

COMPRESSION FAILURES IN WOOD  
DETECTED BY THE APPLICATION  
OF CARBON TETRACHLORIDE  
TO THE SURFACE

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COMPRESSION FAILURES IN WOOD DETECTED BY THE APPLICATION  
OF CARBON TETRILCHLORIDE TO THE SURFACE<sup>1</sup>

BY

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Introduction

Sudden breaking of wood parts in aircraft during service is sometimes due to certain obscure defects termed "compression failures."<sup>2</sup> It is often difficult or even impossible to detect with the unaided eye the most minute of the compression failures that occasionally occur in wood products although even they may be seriously weakening, especially in shock resistance in bending. Any means, therefore, that will render such defects more clearly visible is of value to aircraft manufacturers.

use of Clearing Agents in the Detection  
of Compression Failures

Wood surfaces showing no indication of compression failures have sometimes, upon being varnished, strikingly shown obscure defects that had previously been unnoticed. By applying a coat of varnish to a piece of wood, the scattering of light from the myriad surface wood fragments has been in effect reduced since the varnish, with its smooth surface and index of refraction approaching that of wood, immerses these fragments within itself to make them invisible. The varnish is a clearing agent and thus reveals the subsurface characteristics and irregularities of the wood free from the surface bloom caused by the minute wood fragments. Unfortunately, by the time varnish is applied, manufacture has approached completion and the rejection of defective material at this stage is costly.

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<sup>1</sup>This report is one of a series of progress reports prepared by the Forest Products Laboratory to further the Nation's war effort, Results here reported are preliminary and may be revised as additional data become available.

<sup>2</sup>For further information on the nature, origin, effects, and other methods of detection of compression failures see "Detection of Compression Failures in Wood" Forest Products Laboratory Report No, 1588, June 1944.

The surface bloom can, however, be removed long enough for Inspection purposes at any stage in manufacturing by the application of a nonswelling volatile clearing agent having an index of refraction approaching that of wood (about 1.6). Carbon tetrachloride<sup>3</sup> meets these requirements well and in addition is inexpensive, readily available, and nonflammable. After application, it evaporates quickly from a wood surface leaving the surface unchanged. Water, in contrast, causes swelling and permanent raising of the grain when applied to a wood surface. The freedom from Change after the application of carbon tetrachloride is illustrated in figure 1. Carbon tetrachloride<sup>3</sup> should be used only in a well-ventilated room since prolonged exposure to its vapors may be harmful.

If compression failures are present they can be readily seen on the tangential face of a smoothly surfaced specimen after spreading carbon tetrochloride over the portion under examination. The minute failures become evident to a greater or lesser degree, depending upon the orientation of the light and the angle from which they are viewed. Seen directly from above, compression failures appear bright when light at a low angle strikes directly along the grain and dark when it strikes at right angles to the grain. Figure 2 shows a section of Sitka spruce that has compression failures, both before and after the application of carbon tetrachloride.

Compression failures large enough to be seen without treatment are also rendered more evident by the application of carbon tetrachloride. The more advanced failures usually appear dark against the lighter background of the wood surface regardless of the orientation of the light (fig. 3).

The explanation of the somewhat dissimilar effects with minute as against gross compression failures is that in the minute failures the only function of the clearing agent is to eliminate the surface bloom so that the difference in the angle of light reflection caused by fibril displacement is made more evident, while in more severe compression failures the appreciable cell-wall dislocation that has taken place permits the clearing agent to soak down into the subsurface of the wood to make it appear dark.

Carbon tetrachloride can be applied to small areas with an eye dropper. A brush may be more convenient when applying the reagent to larger surfaces.

It is believed that the use of such clearing agents as carbon tetrachloride should be of considerable value in the detection and elimination, from critical aircraft construction, of that type of wood having low strength by reason of incorporated compression failures.

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<sup>3</sup>Trichloroethylene has properties that are similar to those of carbon tetrachloride.

### Summary

Carbon tetrachloride spread over a wood surface containing compression failures renders such failures more apparent to the unaided eye. The compression failures may be viewed directly from above and the illumination provided from the side at a low angle either directly along or perpendicular to the grain. Minute compression failures appear brighter than the surrounding wood when the light is along the grain and darker than the surrounding wood when the light is perpendicular to the grain. Gross compression failures appear dark regardless of the orientation of the light.

