIFY GRIT SIZE WHEN ORDERING

ELECTROGRIP® PRECISION DIAMOND ROUTERS

For use with:

- **Power Hand Tools**
- **Routing Machines**
- **Milling Machines, horizontal and vertical**



Electrogrip diamond routers are manufactured in a wide variety of sizes and styles designed specifically to machine, trim, groove and grind forms in composites or abrasive materials. They produce finishes which are free from chipping or crazing. These tools cut by an abrasive action which differs from the shearing action of cutters generally used in the metalworking industry. Because of their free cutting action there is no excessive heat and little wear. For best performance, these tools should be run at speeds of 5,000 to 6,000 surface feet per minute. Short shaft lengths eliminate whipping and deflection when operated at high speeds.

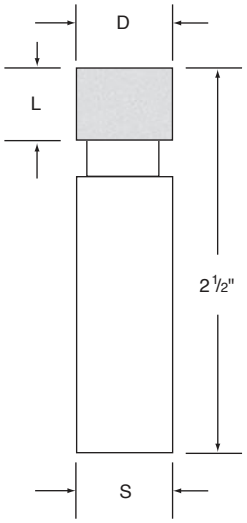
Electrogrip diamond routers work effectively on materials such as composites, fiberglass, aluminum oxide, wood, particle board (MDF), bakelite with abrasive filler, carbon (unfired), melamine plastic and many other abrasive-filled materials.

Coarse 30/40 Part Number	Fine 40/60 Part Number	S	D	L
R14C	R14F	1/4”	1/8”	1/2”
R18C	R18F	1/4”	1/8”	1”
R24C	R24F		1/4”	1/2”
R28C	R28F		1/4”	1”
R34C	R34F	1/2”	3/8”	1/2”
R38C	R38F	1/2”	3/8”	1”
R44C	R44F	1/2”	1/2”	1/2”
R48C	R48F	1/2”	1/2”	1”
R54C	R54F	1/2”	5/8”	1/2”
R58C	R58F	1/2”	5/8”	1”
R64C	R64F	1/2”	3/4”	1/2”
R68C	R68F	1/2”	3/4”	1”
R84C	R84F	1/2”	1”	1/2”
R88C	R88F	1/2”	1”	1”

When ordering standard routers, please specify grit size, “D” dimension and “L” dimension. Note: other shank lengths and diameters can be made to order.

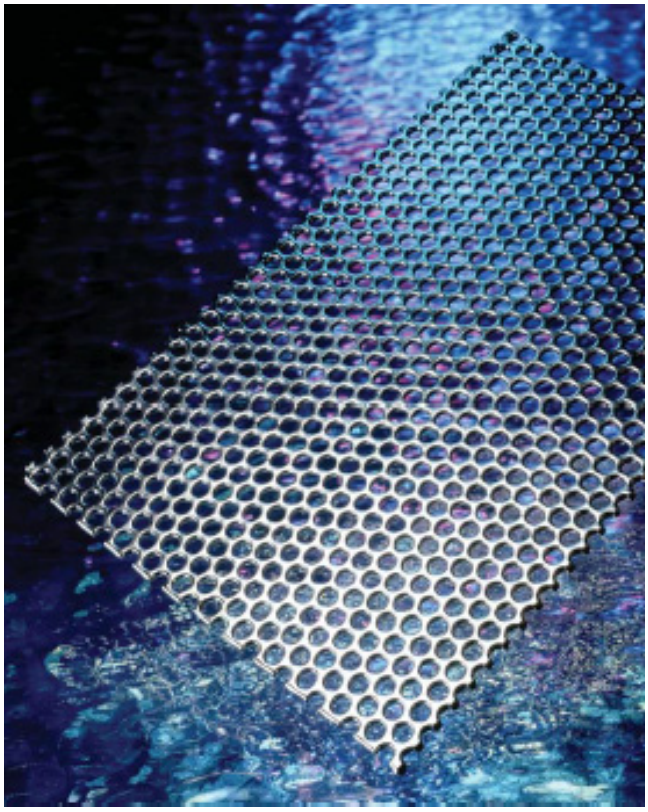
HOW TO ORDER:

When ordering other than catalog items, the following information is necessary — tool diameter (D), shank diameter (M), diamond length (L), overall length (if longer than 2-1/2”), grit size, type and hardness of material to be used on.



