TECHNICAL BULLETIN

CRANKSHAFT MICRO-FINISHING WITH MICRO-MESH

Since 1982, MICRO-SURFACE FINISHING PRODUCTS has been involved in micro-finishing crankshafts. The experimental work that was done during the early 1980's addressed the needs of the automotive industry for that decade and beyond.

Engines of the 1970's were built to specifications that are considered very broad. In the 1980's the automotive industry began developing small displacement high horse power engines that required improved bearing surfaces.

The specifications were analyzed and criteria for shape of the bearing or geometry was included along with roughness average (Ra). Significant improvement in bearing life resulted as bearing quality improved.

After grinding of the bearing surface, geometry could be adjusted to achieve optimum bearing quality. Ferrite caps (in cast iron) were removed and final finishing was done using abrasive tapes pressed against the bearing area with a back-up tool that conformed to the bearings. The coarseness of the tape, the hardness of the tape back-up tool, the dwell time on the bearing and the pressure on the back-up tool were significant factors in meeting a given bearing quality specification.

Crankshaft finishing machine builders such as Industrial Metal Products Company in Lansing, Michigan, found that a given specification could be met using abrasive tapes in successive stages. Stage one was usually designed to achieve geometry and produce a finish that was acceptable for some manufacturers.

Where better surface finish was required or where ferrite cap removal was desired, a second stage was added. This step usually did not remove more than .0001"-.0005" of stock, but improved a surface finish.

By the mid-1980's the specifications often required a third stage to bring the finish into conformance. The third stage was used to reduce the Ra and to debur the edges of ferrite cap craters on cast iron crankshaft. MICRO-MESH 600 MX material was found to be the only material capable of producing the bearing quality required at this stage.

With 2 and 3 stage crankshaft machines common place in the late 1980's, bearing quality improved. However, cost per crank increased significantly. While machines were a large capital expense, use of abrasive tape came into focus as a large operating expense on a cost per crank basis.

The length of common coated abrasive tape used in many 2 or 3 stage crank machines was often 1/3 to 1/2 the circumference of the bearing. This resulted in a new piece of tape 1"-2" in length being used for each bearing surface on each crank. With 7-12 bearing surfaces per crank and running 20-60 cranks per hour, many machines consumed as much as 50 feet of abrasives per hour. At a typical cost of $120.00 per 450' roll (or $13.00/hour) for abrasive media, ways to reduce this cost were sought. The factors in cost included tape breakage and back-up tool wear due to the abrasive sliding across the surface.

An obvious cost savings would be made by reducing the index or amount of tape pulled through for each bearing. When common abrasive materials are used, index could only be reduced to 1"-3/4" without a corresponding reduction in bearing quality.

During 1989, tests were performed at General Motors that indicated that the 3rd stage MICRO-MESH 600 MX material could be used with extremely short index or pull through. In general industrial applications MICRO-MESH has always proven to last 7-10 times longer than common coated abrasives. The normal crankshaft machine pulls or indexes new abrasive tape for each crankshaft. Abrasion tests show that MICRO-MESH 600 MX used once retained 97.8% of its' new effectiveness. The design of MICRO-MESH allows the abrasive crystal to float on a thin resilient layer. The crystals are not crushed and retain their cutting ability much longer than common abrasives when pressed against the crankshaft bearing.

As a result of this test, index or pull through of 1 1/2" of tape per crankshaft was reduced to 3/4" and finally to 3/8"; with no change in bearing quality. Total tape usage on this machine dropped 63% in the first year of running with a reduced index.

More recently, the economy of using MICRO-MESH indexing every 3rd crankshaft was successfully tried. An index rate of 3/4" was maintained and 3 crankshafts were put through before pulling 3/4" of tape. Bearing quality was not affected.

Because of the significant saving shown in the above tests, material was developed to achieve finishes equal to those of the second stage material. Being able to reduce index or skip index for second stage would reduce material costs even further.

One of the concerns in using MICRO-MESH on second stage is the difference in backup tool material. If the material was hard, such as India Stone or steel, the slick film back and cloth back materials tended to slip on the hard surface. Several film materials are available. However, the best material for stone shoes appeared to be one developed at MICRO-SURFACE and referred to as MX EH "Soft Grip". This is a patented concept using a resilient material on the back of the 5 mil polyester film to give the grip needed to hold the hard shoe surface.

