Ford Motor Company

FORD LABORATORY TEST METHOD CA 001-04

DEPTH OF INDUCTION HARDENING AND HARDNESS OF CAMSHAFT AND AUXILIARY SHAFT

Application

This procedure is used to determine the depth of induction hardening and hardness of induction hardened camshafts and auxiliary shafts.

Apparatus Required

Abrasive Cut-off Machine, with coolant
Radiac or equivalent.

Belt Sander, with coolant
With 180 grit belt.

Metallographic Polishing Plate
No. 1 and 0000 grit paper.

Versitron - Rockwell Hardness Tester

Rockwell "C" Hardness Tester

Rockwell "30N" Superficial Hardness Tester

Brinell Glass or Equivalent

Tongs

Grinder, Pedestal Type

Materials Required

Nitric Acid (M-1008)*
Caution: Corrosive.

Date	Action	Revisions	
2001 04 30	Revised	Editorial – no technical change	A. Cockman
2000 03 07	Revised	Editorial – no technical change	A. Cockman
1992 08 18			

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Ethyl Alcohol (M-1044C)*

Caution: Low flash point.

* Refer to Industrial Hygiene for health and safety comments.

Solution Preparation

Nital Etch

Add nitric acid to ethyl alcohol to produce a solution containing 3 % nitric acid by volume.

Note: **Always** add acid to alcohol when preparing solution.

Conditioning and Test Conditions

All test values indicated herein are based on material conditioned in a controlled atmosphere of 23 +/- 2 °C and 50 +/- 5 % relative humidity for not less than 24 h prior to testing and tested under the same conditions unless otherwise specified.

Procedure

Depth of Induction Hardening

Preparation of Sample - Camshaft Lobe

1. Section Lobe from camshaft by cutting through sections "A-A" and "B-B" as shown in Figure 1, cutting through shaft diameters using an abrasive cut-off wheel.

2. The cut-off wheel must be free cutting and flooded with water reducible coolant (or water) to prevent overheating of sample. The sample should be cut slowly; samples can overheat during rapid cutting even when flooded with coolant.

3. The sectioned lobe should be identified as follows:

   . Lobe number (numbering of lobes starts at post end).
   . Lobe face towards front of camshaft (post end).
   . Lobe face towards rear of camshaft.

4. After identification is completed, the lobe is sectioned by cutting through the lobe as shown in Figure 2. The same precaution should be exercised as noted in step no. 2 to prevent overheating.

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5. Either of 2 sections may be used for evaluation. However, the section used must be exactly one half of the lobe cross section to avoid erroneous readings. Remove excess cut-off metal and casting skin from side face of sectioned sample using belt sander or other abrasive. Finish grind to smooth surface with No. 1 grit paper. Use water reducible coolant (or water) to prevent overheating of sample.

6. Etch sample in the nital solution for the time required to provide the best differentiation between heat affected zone and core.

Preparation of Sample - Auxiliary Shaft Journal

1. Section journals from shaft by cutting through sections "A-A", "B-B","C-C", and "D-D" as shown in Figure 4 using an abrasive cut-off wheel. The shaft and wheel must be flooded with water reducible coolant (or water) to prevent overheating.

   Note: Check surface hardness of thrust face before grinding for depth of induction hardening. Refer to applicable Engineering print for designation of thrust face.

2. Using the belt sander, grind the A, B, C and D surfaces flat. Grind the shaft stub to permit proper seating on hardness tester anvil for determining thrust face hardness. **Do not grind thrust face**. Use water reducible coolant (or water) on belt to prevent overheating.

3. The sectioned journal should be identified as follows:
   - Journal number.
   - Thrust face toward front of auxiliary shaft.
   - Thrust face toward rear of auxiliary shaft.

4. Use Rockwell 30N hardness tester. Ignore the first reading. A minimum of 3 readings should be taken on each thrust face.

5. Turn journal over and check surface hardness on opposite thrust face.

6. Using the belt sander with water reducible coolant (or water) to prevent overheating, grind "A-A", "B-B", "C-C" and "D-D" surfaces sufficiently to remove thrust face induction hardened zone. Grind carefully to assure faces remain parallel (to the eye).

7. Finish grind with number 1 grit paper.

8. Etch sample in the nital solution for the time required to best provide differentiation between heat affected zone and core.

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