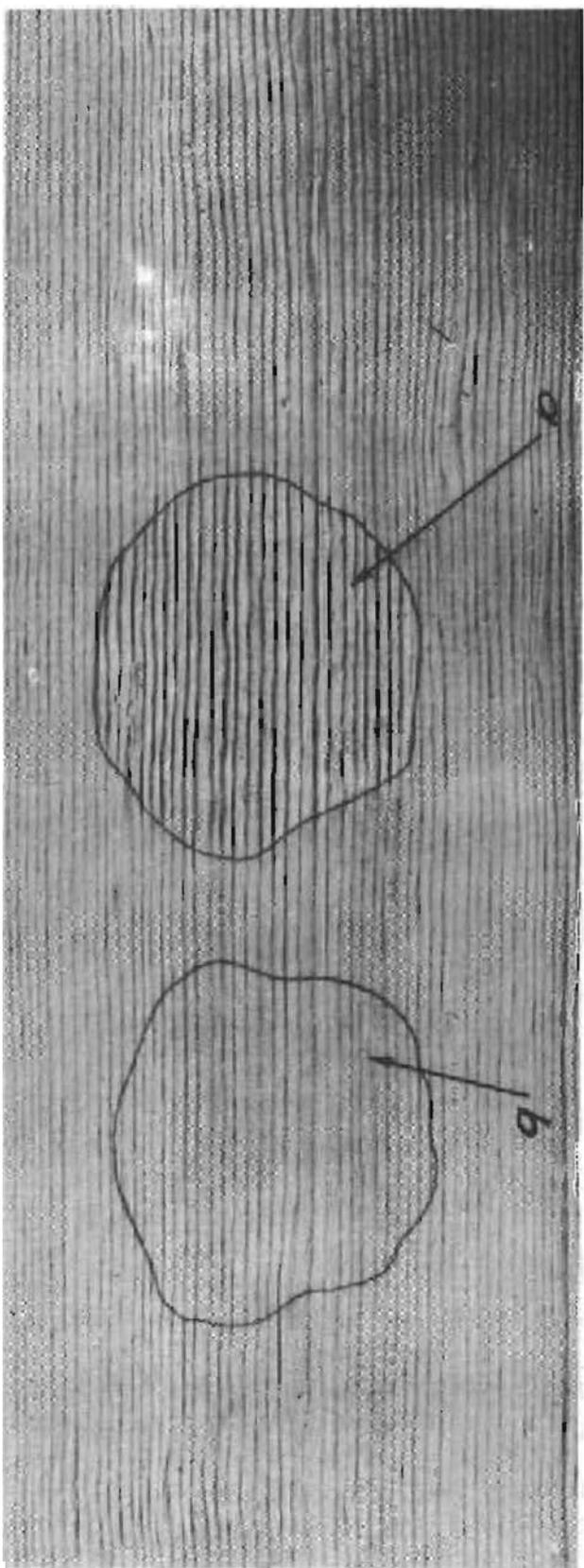


Figure 1.--Douglas-fir board showing area a wetted with water and area b wetted with carbon tetrachloride. Both areas are shown after drying. No raised grain occurs in area b.

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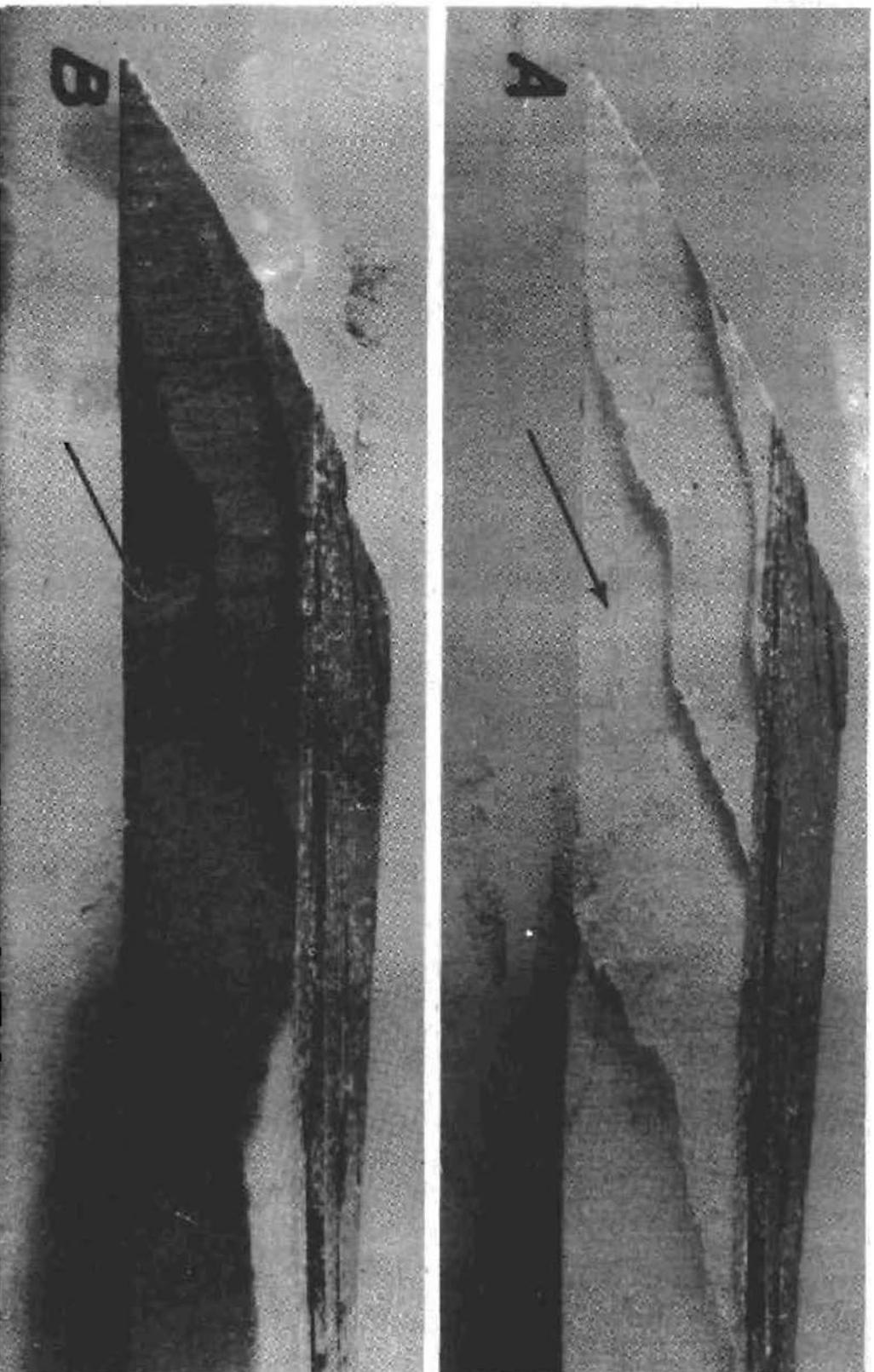


