Precision Ground Flatstones

$595.00 per set

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INTRODUCTION

When a flatstone is rubbed on a surface, small asperities and high spots are caught in the porous cavities of the flatstone and are sheared off. As the swollen material around the high spot is trimmed by the flatstone, the contact area between becomes relatively large and the cutting action essentially stops. This idea of shearing high spots can also apply to the finish of a piece. In addition to preparing or repairing a piece, a flatstone can be used to improve the surface finish.

This poster demonstrates and analyzes the effects of using a flatstone to improve the finish of a ground workpiece.

MOTIVATION

In grinding there are inevitable variations in the finish which occur due to many factors such as feed rate, spindle speed and machine tool stiffness. A flatstone can help reduce the effects of these variations by blunting the highest peaks. In other words, a flatstone can microfinish a precision-ground surface.

APPROACH

We ground several pieces of mild steel, each to a different surface finish ranging from 5 to 13 μin. This was done on a Mitsui CNC Surface Grinder with a roto-grinding attachment. We scanned the surfaces before and after stoning using a Mitutoyo SJ-400 profilometer with a diamond stylus. The following pictures are of a surface before and after stoning. Note how in the second (bottom) reading the irregularities have been "sheared" off, resulting in a smoother surface. The finish indicated by Ra (Roughness Average) started at 8.6 μin and after stoning improved to 6.2 μin.

Blunting the peaks increases the bearing area so that parts feel smoother, but not so smooth that they stick together.

Profilometer Readings: Ra (Flatness Avg.)		
Before (μin)	After (μin)	Percent Improvement
5.4	4.7	13%
6.8	3.7	46%
7.8	6	23%
7.9	5	37%
8.6	6.2	28%
9	6.4	29%
11	8.5	23%
11.1	6.7	40%
11.4	8.6	25%
11.9	9.6	19%

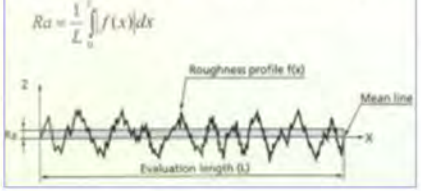
RESULTS

Above are readings from different samples prior to and after one minute of vigorous stoning. Depending on how hard the stone is applied the percent improvement ranges from 13 to even 45 percent improvement in the surface finish. These readings are based on the Roughness Average, as explained by this poster clipping below taking from Surfcom: Surface Finish Parameters provided by Zeiss.

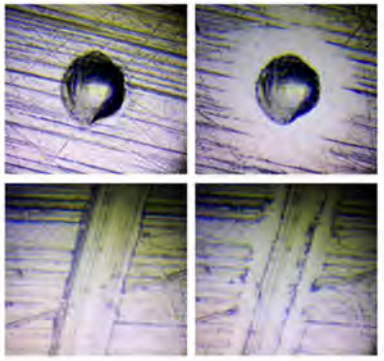
Ra Roughness Average / Arithmetic Average (ISO 468, ANSI B46.1, DIN 4768, JIS B0601)

Arithmetic average of the deviation of the peaks and the valleys on the profile from the mean line. Also called CLA, Center Line Average.

$$Ra = \frac{1}{L}\int_0^L |f(x)|dx$$



There is also a visible change to the surface. The high areas in an otherwise flat surface as they get sheared off as the stone bears down on the surface take on a mirrorlike quality.



Flatstones can also be used to repair a damaged surface.

Here we have conducted our own experiments to repair a part with a flatstone after it has been damaged. The photos above are before and after documentations of surface repair using a flatstone. The top pictures were created using a machinist's punch and the bottom pictures were created using a carbide scribe. Notice how using a flatstone has removed the high spots surrounding the damaged areas.

CONCLUSIONS

Flatstones are not only essential components to precision assembly; they also can be used to improve the surface quality of a precision ground surface as well as repairing a damaged surface.

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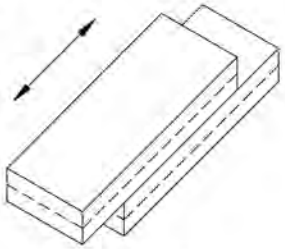
GF-5 Precision-Ground Flatstones

These stones have been ground flat on both faces with a diamond wheel. The long sides are ground perpendicular to allow stoning up to a shoulder. The ends are unground. The stones are used to remove the swellings which surround the inevitable tiny nicks and dents found on any machined surface. They are much like gage block stones, but with a more aggressive cutting action.

The stone's porous structure allows asperities to penetrate far enough to be trimmed off. When the raised area is reduced in height to about ten microinches, the force is spread out between two relatively large flat surfaces, and cutting activity substantially stops. Proper application will avoid scratching the work and will prolong the useful life of the stone:

- Prepare the work by locally removing large burrs with a file or an unground stone. Clean with solvent and tissue.
- Before stoning a workpiece, rub the two stones together to remove or cut down embedded debris, which could scratch the work.
- Slide the stones onto the workpiece with light pressure to avoid scratches from loose particles. Small projections are easily felt if the work is clean. Concentrate on the feel; loose debris can be felt rolling around. Stop immediately and reclean.
- Gradually bear down, always working in the direction of the original grind lines on the work.
- Clean the stones by spray rinsing or ultrasonic cleaning followed by air blast. Store in the original container to avoid misuse on rough work.



Work stones together before each use