

**The “Maximizer®” Vitrified CBN**

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## **Abstract:**

The paper describes the new "Maximizer®" vitrified CBN reviewing the parameters for its use. Some of the parameters include; spindle horsepower, Q' (Q prime), balance requirements, dressing equipment, dressing parameters, coolant requirements and feed rates. The paper will also discuss an actual field application and the results obtained. All of the above parameters will be discussed and a summary will be offered giving comparisons of wheel life and productivity gains over the present process.

## **Summary & Conclusions:**

The new “Maximizer®” developed by SuperAbrasives Inc. Wixom, Michigan is the final bridge that links vitrified CBN to all forms of manufacturing. Because this product can be used on present grinding equipment and low horsepower equipment, it can be retrofitted to almost any cylindrical grinding process.

The “Maximizer®” allows for established levels of Q' (Q prime) with about half the horsepower needed of the previously accepted norm. Example would show a 5 horsepower grinding spindle could produce 0.5 Q' stock removal without strain to the system. The example shown in the field test provided an in-feed of 0.160” per minute on approximately 1” diameter part using an 18” diameter wheel with a 1.5” length of contact (wheel contact width). This was done with a synthetic coolant and less than adequate coolant flow utilizing “lock line” nozzles. There was no burning and part geometry was maintained part to part for 150 parts (750 diameters), exceeding 7 times the life of the “SG” (seeded gel – ceramic) wheel.

Although horsepower, dynamic balancing, coolants and the flow velocity of those coolants are important for maximizing the grinding process, this new product called the “Maximizer®” from SuperAbrasives has proven to maximize the machines already in the field and allow the customer to review the purchase of less optimal and expensive machines in the future. Only a rotary dresser is needed to retrofit a machine for utilization of this new product.

**Field Testing the “Maximizer®” – O.D. Grinding of Input Shaft with Vitrified CBN on low horsepower grinder.**

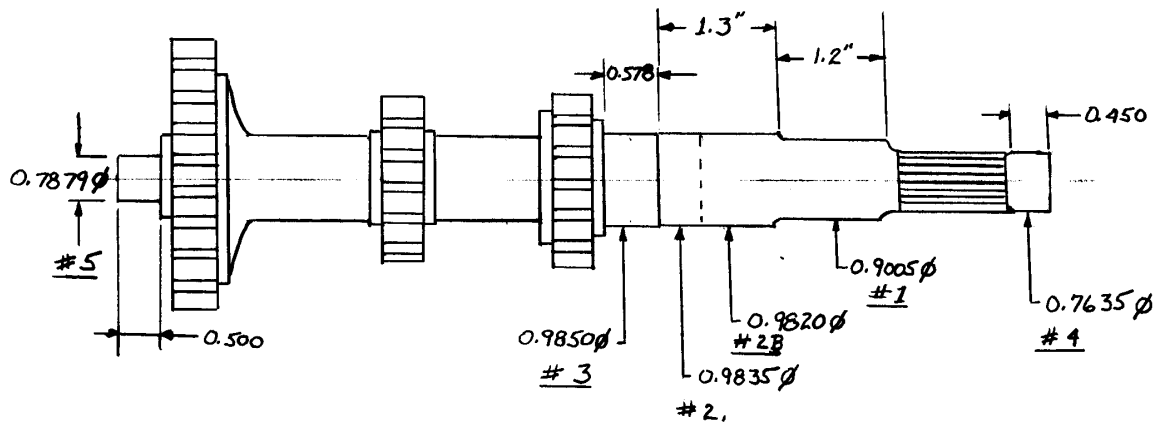
**Equipment:**

- The machine chosen for this test application was a Toyoda GL4E CNC cylindrical grinder with 7.3 horsepower (5.5 Kw). The grinder came equipped with an in process gage from Toyoda (“Auto Sizer”) and the parts were presented to the machine from an overhead gantry system.

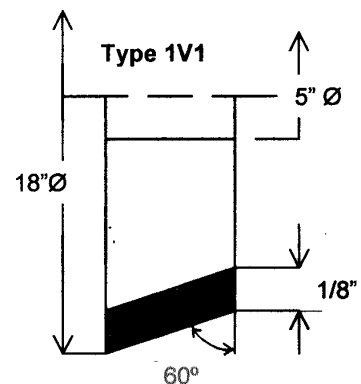
The coolant tank was standard equipment from Toyoda (100 gallon capacity) with coolant delivered through lock lines coming off a manifold. Two nozzles were directed into the wheel and one larger lock line directed into the cutting zone. The hose was a 1-1/2” line coming from the pump with very little flow rate (gallons per minute and pressure was not recorded but approximated at 20 GPM at 15 psi).