The MX EH "Soft Grip" is preferred over using abrasive grit on the back of the film to prevent slippage as it does not abrade the surface and promote shoe wear. The MX EH grip for abrasive backed tape is like a gym shoe on a hard floor as compared to a football spiked show on the hard floor. The gym shoe grips the floor as the tape backing grips the hard shoe. The spikes embed themselves and tear at the floor in order to hold.

Tests were run in August 1992 to develop more data on the effects of using MICRO-MESH MX EH on 2nd stage finishing. Since the profile and geometry are developed in the first stage, after grinding, the concerns for finish at 2nd stage were:

- To develop an acceptable value for roughness average (Ra).

- To develop an acceptable percentage of flat area relative to measured length (bearing ratio) (TP).

For comparison testing, nodular iron crankshafts were run using 15 micro film back material versus MICRO-MESH 320 MX EH "Soft Grip" material. The back up tool used India Stone inserts to press the material against the crankshaft. The pressure setting on the tool was 70 psi.

The comparison results are as follows:

- Roughness Average (Ra) – MICRO-MESH abrasives gave a better surface by at least 1 micro inch.
- Highest peak above centerline (RP) – MICRO-MESH abrasives produced lower peaks by 2.75 to 6.75 micro inch.
- Highest peak to lowest valley (RT) – MICRO-MESH abrasives gave larger readings.
- Bearing ratio (TP) – MICRO-MESH abrasive produced better values 10% slice.

In the last year or so, industry standards have changed. There is less concern about peak to valley. The more logical approach is that the valleys don't have the same effect on bearing life as the high peaks. The high peaks are load bearing points. Bearing ratios (TP) taken at 10% - 50% slice levels for example have more meaning in actual running conditions than peak to valley (RT).

Micro photographs also showed that MICRO-MESH leaves significantly fewer ferrite caps. A count of ferrite caps was made from 200X magnification for this comparison.

Conclusions drawn from the above information:

- MICRO-MESH generally out-performs 15 micron material in the critical areas of Ra, high peak removal and ferrite cap removal.

- Bearing Ratio values at slice levels of 10-50% indicate very acceptable percentages of flat bearing surface.

- MICRO-MESH comes very close to achieving 3rd stage bearing quality on the 2nd stage.

MICRO-MESH MX EH is an alternative material for 2nd stage of micro finishing machines. Since MICRO-MESH can be used to reduce index and or skip index, significant cost reductions on the 2nd stage of 2 and 3 stage machines are now available.

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TECHNICAL BULLETIN

BELT FINISHING WITH MICRO-MESH

MICRO-MESH™ finishing belts provide desired surface qualities and economic benefits to many types of finishing operations, and are available in a range of standard as well as custom sizes.

Generally recommended for fine finishing steps, MICRO-MESH is constructed with a thin layer of soft resilient material between the cloth back and the abrasive crystals which provide the unique "cushioned" suspension action for the abrasive. This unique design allows the abrasive crystals to recede into the resilient layer and align at an even cutting plane. This eliminates deep random scratching and results in uniform scratch patterns and significantly longer product life than conventional abrasives.

MICRO-MESH cuts rapidly due to its larger crystals. This design allows more abrasive crystals to contact the workpiece. MICRO-MESH outlasts conventional abrasives because the relatively large crystals do not load up, fracture or generate heat into the workpiece.

Equipment

MICRO-MESH belts work well with almost any of type floor or bench machines including centerless, flat belt and platen sanders. Since regulating speed and pressure is difficult with portable belt sanders, they are not recommended. It is generally more effective to take the part to the machine, rather than the machine to the part.

Speed

In general, surface belt speed should be set at less than 5500 surface feet per minute (SFPM). Harder materials typically are run at 3000 - 5000 sfpm while 2500 - 3000 sfpm is better for softer metals, such as brass. Even softer materials such as plastic, should run at 600 - 1000 sfpm and should always be worked wet. Too great a speed and/or pressure will ultimately defeat the cushioning system.

Pressure

For best results, pressure should be kept light. The work of the MICRO-MESH belts is done with the abrasive crystal tips, very similar to the action of a brush. Increased pressure either by the operator or mechanically will cause stretching, premature wear of belts and unsatisfactory results.

Lubrication

The use of a very light water mist on the MICRO-MESH belt is recommended. This mist should be applied at the opposite end of the belt from the contact wheel, allowing the belt to feed the water forward to the part. The amount of mist used should be adjustable. The belt should be wet to the touch where the part contacts the

belt, but not flooded. Generally if the proper amount of water is used, no water should be dripping off the belt at any point.