Figure 2.--A, Section of Sitka spruce with light shining in the direction of grain. Arrow points to minute compression failure which is not visible at this orientation. B, Same section as shown in A with light orientation also the same, but with carbon tetrachloride applied to the surface. Arrow shows minute compression failure made visible by such treatment.

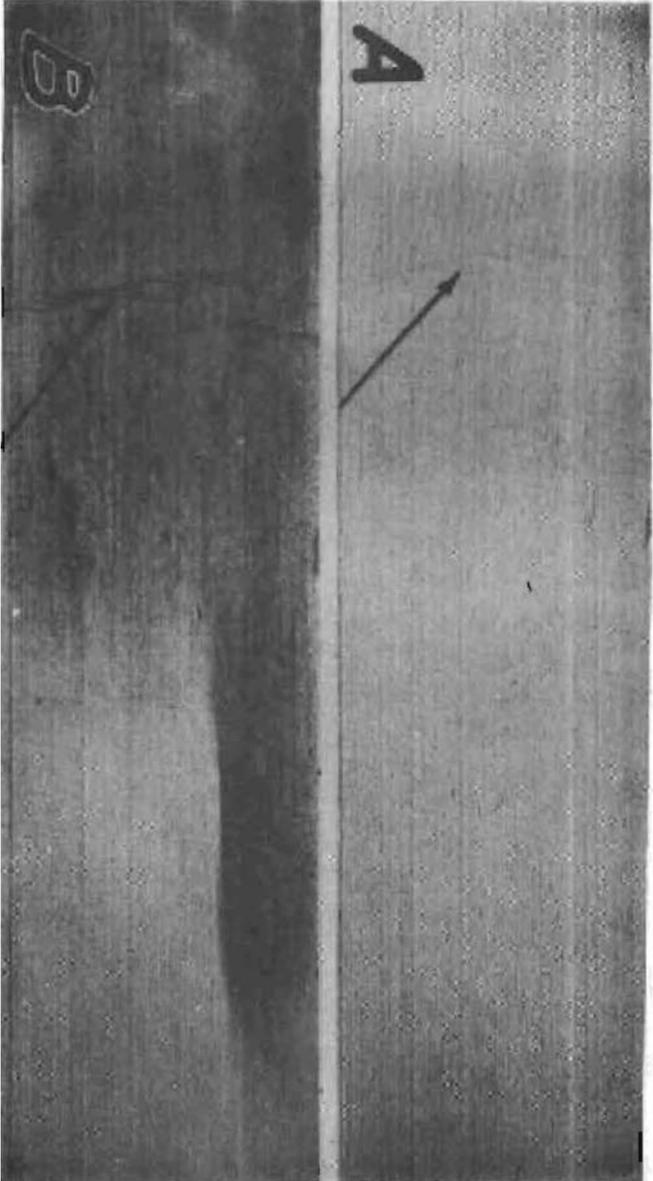


Figure 3.--California red fir board with large compression failure. Arrows point to vicinity of the defect. A, compression failure as seen without treatment; B, the same area wetted with carbon tetrachloride.

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