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FPL SHOW-THROUGH COMPARATOR FOR FURNITURE PANELS

The Forest Products Laboratory has developed an apparatus for comparing, evaluating, and recording the surface imperfections in furniture type panels having particle board cores. The apparatus is known as the FPL Show-Through Comparator. Although the apparatus was intended to be used for research involving evaluation of the show-through pattern of test panels having a high-gloss black decorative laminate on each side of a particle board core, it was found to be equally applicable to the evaluation of furniture panels having a relatively high-gloss surface regardless of surface color or grain.

This note describes the apparatus, sets forth the details of its manufacture, and briefly interprets the results obtained.

Basically the apparatus provides a means of observing (or photographing) the reflection of a standarized grid pattern from the surface being evaluated. It consists essentially of a projector, test panel, translucent screen, and a camera. Figure 1 shows in diagrammatic form a plan view of the apparatus. Figure 2 is a photograph of the apparatus, with a typical pattern shown on the translucent screen. For purposes of comparison it is important that the area on the test surface covered by the projected grid pattern be 9 inches square. The actual size of the projection slide and the size of the image on the translucent screen are relatively unimportant, as they can be enlarged or reduced as desired.

Figure 3 is a replica of the master grid pattern used to produce the 2- by 2-inch projection slide used by the Forest Products Laboratory. By carefully photographing this figure on 35 millimeter color film, using a close-up attachment to fill the slide area, additional master projection slides can be easily made.

An excellent slide of the master grid was made by photographing the printed page of figure 2 using color film in a 35 mm camera equipped with a 50 mm lens and 3x portrait attachment. The distance from the lens to the copy was about 14 inches.

In use this slide is projected on the test surface (as shown in figure 2) so that the area covered by the projection on the test panel is 9 inches square. From this surface it is reflected back to a translucent screen,

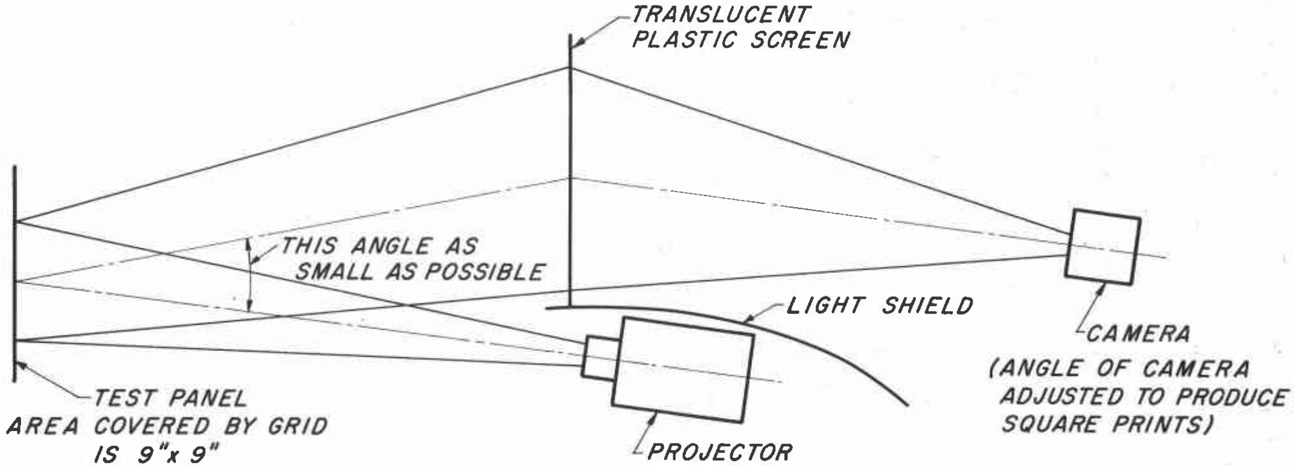

Figure 1.--Diagrammatic sketch of FPL Show-through Comparator.

