

NEWS AND VIEWS OF THIS KILN DRYING BUSINESS

The Problem: How is Case-hardening in Kiln-dried Lumber Determined?

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When kiln-dried wood distorts soon after resawing, ripping, or machining, the cause is usually laid to a condition called "case-hardening." The cause and suggested remedies for the relief of this stressed condition will be discussed in a later article. In this article the discussion will be limited to methods of testing for the presence of case-hardening.

Any distortion that develops in dry wood is due to a change in moisture content or an unbalancing of stresses which exist. When kiln-dried lumber having about the same moisture content in the core as in the shell is machined and warp develops, the cause is invariably due to an unbalancing of the stresses that are present. These stresses are caused by the presence of case-hardening which developed during the very early stages of drying. As the surface layers of the boards dried, the shrinkage stresses developing actually stretched the wood and it became set in the expanded condition. This permanent stretch is also called "tension set," which we believe is a better term for the condition than "case-hardening."

The detection of case-hardening or tension set is a relatively simple procedure, but so often the standard tests are either improperly made or the indications misinterpreted. A key for determining case-hardening is presented here. The basic principles involved in stress analysis are (1) layers of wood in tension become shorter upon release, (2) layers in compression become longer upon release, and (3) layers of higher moisture content shrink more in drying. Stress sections should be observed as soon as cut into prongs and again after coming to equilibrium with room conditions.

Preparing Stress Sections

When making a stress analysis, it is desirable to obtain moisture content data at the same time. Cut three 1-in. sections from a board or kiln sample selected for testing. One section should be left as is and weighed oven dried, and reweighed, and the average moisture content calculated. Another section should be cut as shown for moisture distribution. The core and shell are weighed separately and the moisture content of each determined. The third section should be cut into prongs as shown. Stock less than 6/4 inches thick should be cut to make a three-prong

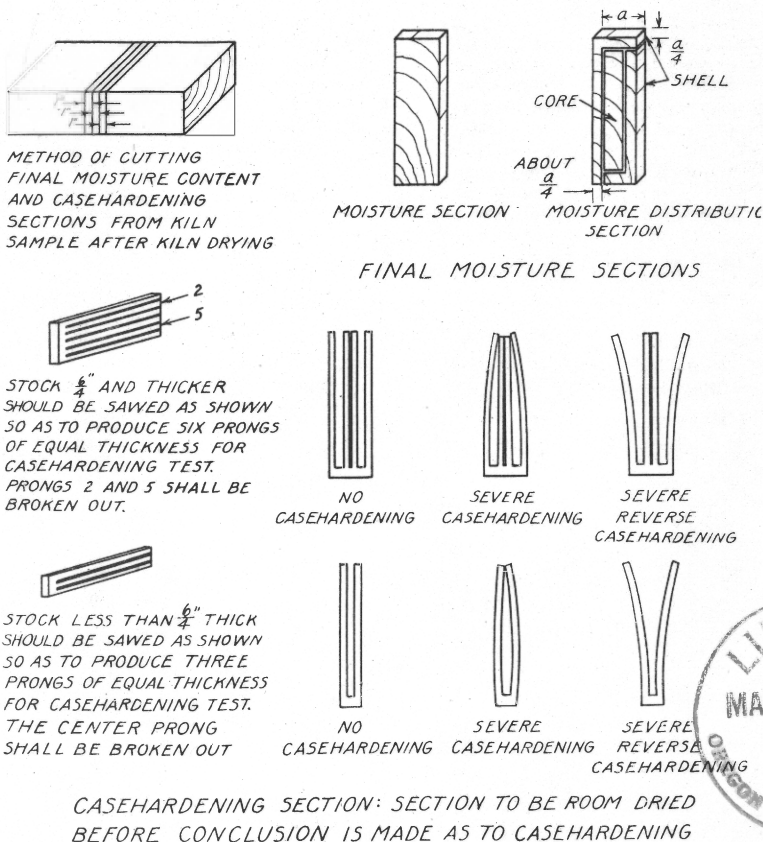


Figure 1.—Method of cutting sections for stress determinations in kiln-dried lumber.

test and thicker stock should be cut to make six prongs. The center prong of the three-prong section and prongs 2 and 5 of the six-prong section are broken out.

Key for Determining Casehardening

When the prongs of the stress section are cut on the band saw the outer prongs remain straight, pinch in immediately, or turn out. The indicated stressed condition is either due to a difference in moisture content between the core and shell or a difference in tension set or a combination of the two. To determine whether tension set or compression set is causing the indicated stresses at the time of sawing it is necessary to room dry the test sections so that the core and shell come to the same moisture content. After room drying the outer prongs may remain straight,

turn in or turn out and it is this indication which determines the presence of stress due to tension or compression set. The following key describes the nine conditions of stress that can exist.

1. *Prongs turn out when sawed.* The shell is in tension and the core is in compression.

A. *Prongs turn in after room drying.*

At the time of sawing the stock was at a relatively high moisture content—usually the initial stages of drying. The shell was at a lower moisture content than the core. The shell has been set in tension and the stock is case-hardened.

B. *Prongs remain turned out after room drying.* At the time of sawing the stock was dry and the core and shell had the same moisture content or the shell may have been somewhat drier than the core. At a time previous to cutting the shell had ab-

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sorbed enough moisture to swell the wood and set it in compression. Compression set exceeded tension set and the stock is reverse case-hardened.

C. *Prongs are straight, after room drying.* At the time of sawing the stock was either completely green and the shrinkage in the shell was not sufficient to cause tension set or the stock was quite dry with the shell at a lower moisture content than the core. The stock is stress free.

2. *Prongs turn in when sawed.* The shell is in compression and the core is in

tension.

A. *Prongs remain turned in after room drying.* At the time of sawing the stock was quite dry with the shell drier than the core. The shell is set in tension and the stock is case-hardened.

B. *Prongs turn out after room drying.* At the time of sawing the shell was at a higher moisture content than the core. Excessive shell moisture regain has caused too much compression set and the stock is reverse case-hardened.

C. *Prongs are straight after room drying.* At the time of sawing the moisture content of the shell was higher than the core. Compression set due to swelling of the shell balanced tension set and the stock is stress-free.

3. *Prongs are straight when sawed.*

Stresses in core and shell are the same.

A. *Prongs turn in after room drying.*

At the time of sawing the moisture content of the shell was less than that of the core. The shell is set in tension and the stock is case-hardened.

B. *Prongs turn out after room drying.*

At the time of sawing the moisture content of the shell was greater than that of the core. The shell has been excessively set in compression and the stock is reverse case-hardened.

C. *Prongs remain straight after room drying.*

At the time of sawing the wood was either green and no drying had taken place, or it was dry, with the core and shell at the same moisture content. The stock is stress-free.