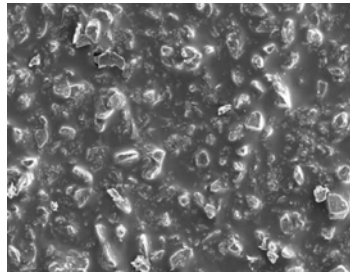


by Donald Zipperian, Ph.D.

## SiC Abrasive Grinding Applications

The use of **Premium SiC** abrasive paper is the most efficient and practical technique for grinding metallic metallographic specimens. Although many qualities of silicon carbide are readily available, only the premium grade SiC powder provides the most consistent results and highest grinding rates.



SEM image of 600 grit SiC, mag 150X

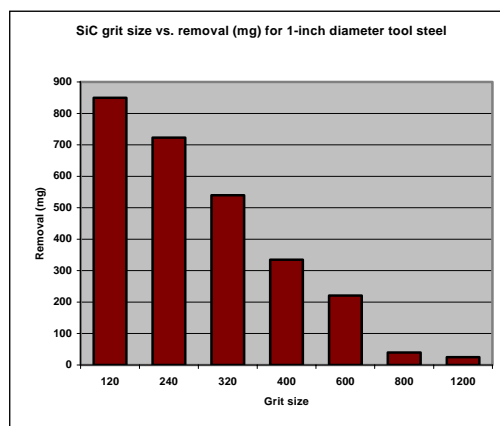
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| Standard grit | European (P-grade) | Median Diameter (microns) | Surface Roughness on Steel, Rc 30 (Ra -nm) |
|---------------|--------------------|---------------------------|--|
| 60            | 60                 | 250                       | -  |
| 80            | 80                 | 180                       | 1140                                       |
| 120           | 120                | 106                       | 1050                                       |
| 180           | 180                | 75                        | 880  |
| 240           | 220                | 63                        | 300  |
| 320           | P360               | 40.5                      | 230  |
| 400           | P600               | 25.8                      | 120  |
| 600           | P1200              | 15.3                      | 110  |
| 800           | P2400              | 6.5                       | 25   |
| 1200          | P4000              | 2.5                       | 20   |

## Abrasive Grit Size

The above table shows the standard conversion for the USA grading vs. the European grading system. For the coarse particles (>220 grit) the grading is the same. The major difference is with the finer particles, where the European sizing uses a "P" designation with the smaller particles (P360 to P4000). The above table also shows the average particle size and resulting surface finish for each grit size. In particular, the 800 and 1200 grit SiC papers are produce surface finishes in the neighborhood of intermediate diamond polishing steps (Ra <50 nm).

The chart to the right illustrates the effect of SiC grit size on removal rate for a tool steel. As shown the courser grit sizes remove material at a faster rate than the finer grit sizes or smaller particle sizes.



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### Considerations for proper SiC grinding

- Particle grit size
- Applied grinding load
- Grinding lubricant
- Orientation or tracking of specimen across the SiC surface

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Premium silicon carbide powders are processed at higher temperatures than the lower quality silicon carbide powders. Thus the premium silicon carbide powders obtain a more complete reaction between the silica and carbon components. The resulting crystal structure is a hexagonal-rhombohedral crystal structure with a hardness of approximately 2500 HV. This crystal structure makes the premium silicon carbide powder an ideal abrasive for cutting and grinding because of its high

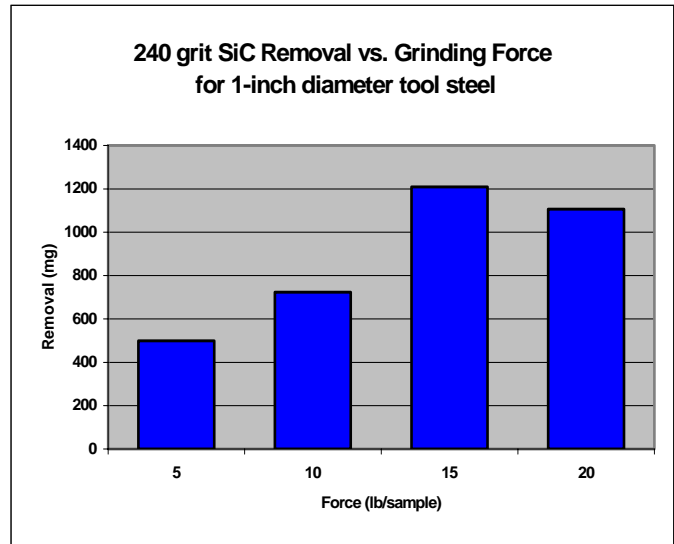
hardness and sharp edges. Premium silicon carbide is also somewhat brittle, and therefore cleaves easily to produce sharp new edges (self sharpening).

