

Kiln Drying Your Wood



Lumber Drying Defects

The success of our business depends on our knowing the causes of defects in lumber and applying the best practices to minimize their occurrence where possible. Since many defects are often not observed in green lumber and are first noted after the drying operation, they are often called “drying defects”, even though most defects have started in the tree, log, or green lumber. Defects that begin with the logs include knots, ring shake, bark, mineral streaks, pitch pockets, compression and tension wood, juvenile wood, and spiral or interlocked grain, all of which form in the tree, directly influence the grade and value of each individual board.

Across the lumber processing industry, it is expected that 3-5% of the lumber that is processed will be defective. We never expect that 100% of the lumber or slabs that are dried will be without defects.

With our dehumidification kiln, we apply best practices and processes to minimize defects. During the drying, we manage the temperature, humidity, air-flow volume and air-flow direction, and lumber moisture content in the best possible way to make drying “easy on your wood”.



What defects can we avoid or minimize?

Defects that we can avoid (or minimize)

- Surface checks
- End checks in freshly cut/sealed log ends
- Case hardening
- Honeycomb checks
- Collapsed wood fiber

Defects we cannot avoid but work to minimize:

- Loose knots
- Checked knots
- Surface checks in large timbers
- Collapse of Wetwood

- Warping of lumber that includes juvenile/sap wood

Defects that we cannot avoid:

- Splits of reaction wood (compression / tension wood)
- Warping of reaction wood (compression / tension wood)
- Boxed heart splits
- End checks / splits from old-cut log ends
- Sapwood fungal/microbial staining
- Cracks caused by logging / log handling
- Warping around large knots in thinner lumber

Common Defects Explained*

Surface checks

- Shows as cracking of the flat sawn surface of the board.
- This is caused by stress developed in the lumber by the exterior drying faster than the interior of the lumber.
- In most cases, it can be avoided by drying at lower temperatures and higher humidity early in the drying cycle.

End checks in freshly cut/sealed log ends

- Shows as cracking on the ends of the boards.
- This is caused by the longitudinal ends of the boards drying easier/faster than the internal length of the board.
- In most cases this can be avoided by sealing the ends and using wide stickers between the boards at the ends

Case hardening

- Causes board to crack and warp due to the exterior of the board being drier than the interior of the board.
- This is caused by drying the board too fast while the interior of the board has a high moisture content
- This can be avoided by using lower drying temperatures and higher humidity levels early in the cycle. As well, providing a daily period of rest (lower temperature/raise humidity within the kiln) where the internal moisture of the boards can find equilibrium by migrating to the outside of the board.

Honeycomb checks

- Internal cracks caused by a tensile failure across the grain of the wood during the drying process.
- This can be avoided by avoiding high temperatures until all the free water has been evaporated from the wood.
- This can be avoided by drying at lower temperatures early in the cycle.

Collapsed wood fiber

- A distortion, flattening or crushing of wood cells that appears as a flattening or distortion of a board.
- This is caused by high temperatures early in the drying cycle, though is not usually visible until late in the drying cycle.
- This can be avoided by drying at lower kiln temperatures early in the cycle.

Loose knots

- Encased knots invariably loosen during the drying process as they are not grown into the surrounding wood, and are held into place by pitch and bark.
- This is caused by a knot shrinking during the drying process in all radial directions, while the surrounding wood dries in the width but not in the length.
- Nothing can be done to prevent this condition, however if the final moisture content can be kept as high as possible, this condition can be minimized.

Checked knots

- Appear as cracks on the end grain of the knot
- This is the result of the differences in shrinkage parallel to and across the annual rings of the knot
- This defect can be controlled by drying at a higher humidity and to a higher final moisture content, but it is impossible to prevent them.

Surface checks in large timbers

- 4" and larger timbers are generally sold green, as surface checking is inherent to drying timbers through conventional means (conventional, dehumidification and vacuum kiln processes).
- This is caused by the exterior of the timber drying while the interior remains wet, cause stresses that result in the cracking.
- The only process that is successful in drying beams without surface checking is by microwave kilns, which are not common and very expensive to purchase and operate. This is why we do not dry timbers larger than 4". And even at 3.5/4", some surface checking will occur.

Collapse of Wetwood

- Wetwood is an abnormal, water-soaked type of heartwood; it is initiated by pathological rather than normal physiological changes in the living tree. It is susceptible to collapse during drying
- Wetwood is often associated with staining due to anaerobic bacteria thriving within this area of the heartwood.
- It is very difficult to avoid the collapsing of wetwood.

Warping/Cupping of lumber that includes juvenile/sap wood

- Timbers and lumber that includes both hardwood and sapwood on the flat sawn surface.
- This is caused by differences in stresses in the radial, tangential and longitudinal directions during drying. Also lumber cut from near the pith can be prone to warping or cupping, particularly from small diameter trees.
- This is difficult to avoid, but can be minimized through good stacking prior to drying. This condition becomes apparent early in the drying process and becomes worse as drying progresses.

Splits and warping of reaction wood (compression / tension wood)

- Trees that grow at angles or are bent, even slightly, due to environmental reasons often split or warp during sawing and drying. Even if sawn flat, warping or cracking is likely as the wood dries to internal stresses.
- This is difficult to avoid, but can be minimized through good stacking prior to drying.

Boxed heart splits

- A boxed-heart split start in the initial stages of drying and become increasingly worse as the wood dries. The difference between tangential and radial shrinkage of the wood surrounding the pith causes such severe stresses in the faces of the piece that the wood is split.
- It is virtually impossible to prevent this defect.

Sapwood fungal/microbial staining

- While staining in wood is often apparent before the green wood is kiln dried, some types of staining can become more pronounced during drying.
- It is impossible to avoid fungal/microbial staining defects.

*Credits: References and excerpts from United States Department of Agriculture / Forest Service, Forest Products Laboratory, Agriculture Handbook No. 188; Dry Kiln Operator's Manual



Kitsap Dry Kiln
Dry Kiln & Mobile Sawmill Services

Dean Lofall, Owner / Operator
dean@kitsapdrykiln.com - 360-551-0643
www.kitsapdrykiln.com