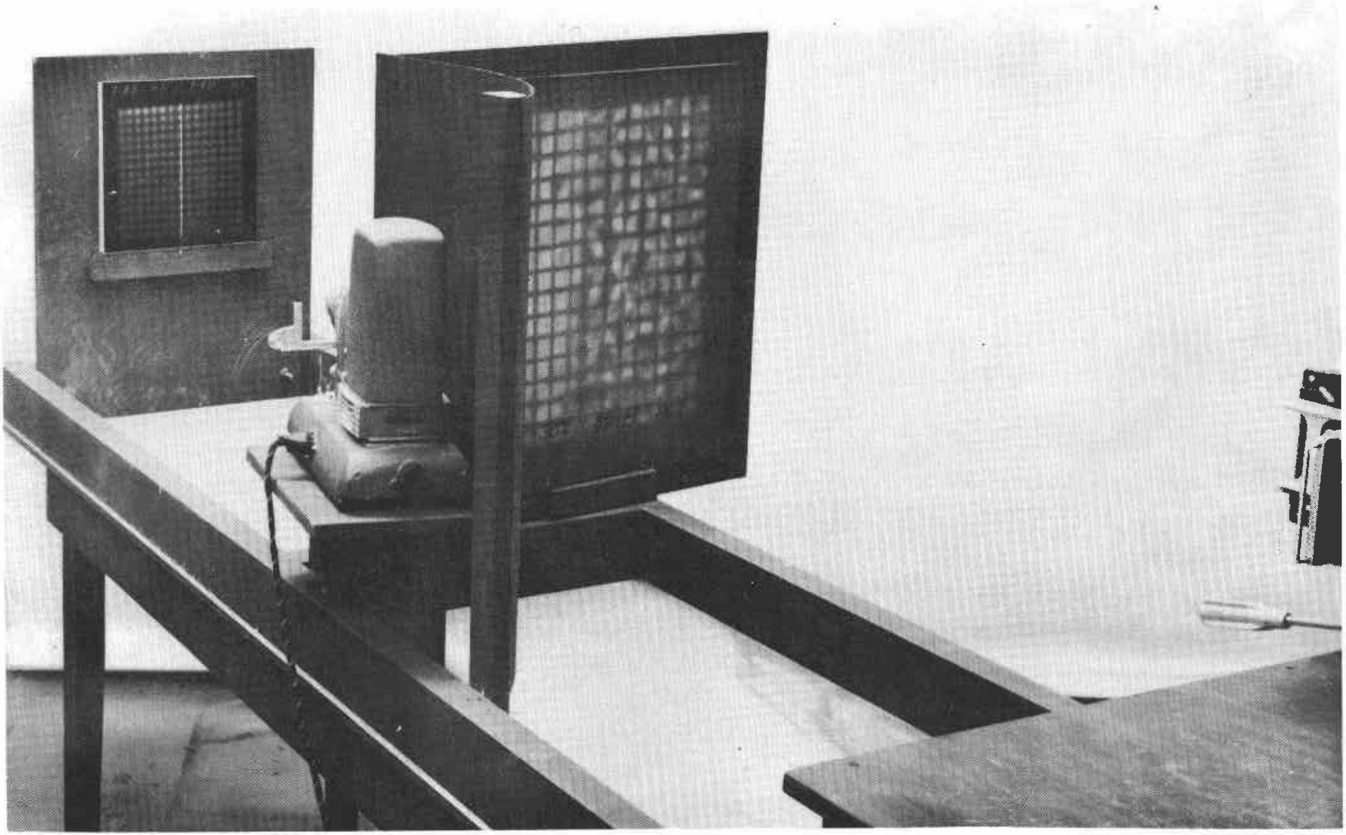

Figure 2.--FPL Show-through Comparator for furniture panels.

Made of thin plastic stretched tightly on a frame. (A plastic shower-bath curtain is a good source for this screen.) The focus is adjusted so that the image is in sharp focus on this screen and not on the test surface being evaluated. The correct focus is most easily established by substituting a perfect reflective plane surface in place of the test panel, such as a ground glass (used by photographers) or a ground plate glass that has one surface roughened by means of sand blasting. An ordinary mirror cannot be used as there will be a double reflection, one from the face and one from the silvered back. There is usually sufficient depth of focus so that the difference in thickness between the ground glass surface used in the focusing check and the panels to be evaluated is unimportant. Each grid pattern to be photographed is permanently identified by a code number in the lower portion of the grid pattern printed on clear glass with a felt-tipped marking pencil.