The resulting **Premium SiC** abrasive is an excellent abrasive for maximizing cutting rates while minimizing surface and subsurface damage. For metallographic preparation, **Premium SiC** abrasives are applied or coated onto abrasive grinding papers. To increase the durability as well as to improve the ability to remove used papers, a thin mylar film backing is bonded to the **Premium SiC** paper.

## Grinding Forces / Pressure

Applied grinding pressure or the applied force is a very important parameter for optimizing removal rate as well for increasing the overall efficiency of the grinding paper. The removal chart to the right shows the effect of increasing the applied force to a 1-inch diameter tools steel in a 1.25-inch diameter mount. Whereas most procedures for metallographic grinding recommend 5-10 lbs of force per 1.25-inch mounts, the chart

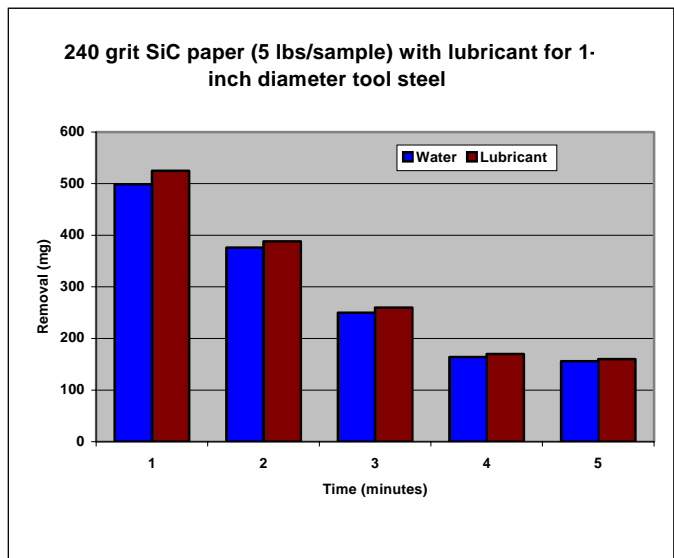
to the right indicates that the most efficient use of SiC paper is at a grinding force around 15 lbs per sample. This is an important consideration to take into account when grinding because many machines are not capable for grinding at these loads with a full set of loaded samples. In other words, the grinding rate and the life of SiC paper can be tripled by increasing the grinding forces.



## Grinding Lubricants

Another less significant but important consideration is the grinding lubricant. In general, for hard materials a lubricant does not make a significant difference in the grinding rate or life of the SiC paper; however, for softer more

gummy materials, the use of a lubricant can increase the performance of SiC paper. The role of the lubricant in this case is to prevent the build-up of the grinding swarf onto the SiC paper.



## MRD and Specimen Orientation

Material Removal Differential or MRD is a common and annoying problem when grinding with SiC papers on automated machines. It manifests itself after polishing in the form of a quarter moon at the edge of the sample.

occurs because the SiC paper does not break down evenly if the sample does not track over the entire diameter of the SiC paper.

MRD is a result of the specimen not tracking over the entire diameter of the SiC paper and is a much more common problem with plain-backed SiC paper using a clamping ring. MRD

The solution to this problem is to orient the sample in the specimen holder and to position the specimen holder so that it tracks over both the outside as well as the inner diameter of the SiC paper, thus allowing the SiC paper to break down uniformly.

*“The efficiency of SiC grinding papers when used properly is the best method for rough grinding.”*

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