Water is the best lubricant/coolant to use for all materials except aluminum. Where flash rusting is a problem, as with ferrous parts, an inorganic rust inhibitor such as sodium dichromate can be added to the water. Many organic rust inhibitors contain solvents that may cause crystal loss or delamination. It is always recommended to test any water additive's compatibility with a scrap piece of MICRO-MESH.

Belt "grease" compounds should **never** be used on MICRO-MESH. Grease fills the abrasive crystals and particles of material removed (swarf) will pack into the grease, loading the MICRO-MESH and rendering it totally useless. Such belt compounds are used to soften the cut of common abrasives and to lubricate. **The use of grease compounds is not recommended with MICRO-MESH.**

Process

The finishing process used for a given part depends on such factors as beginning surface condition of the part, finish desired, and the type of material being finished. Surface evaluation is a matter of experience, trial and error.

If the surface of the part is too rough, a common abrasive belt may be necessary to bring the surface to a starting point MICRO-MESH can handle in a time-effective manner. However, since common abrasives usually leave random scratches deeper than the grit size of the belt, it is better to start with as fine a grit as possible for deburring or roughing steps. The random scratches can then be more easily removed with the initial MICRO-MESH step.

Evaluation and process recommendations can be made by sample part testing in the *Micro-Surface Finishing Products* Applications Lab. Call 1-800-225-3006 for details.

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GUIDELINES FOR MAKING BELTS WITH MICRO-MESH AND MICRO-MESH MX ABRASIVE MATERIAL FROM MICRO-SURFACE FINISHING PRODUCTS, INC.

1. MICRO-MESH and MICRO-MESH MX abrasive products are cloth backed cushioned abrasives. There are no chemical treatments of any kind on our cloth backed materials. Therefore there is no need to scuff the backs of splicing area before beginning splicing operation.

2. We recommend butt splices only, as other types of splices can cause uneven finishes.

3. A bias cut of 45, 55, or 67 degrees is recommended for a splice.

4. **Do not** attempt to scythe joints with MICRO-MESH or MX abrasives, it is unnecessary and will damage the belt.

5. The splicing tapes to be used can vary according to customers needs or grit of abrasive material:

   Mylar tape (non-frozen and non-adhesive) - Glue both tape and splice. Wait until dry before adhering to splice area.

   Polyester/Mylar tape (frozen) - Glue splice joint; wait until dry and apply tape to glued splice area.

6. Heat and pressure are required to assure a complete bonding. Usually 250 degrees with firm pressure for 10 seconds (consult with tape manufacturer for further details).

For questions or comments, please contact our technical department at 1-800-225-3006.

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MICRO-MESH MX

DESCRIPTION: MICRO-MESH is a series of cloth-backed cushioned abrasives designed to produce very low roughness average (Ra) scratch patterns on a variety of materials. On metal the coarse grades of MICRO-MESH MX can achieve finishes below 1.0 micro inch with proper surface preparation and application.

Surface preparation prior to MICRO-MESH MX use includes establishing the geometry of the part reduction of the Ra to 20 micro inch or less using the most economical conventional method available. One application of MICRO-MESH MX should reduce the Ra to 10 micro inch.

Subsequent applications will further reduce the Ra by approximately 1/2 until the specified finish is reached. Using a combination of one or more of the MX series and variation of material feed, speed or pressure can produce sub 1.0- micro inch finish.

MICRO-MESH MX can also be used on painted metal surfaces and other hard surfaced materials.

MATERIALS: Silicon carbide crystals on a resilient layer over cloth back. The backing is stamped with the following grade number for easy identification.

60MX	120 MX	240 MX	400 MX	*1200 MX
80 MX	150 MX	320 MX	600 MX	
100 MX	180 MX	360 MX	*800 MX	* aluminum oxide crystals

AVAILABILE IN:

Sheets: 3" x 6"
6" x 12"
12" x 12"

Tapes: 1/2" - 2" widths

Discs: Various Sizes

Rolls: 4" x 50'
6" x 50'
6" x 25'
12" x 25'

Handi-Files: 1/2" x 5 3/4"
5/8" x 5 3/4"

Soft Touch Pads: 2" x 2"
3" x 4"

Kits : MX-90 Metal Finishing

Belts: Various Sizes

STORAGE & HANDLING: When stored between 0-120 degrees Fahrenheit a clean and dry environment, life is nearly unlimited. No special handling required.

