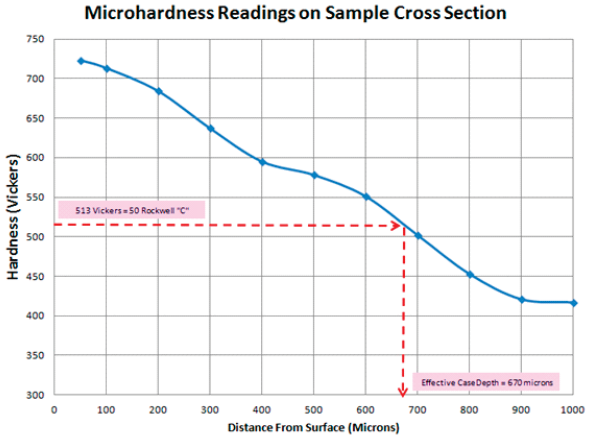
CAMEO® Metallographic Procedure for Case Depth Samples

LECO Corporation; Saint Joseph, Michigan USA

Case hardening is a process for hardening ferrous materials (i.e., steels or cast irons) in such a manner that the surface layer is substantially harder than the remaining material (known as the "core"). This process usually includes one of the following treatments: Carburizing, Nitriding, Carbonitriding, or Induction Hardening. In all of these processes, the surface chemical composition and/or mechanical properties are affected.

There are at least two different ways that the depth of the case is defined. "Total Case Depth" is usually defined as the perpendicular distance from the surface of a hardened case to the point at which differences in chemical and physical properties between the case and the core can be distinguished. Establishing the Total Case Depth can be accomplished by metallographic means (mount, grind, polish and etch) or with a microhardness tester.

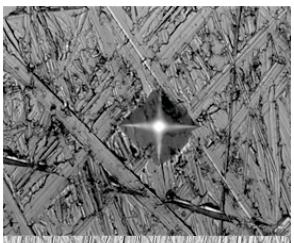
Most laboratories, however, need to determine a material's "Effective Case Depth". This is the perpendicular distance from the surface of a hardened case to the deepest point at which a specified level of hardness is maintained. There are many hardness criteria, with a popular choice being Rockwell "C" 50 (Vickers 513). To establish the Effective Case Depth, a sample cross-section is usually microhardness-tested at precise intervals starting near the surface and proceeding toward the core. The distance from the surface where hardness drops to the specified value (513 Vickers in the chart below) is deemed the Effective Case Depth (670 microns in the example below).



The tiny Vickers (or Knoop) impressions require measurement at high magnification; usually at least 500X. To make accurate measurements possible, the sample must be given a finish free of large scratches, which are especially troublesome if automatic hardness testing is to be done. A "tried and true" metallographic procedure might include the use of three or four grinding steps using Silicon Carbide abrasive discs, followed by one or two polishing steps. With LECO's CAMEO discs, this procedure can be reduced to only THREE STEPS: grinding, pre-polishing and final polishing. The following procedure utilizes the CAMEO Magnetic Disc System with the LECO GPX 200 Grinder/Polisher, with fixed sample holder.

Sample for Case Depth Analysis (GPX200 — 1.25" Mounts)

Disc	*Abrasive/ Fluid*	*Time (mm:ss)*	*Head Dir.*	*Lbs. Head Press.*	*RPM Head Speed*	*Wheel Dir.*	*RPM Wheel Speed*
Platinum 1	Water	2:00	CW	35	75	CCW	175
Silver Disc	6µ/ME	2:00	CW	35	75	CCW	175
Ultra Silk	3µ/ME	3:00	CW	45	100	CCW	200



After Platinum 1 Grinding Step
There are a large number of very large scratches visible on the surface. The Vickers hardness impression has a couple of edges that may have been influenced by the scratches and the impression corners are not distinct.

After Silver Disc (Pre-Polishing) Step
There are still a large number of less severe scratches visible on the surface. The Vickers hardness impression corners are not distinct.

After UltraSilk (Polishing) Step
There are only a few minor scratches visible on the surface. The Vickers hardness impression corners are distinct, and an accurate measurement of the diagonals is possible.

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Metallographic Application Note