



Memorandum

To: L. Robertshaw

City:  
Date: 6th March, 1981

Copies: A.A. Hunter

From: K. Claybourne

Subject: "GRINDO-SONIC" SELECTION OF HONING STONES (CYLINDER LINERS)  
AND CHECKING OF "E" MODULUS ON CAM GRINDING WHEELS

Honing Stones:-

Over the years and up to November 19th, 1979, problems have been encountered on the honing of cylinder liners. We have had glazing of bores, retraction glazing marks and time cycles dragging out from one minute to five minutes, this meant the hone was a constraint in the line and production stood at 270 liners per shift. During this period we also encountered sizing problems associated with glazed bores, and roundness, due to higher honing pressures which had to be used, and due to the higher pressures there was a high mortality rate on the work-holding rubber bushes used in the hydraulic fixtures (these would split). When glazing and problems with bore texture occurred, honing stones could be changed any time within their life span so we suffered a fairly high rejection rate and wastage, sometimes hones lasted only half an hour. Both the abrasive company and the machine tool company engineers have been to Darlington many times over the years at high cost to "Cummins", but have never solved the problem on any permanent basis.

It was discussed and suggested at management level that some method of abrasive checking should be sought and a visit was made to P.E.R.A. at Melton Mowbray. During these discussions the pros and cons of abrasive checking and viability of additive packed coolant as opposed to the type of coolant which was being used at that time (which I thought of only as a flushing agent). The plan proposed by P.E.R.A. at a cost of £1000 was not adopted by management but the coolant situation was discussed with "Mobil" engineers.

However it so happened that the "Grindo-Sonic" Sales Engineer had contacted Mr. G. Veal (Quality) and it was he who introduced the Engineer to me.

The checking is done by placing the honing stone on a foam rubber mat on the opposite side to the working face, placing an electronic probe (spot indicator to the top, or direction of strike) and slightly tilting the stone, then tap the stone with a small screwdriver or similar object. This creates a bending or vibrating moment which the machine computes and records as a "Grindo-sonic" number which can be fed into a computer along with the volume, dimensions, and weight of the stone, and transposed to give the "E" modulus.

It was decided that as the stones were of consistent volume and weight that we would base our hardness or "Grindo-sonic" readings on a series of numbers with one grade of hardness covering a spread of 44 points. A batch of 1,800 stones GC-320-J-VTNS, were checked and marked with the resultant "Grindo-sonic" numbers and spread, 800 to 1100, and from the previous statement that 44 points equals one grade, then the 300 points spread was equivalent to 6 grades. Actual honing tests then took place with sets of stones made up from middle and extreme ends of the spread in a spread of 10 points per set.

The following are the results:

<u>Grindo-Sonic No./Set</u>	<u>No. of Components Machined</u>	<u>Comments</u>
'A'        800	600 plus	Glazing & extended time cycles
'B'        850	450	Good texture & surface Finish time cycle 55 sec.s
'C'        950	350	Good texture & surface Finish time cycle 55 sec.s
'D'        1,100	35	Marking of bore due to fast erosion of abrasive

From the results one would reason that given the condition of random selection of hones then a mix of 'A' and 'D' at the extreme end of the spread would give eccentric wearing of the set of hones with the 'D' or soft hones wearing at a more rapid rate leaving the 'A' or hard hones larger than 'D', these hard hones in fact did not retract far enough and stood proud of the honing head guides giving the glazed condition on retraction.

The extended time cycles were due to the 'A' type hones which although giving good tool life, glazed and finally stopped cutting and when the pressures were lifted to quicken up the time cycle, the rubber bushes would tear, one could see the torsional stress on the bushes as the sizing gauge needle fluctuated up and down

The 'D' hones marked the bores badly as the bond and abrasive erroded at a rapid rate and it was with a feeling of disbelief, when testing these hones, that after only 35 liners the hones were found to be worn to the steel shoe (this was repeated several times).

The 'B' and 'C' hones performed very well and retained throughout one full days observation, a 55 second time cycle giving excellent texture and finish. During that day 120 liners were manually fed to the two spindle machine and honed within the hour.

After discussions with "Carborundum" we purchased several batches of GC-320-J-VGNS hones and from a heavy fall-out from the desired spread of 850-950 "Grindo-sonic", they eventually produced batches with fall-out down to 5%.

The surface finish was then changed and a completely new standard issued by Product Engineering giving 7-25 R.M.S. To achieve the new standard over 30 abrasives were tried from continental and U.K. suppliers, but some U.K. suppliers would not accept "Grindo-sonic" as was the case with Carborundum, but nevertheless it was Carborundum and Atlantic of West Germany who succeeded although the "Atlantic" combination of rough and finish hones did give a small amount of scrap due to the non-clean up condition of the finish hone (this was the unbalance of the stock to rough surface finish from the rough hone).