ELECTROGRIP® ABRA-SCREEN

Diamond plated screen for use in operations usually performed with coated abrasive papers.



Advantages:

- Long lasting diamond abrasive
- Free cutting, well exposed abrasive
- Minimal loading with abraded material
- Ideal for hard and highly abrasive materials

Electrogrip diamond plated screen is manufactured in a variety of sizes and grit choices. It is used as a general purpose abrasive for operations such as deburring, edge breaking and removing high spots from flat surfaces. In fact, it can be used as a substitute for coated abrasives in all applications, except where flexibility is required. Because the tough diamond abrasive is electrochemically bonded and well exposed, these tools exhibit a free cutting action with no excessive heat and little wear. The perforations provide ample clearance for abraded material, keeping the abrasive free from loading. This feature is also well suited for use with a dust collection system.

Coarse 100/1200 Part Number	Fine 325/400 Part Number	Width	Length
AS-24C	AS-24F	2”	2”
AS-26C	AS-26F	2”	2”
AS-46C	AS-46F	3”	4”
AS-1212C	AS-1212F	3”	112”

Other sizes and shapes available upon request.

DI-FLEX SUPERABRASIVE SHEETS AND DISCS

Di-Flex superabrasive sheets and discs feature diamond particles electroplated to a thin sheet of material. This material, when plated with diamond, is semi-flexible and can be used for a variety of applications.

Di-Flex can be used as a general purpose abrasive for operations such as deburring, edge breaking and removing high spots from flat surfaces. Because this material is semi-flexible, it can also be used on areas of parts where some flexibility is required. Di-Flex can be adhered by a pressure sensitive adhesive backing to tables, tools, wheels and other areas where an abrasive can be used. Di-Flex is available with or without a pressure sensitive adhesive backing, in discs from 1” - 30” in diameter or can be supplied in squares and rectangles.

We can also supply Di-Flex to your specified shapes.

STANDARD DIAMOND PLATED STRAIGHT PERIPHERAL DRESSING TOOLS

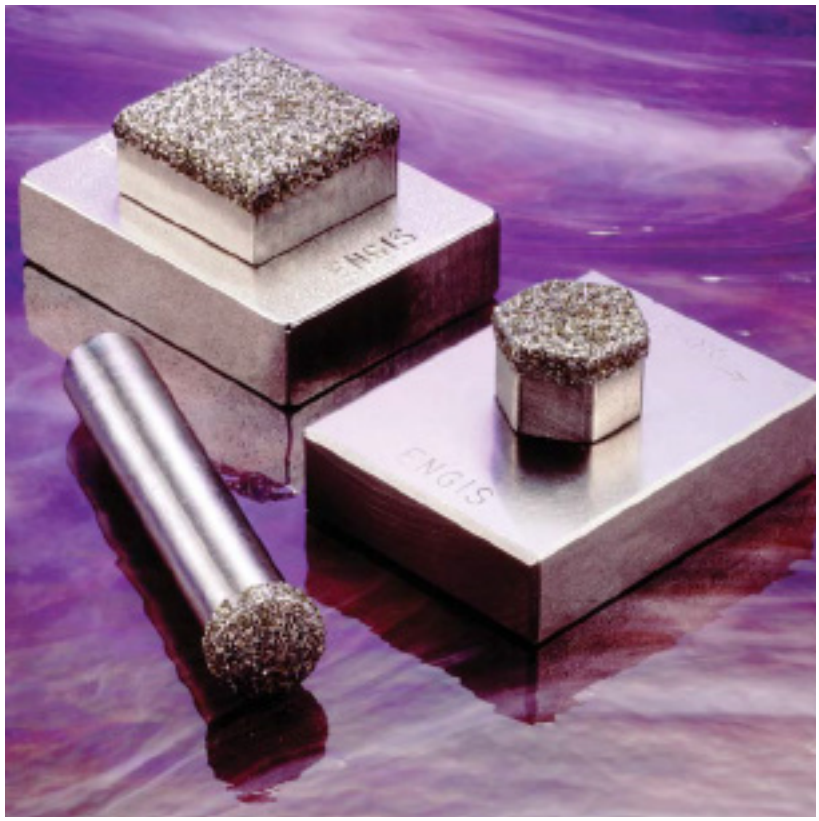
For use on:

- **Surface Grinders**
- **Cylindrical Grinders**
- **Tool Grinders**
- **Optical Projector Grinders**
- **Other grinders with traversing capabilities**

Engis Electrogrip® diamond straight dressing tools are designed to dress aluminum oxide and silicon carbide grinding wheels straight and true, removing previous forms or shapes, quickly and efficiently.