APPLICATION: MICRO-MESH MX may be used by hand or machine. A firm foam block should be used as back-up during hand applications. The cutting ability of MICRO-MESH MX is increased by increasing the rigidity of the back-up material. MICRO-MESH MX may be used wet or dry. Most water or oil base lubricants are acceptable for used with MX. Lubricants should be tested for compatibility before general use. Always finish clean-up with soap and water to remove solvent.

When using water as a lubricant do not soak MX in water for more than four hours. Apply water by dipping or spraying.

Using MX with a sharp edged back-up may cause it to wear faster on the narrow edge.

Specific application instructions are available upon request from MICRO-SURFACE at 1-800-225-3006.

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TECHNICAL BULLETIN

METAL FINISHING WITH MICRO-MESH® MX

Sanding is used to establish a part's geometry or finish. Geometry is commonly established with coarse grits of coated abrasives, bonded abrasive wheels or by hand turning. Finishing is generally achieved with successively finer grades of abrasives until the desired surface quality (appearance) is obtained.

MICRO-MESH MX is a series of cushioned abrasives with a slightly stiffer backing, and several coarser grades than the MICRO-MESH Regular series. MICRO-MESH MX enables the user to achieve the desired finish faster and often with less steps than with conventional abrasives. Start to use MX as soon as practical in the finishing sequence.

All MICRO-MESH Regular and MX grades are constructed with a thin layer of soft resilient material between the cloth back and the abrasive crystals. This provides the unique "cushioned" action for the abrasives. This unique design allows the abrasive crystals to recede into the resilient layer and float to an even cutting plane. This eliminates deep random scratches and results in uniform scratch patterns and significantly longer product life than conventional abrasives.

MX grades cut rapidly due to the relatively large crystals and because the flexing action allows more abrasive crystals to contact the workpiece. The flexibility of the crystals keeps the swarf loose and prevents loading. MICRO-MESH outlasts conventional abrasives because the relatively large crystals do not load up. The flexibility prevents the crystals from fracturing and generating heat into the workpiece.

MX is economical to use. In dry applications, it outlasts conventional abrasives 5 - 7 times, When used wet, the life advantages increase 7 - 15 times that of conventional abrasives. MX can be used with most standard cutting oils, honing oils or coolants, either water or oil based. The objective is to flush the surface of the MX and the workpiece to keep it free of swarf. MX can not be used with solvents like acetone or certain chlorinated solvents. Lubricating with grease type or filler type lubricants will cause rapid loading. Such belt compounds are used to soften the cut of common abrasives which is not necessary since MX is engineered to have a controlled aggressiveness. Once the abrasive crystals have receded to their given level, further down pressure will not increase the rate of removal or surface quality but will put stress on the material. Keep the pressure light.

Machine Speeds
On .plastics and woods - speeds of 1000 sfpm (less if possible). Plastics should always be worked with a water mist.

Metals - Speeds below 6000 sfpm are recommended.

The floating action of the abrasive crystals in MX does not require high speed operation to achieve super finishes. If higher speeds are used, feed rates and pressure should be reduced. As a general rule, higher speeds promote a faster cut, while slower speeds produce a better finish.

Contact wheels should be kept as soft as possible for best finish and longest life. A non-serrated 40 durometer rubber wheel or a cloth wheel should be used. MX can also be used on inflatable wheels as replacement for buffing wheels.

If a "mirror" or highly reflective surface with no visible scratches are required, more steps are needed than for a #4 or #7 finish.

Steel, stainless and ferrous metals
The following is general information to help, not meant as an instruction sheet. Variables such as speed, pressure and differences in materials to be finished may change the combination of MX used. When starting with mill finished or ferrous stock, it may be desirable to use a conventional 240 or 280 p grit to remove all mill marks, scale, etc. A combination such as 100MX and 240MX. 400 MX is recommended for finishing steels. 400 MX cuts like a 400-600 grit but should leave a 1200-1500 grit finish. When a finer finish is required, use 600, 800 or 1200 MX. Sand casted material will require more steps with conventional abrasives before using MX.

Copper, brass, bronze, aluminum and other soft metals
The procedure is similar to that of steel. However, the starting point can be 80 MX, 100 MX or finer depending on the softness of the material. Coarse castings will require conventional abrasive steps prior to using MICRO-MESH. When finishing aluminum, it is important to slow the surface speed down and use a coolant made for aluminum.

Hataloys, titanium, nickel, stellite and other special materials and alloys
Each of these materials requires a trial piece run to determine the best sequence for achieving the desired finish. For more information and reference call 1-800-225-3006.