The Carborundum hones on test were GC-220-J-VGNS, these performed well and gave tool life up to 3000 liners but unfortunately there was a large fall out from the 850-950 Grindo-Sonic spread desired on the first batch of 500.

Again we tried GC-220-I-VGNS but again when produced in a 500 batch there was a heavy fall-out. We have now received a batch of GC-220-G-VGNS which is 4 grades softer than the "J" grade originally tried. These are awaiting "Grindo-sonic" marking. The supply of hones was such a problem that tests were set up with hones from "Atlantic" of West Germany who have assured me that they will hold a spread of 100 points "Grindo-Sonic". They flew in hones direct to Teesside and we had excellent tests. A 500 batch of rough and finish hones are due early April.

I have found "Grindo-Sonic" most predictable in time cycle, tool life and honing texture and on the new standard, hones have given tool life as high as 3000 liners.

Dave Horner has kept me well informed on the non-lubrited liner tests in Essen and it would seem that oil usage has been reduced at a ratio of 4:1 along with ring wear and blow by. He has now got a set of 30 liners, 25-35 R.M.S. new standard texture, for more unlubrited engine tests.

CAM GRINDING WHEELS

To date we have been keeping records of the "E" modulus on our cam grinding wheels which are all marked numerically and recorded on the operators work sheets, on wheel change. If there is any problem with the wheels we can refer to our records and assess whether the wheel is on the soft or hard end of the spread.

To date, after over 100 wheels: injector and valve have been checked, there has been no violent spread, but they have held within 0.6 of a grade. However some concern was felt when, after a meeting with the "Norton" management, it was discovered that they had changed the abrasive mix in the 23A series from regular alundum and 32 alundum to 32 alundum and 57 alundum.

A batch of wheels have been tested with the original 23A series of abrasive and not only have we got back to standard times but have been 30 seconds under with the .050"/.055" stock removal, against the .030"/.035" stock condition when the time standards were set around 1972. We were also able to cut the dress to one on the rough "Norton" cycle, thus saving 50% ABRASIVE. A letter has been sent to "Norton" to supply wheels of the old abrasive type only. We should get good wheels within two months as the old 23A series are phased in.

I have tried some "Atlas wheels and can only assume that they grind more slowly than U.K. as:-

- a) We had a heavy loss of abrasive and had to dress more often with the MB18 bond
- b) We had burnt shafts grinding with the vitrified bond used as a purely roughing wheel.

*K. Claybourne*

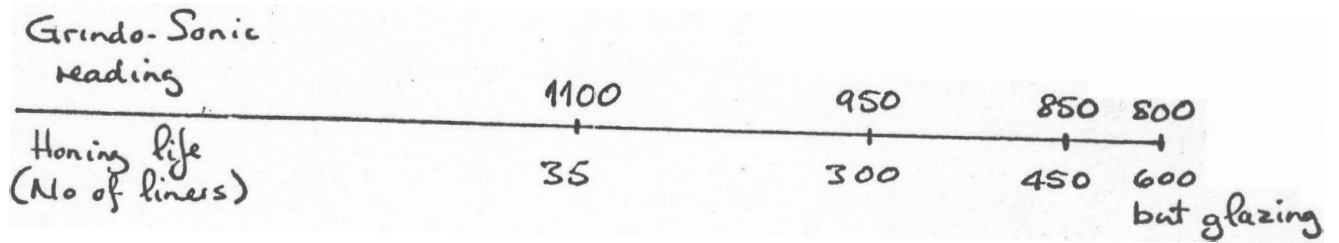
K. Claybourne/aa

Tooling Engineer

## Honing - Cummins Engines

### Identification of pictures

- A Honing stone is checked with the Grindo-Sonic instrument for hardness of the bond, for classification in obtaining sets of stones that are closely matched
- B Highly uniform surface texture is obtained with the new procedures developed by Cummins for honing cylinder liners
- C The set-up on a Gehring two-spindle machine for honing the bores of wet cylinder liners



Test honing of cylinder liners with stones of varying bond hardness, although nominally of GC 320-J-VGNS grade, resulted in widely different working life

or as a table, perhaps:

Grindo-Sonic reading	Honing life (No of liners)	Comments
1100	35 ←	MARKING OF BORES DUE TO FAST EROSION OF ABRASIVE.
950	300	
850	450	Glazing of work
800	600	