Advantages:

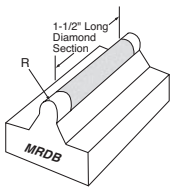
- **Can dress thin wheels without vibration or chipping**
- **Dressing load is distributed over a period of time and distance**
- **Does not require re-orientation to keep diamond sharp**
- **Easily dresses aluminum oxide and silicon carbide**
- **Improves surface finish because phonographing and/or grooving of the wheel being dressed is eliminated**



A. ENGIS LP-1 Diamond Straight Dressing Block

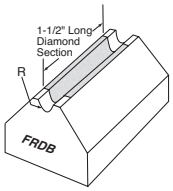
B. ENGIS MINI-DRESS Diamond Straight Dressing Block*

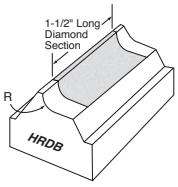
C. ENGIS MINI-MATE I – 3/8˝, MINI-MATE II* – 7/16˝ Diamond Straight Dressing Tool*



Male radius dressing block MRDB and radius

Female radius dressing block FRDB specify FRDB and radius





Half radius dressing block HRDB and radius

Style	Std. Radii	Style	Std. Radii	Style	Std. Radii
MRDB FRDB HRDB	.010”	MRDB FRDB HRDB	.281”	MRDB FRDB HRDB	.781”
	.015”		.312”		.812”
	.020”		.375”		.843”
	.025”		.406”		.875”
	.030”		.437”		.906”
	.031”		468”		937”
	.040”		.500”		.968”
	.046”		.531”		1.000”
	.050”				
MRDB FRDB HRDB	.062”	MRDB FRDB HRDB	.562”		
	.078”		.593”		
	.094”		.625”		
	.125”		.656”		
	.156”		.687”		
	.188”		718”		
	.250”		.750”		

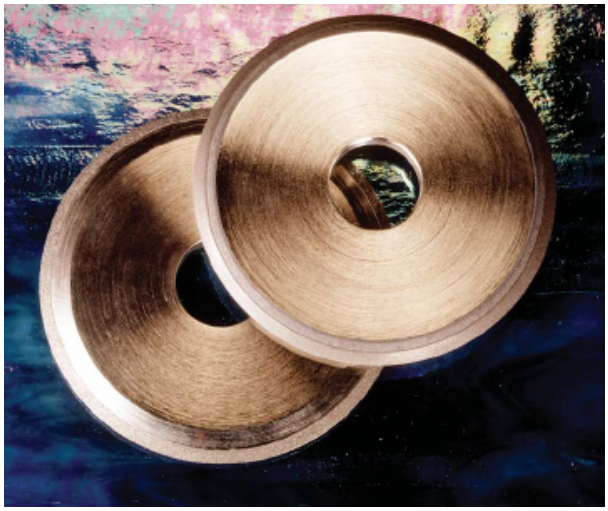
WFM ROTARY DRESSING DISCS

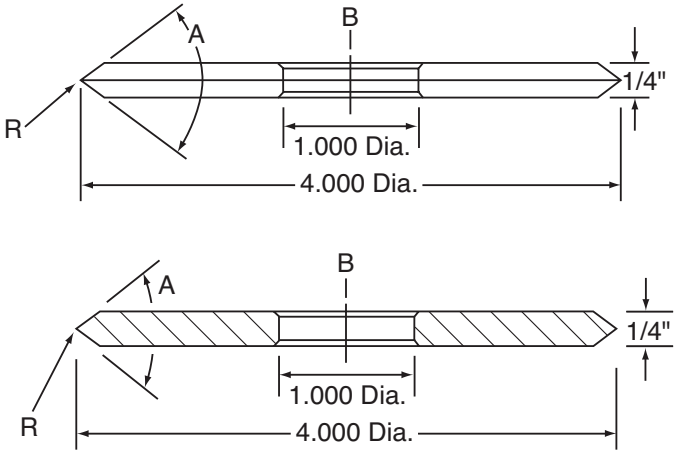
Engis manufactures both direct and reverse plated grinding wheel dressing discs. These discs were developed for use on grinding wheel dressing and profiling systems and can be used for any type of dressing system that requires a 4" diameter power-driven dressing disc.