**Workpiece/Tooling:**

- The part was an input shaft with 5 diameters to grind (see sketch below). The material was 8620 hardened to 58-62 Rc. The finish requirements were 32 – 63 depending on the specific diameter. Tolerance requirements were circular run-out of 0.0005”.



- The grinding wheel (The “Maximizer®”) manufactured by SuperAbrasives, Inc. Wixom, Michigan was 18” x 1.3” x 5 Type 1V1 (30° angle). Calculating the “P” line (actual length of contact line) was 1.5”. The “X” dimension was 1/8” of vitrified CBN.



- The only additional equipment needed for a successful process was the addition of a rotary dresser. Chosen was a GII solutions incorporated model 1300. This model has a small footprint (approximately 2.5" x 2-3/4" x 5" long) and can rotate in both directions with a range of between 500 to 12,000 rpm.



- The dresser used to dress the Vitriified CBN was a 4" x1/2" x 0.4999 natural diamond dresser with a series of 0.020" inch radius diamond around the periphery. The diamond dresser was manufactured by Consort diamond.



- Dressing was static only.
- Coolant was a synthetic manufactured by Castrol, product number WY3-057B. This product was high in lubricity and made for CBN grinding.

#### Testing Parameters:

- **Truing and dressing** - After static balancing and mounting the wheel, the wheel was trued at an infeed of 0.001" on diameter (0.0005" per side) at a traverse rate of 15" per minute (0.008" per revolution of the wheel rpm). The wheel velocity for dressing was approximately 8,500 SFPM (1,800 rpm for an 18"Ø wheel) and the dressing roll velocity was 5,400 SFPM (5,200 rpm for a 4"Ø dressing roll). The wheel to dressing roll ratio ( $V_s/V_w$ ) was 0.6:1.

After the wheel was trued final dressing was accomplished with a total in-feed of 0.0007 (7 passes with an in-feed of 0.0001 per side) at a traverse rate of 3.75" per minute or 0.002" per revolution of the wheel.

- **Process cycle:** - Grind 1 thru 4 diameters (see part drawing for sequence) was ground and the robotics flips the part and grinds diameter number 5. It should be noted that because of the in-feed rate of the process was so rapid compared to conventional process it was decided to make 2A and 2B separate diameters. In-feed rates for all parts were:

Rough grind – 0.160" per minute to within 0.0015" of finish diameter

Finish grind – 0.030" per minute to size

Dwell – 1 second

It should be noted that the finish cycle was introduced because the Toyota "Auto Sizer" was unable to relay data fast enough. The work rpm was 400 rpm for all diameters.

**Results:**

The test process yielded an increase in productivity of 45% over the present process. Wheel life was 7.5 times that of the SG (seeded gel) wheel. The actual figures are as follows:

Production (parts per hour) with the SG wheel	28
Production (parts per hour) with the "Maximizer®"	40
Number pieces per dress with the SG wheel	20
Number of pieces per dress with the "Maximizer®"	150

Consistency from part to part is exceptional with no variation between parts. Parts were cool and no burning has been detected even though grinding in-feed is many times more aggressive than the old process. The actual cost savings was in excess of \$80,000.00 for the one machine alone. Other machines are being changed over to the new "Maximizer®"

**Conclusion:**

The new "Maximizer®" from SuperAbrasives, Incorporated shows great promise for introducing CBN into every area of production grinding. No longer are machine conditions a factor. This new wheel allows for the use of CBN with low horsepower machines, applications using synthetic coolants, less than ideal coolant flow rates and it produces finishes with just static balance.

This paper is not inferring that to maximize the grinding process the user should not review the use of higher horsepower machine, dynamic balancing, coolant flow and pressures needed to maximize the process or down play the productivity gains from using straight oil or micro-emulsion oils. This new wheel now offers a way to maximize the grinding process with present machinery and the opportunity for manufacturers to review the use of lower horsepower machines in the future.

Most present equipment can be retrofitted with rotary dresser allowing the user to utilize this new technology. New equipment can be equipped with a rotary dresser and it would be recommended that a variable speed dresser with unidirectional capability be purchased. It is also important to use a dressing wheel that has a given contact radius (suggest no more than 0.050").