WFM discs are used to dress conventional, as well as vitrified and resin bonded, diamond and CBN grinding wheels.

Similar to the chisel-type dressing tools, these discs are available with a selection of angles and edge radius in both the reverse and direct plated types.

For fast delivery Engis can supply 1" and 10 mm bore sizes from stock.





For Ordering Special WFM Discs
When ordering specials, please specify each dimension required:

B (Bore Size)
T (Thickness)
D (Diameter)
A (Angle)
R (Radius)

WHEEL FOR WHEEL FORMING MACHINE: WFM-1A – DIRECT PLATED

Part Number	A Angle	B Radius
WFM-1A-104	40˚	.010"
WFM-1A-204	40˚	.020"
WFM-1A-254	40˚	.025"
WFM-1A-106	60˚	.010"
WFM-1A-206	60˚	.020"
WFM-1A-054	40˚	.005"
WFM-1A-306	60˚	.030"

REFORM DRESSING WHEEL: WFM-2A–TYPE 1 – REVERSE PLATED

Part Number	A Angle	B Radius
WFM-2A-206	60˚	.020"
WFM-2A-026	60˚	.002"
WFM-2A-056	60˚	.005"
WFM-2A-106	60˚	.010"
WFM-2A-054	40˚	.005"
WFM-2A-104	40˚	.010"
WFM-2A-204	40˚	.020"
WFM-2A-209	90˚	.020"
WFM-2A-154	60˚	.015"

REFORM DRESSING WHEEL: WFM-2A–TYPE 2 – REVERSE PLATED

Part Number	A Angle	B Radius
WFM-2A-634	40˚	.0625"
WFM-2A-306	60˚	.0300"
WFM-2A-626	60˚	.0625 "

CUT-OFF GRINDING:

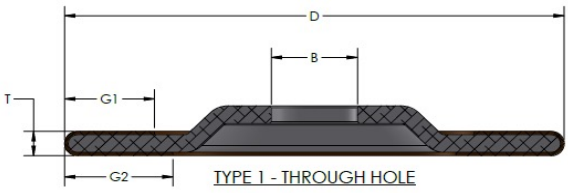
Cut-off grinding is the most widely used metal cutting process for the removal of gates and risers.

Equal or higher stock removal rates are achieved with cut-off grinding than with alternative machining processes such as turning.

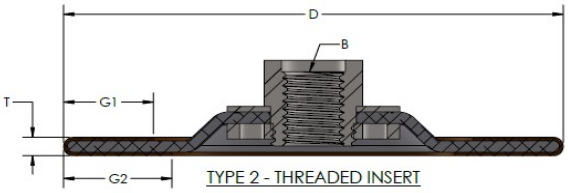
Demands of cut-off grinding:

- High G-ratios
- Straight cuts
- Smooth cutting surface
- Short cut-off times
- Minimal wheel thickness
- No or minimal heat in the work piece
- High wheel peripheral speeds
- High level of safety

STANDARD TYPES FOR HAND GUIDED CUT-OFF GRINDING:



TYPE 1 - THROUGH HOLE



TYPE 2 - THREADED INSERT

Type Number	Size	Grit	Shape	Speed	Core	Weight
	D x T x B	Full Wrap, both sides				Pounds
T27S30-18-38TD	3 x 1/8 x 3/8	30/40	T27	18,080	Steel	0.31
T27S40-18-58TD	4 x 1/8 x 5/8	30/40	T27	15,280	Steel	0.55
T27A45-18-58CD	4-1/2 x 1/8 x 5/8-11	20/30	T27	13,580	AL	0.49
T27A45-18-78TD	4-1/2 x 1/8 x 7/8	20/30	T27	13,580	AL	0.26
T27A50-18-58CD	5 x 1/8 x 5/8-11	20/30	T27	13,580	AL	0.55
T27A50-18-78TD	5 x 1/8 x 7/8	20/30	T27	13,580	AL	0.33
T27A70-18-58CD	7 x 1/8 x 5/8-11	20/30	T27	8,600	AL	0.93
T27A70-18-78TD	7 x 1/8 x 7/8	20/30	T27	8,600	AL	0.70
T27A90-18-58CD	9 x 1/8 x 5/8-11	20/30	T27	6,600	AL	1.42
T27A90-18-78TD	9 x 1/8 x 7/8	20/30	T27	6,600	AL	1.19

HORIZONTAL GRINDERS — CUTTING AND NOTCHING

Type Number	Size	Grit	Shape	Speed	Core
1FF1S30-18-14TD	3 x 1/8 x 3/8	30/40	1FF1	18,080	Steel
1FF1S30-18-38TD	4 x 1/8 x 3/8	30/40	1FF1	15,280	Steel
1FF1S40-18-14TD	4 x 1/8 x 1/4	30/40	1FF1	19,100	Steel
1FF1S40-18-38TD	4 x 1/8 x 3/8	30/40	1FF1	19,100	Steel
1FF1S40-18-58TD	4 x 1/8 x 5/8	30/40	1FF1	19,100	Steel
1FF1S20-14-38TD	2 x 1/4 x 3/8	1FF1	30/40	25,465	Steel
1FF1S30-14-38TD	3 x 1/4 x 3/8	1FF1	30/40	20,370	Steel
1FF1S40-14-38TD	4 x 1/4 x 3/8	1FF1	30/40	15,280	Steel

"SNAGGING" OR GRINDING CASTINGS:

Snagging is the removal of flashes, burrs, gates, risers, and casting faults on the surface. These are holes in the casting skin, clusters, sand inclusion points and cracks or fissures. After cut-off grinding this is the second most prevalent form of grinding.

This encompasses the general means used by all foundries with either portable, stationary, or automatic "fettling" machines. The surfaces treated by snagging are usually flat or in some cases a "notch" or crevice.

Operator safety, fatigue and productivity are greatly impacted by the method and choice of grinding wheel used.

What demands are made of a snagging wheel

- High G-ratio
- Good surface
- Good cut rate (free cutting)
- No or minimal heating of the work piece
- Good edge stability
- High level of safety

STANDARD TYPES FOR HAND GUIDED SNAG GRINDING:

Type Number	Size	Grit	Shape	Speed	Core	Weight
T27A30-14-38TD	3 x 1/4 x 3/8	30/40	T27	18,080	AL	0.15
T27A40-14-58TD	4 x 1/4 x 5/8	30/40	T27	15,280	AL	0.27
T27A45-14-58CD	4-1/2 x 1/4 x 5/8-11	20/30	T27	13,580	AL	0.59
T27A45-14-78TD	4-1/2 x 1/4 x 7/8	20/30	T27	13,580	AL	0.36
T27A50-14-58CD	5 x 1/4 x 5/8-11	20/30	T27	13,580	AL	0.69
T27A50-14-78TD	5 x 1/4 x 7/8	20/30	T27	13,580	AL	0.46
T27A70-14-58CD	7 x 1/4 x 5/8-11	20/30	T27	8,600	AL	1.18
T27A70-14-78TD	7 x 1/4 x 7/8	20/30	T27	8,600	AL	0.95
T27A90-14-58CD	9 x 1/4 x 5/8-11	20/30	T27	6,600	AL	1.82
T27A90-14-78TD	9 x 1/4 x 7/8	20/30	T27	6,600	AL	1.59

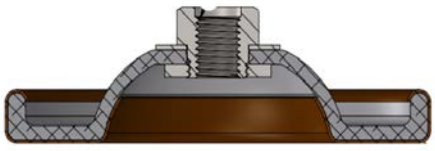
PORTABLE GRINDING OF CASTINGS:

Portable grinding is also considered snagging, but inclusive of a wider variety of methods and tools.

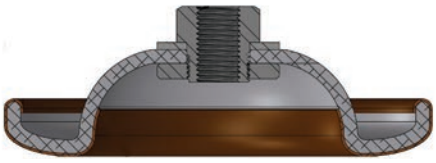
This includes the processes used by all foundries to clean cavities, seams, blemishes (cosmetic defects), and otherwise “non-flat” areas of the casting (shoulders, bores, radius, and hard to reach areas).

ANGLE GRINDERS, STRAIGHT GRINDERS (IN-LINE GRINDERS) AND FLEXIBLE SHAFTS:

- Mounted points
- Tungsten carbide burrs
- Shape 1
- Cup wheels (Shape 11 and Shape 6)



HS48486-1



T11A60-20-58CD

Type Number	Size	Shape	Grit	Speed	Core
HS48486-1	6 x 2 x 5/8-11	T11	20/30	7,260	AL
T11A60-20-58CD	6 x 2-1/16 x 5/8-11	T11	20/30	7,260	AL

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