It is important that all surfaces to be evaluated, such as decorative laminates and finished wood veneers be coated with a uniform film of kerosene. This can be done by wiping the surface with a lint-free rag which has been dipped in kerosene. The proper amount of kerosene to be used can be determined after a few trials, and should be enough to produce a high-gloss reflective surface but not enough to flow (and show flow lines) on the vertical surface. It will take a few seconds for the "wipe marks" to disappear from the surface, after which the surface is suitable for photographing for a matter of several minutes, before excessive drying produces a dull reflection.

Figure 4 presents photographs of four typical surfaces, which may be of assistance in interpreting the grid patterns produced on the translucent screen. The upper left grid is that produced by reflection of the master grid from a ground plate glass surface, and represents a perfect surface. The upper right grid, figure 4, is that produced by a typical particle board core having a high-gloss black laminate glued to both sides, the left half of the panel exposed to relatively dry conditions (30 percent relative humidity), and the right half exposed for 2 months to relatively damp conditions (80 percent relative humidity). This type of pattern is typical of particle board cores, some being better and some much worse, but all perhaps being best described as "mottled" or "dimpled."

The lower left grid of figure 4 is typical of a plywood core underneath a decorative laminate, again the left half after being exposed to 30 percent relative humidity and the right half after exposure to 80 percent relative humidity. This pattern can probably be best described as a "crossed wave" pattern, the waves in each direction being caused by the grain of the veneers in the core.

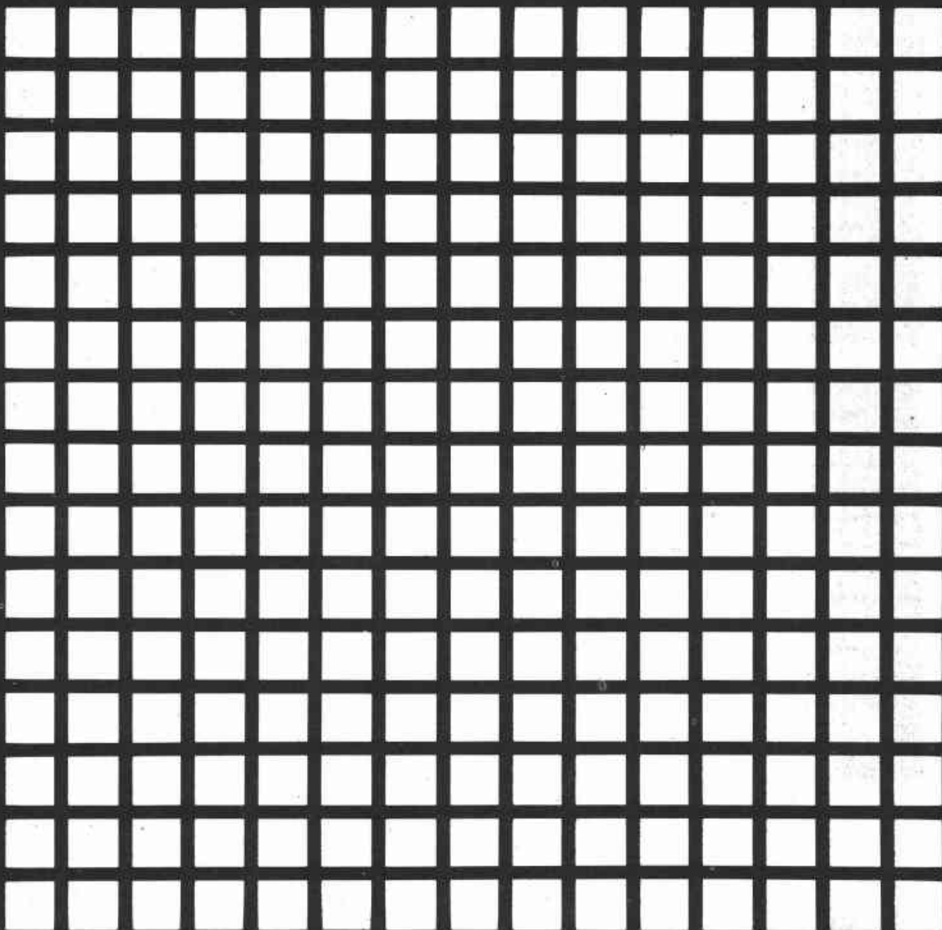

Figure 3.--Master grid pattern used in FPL Show-through Comparator.

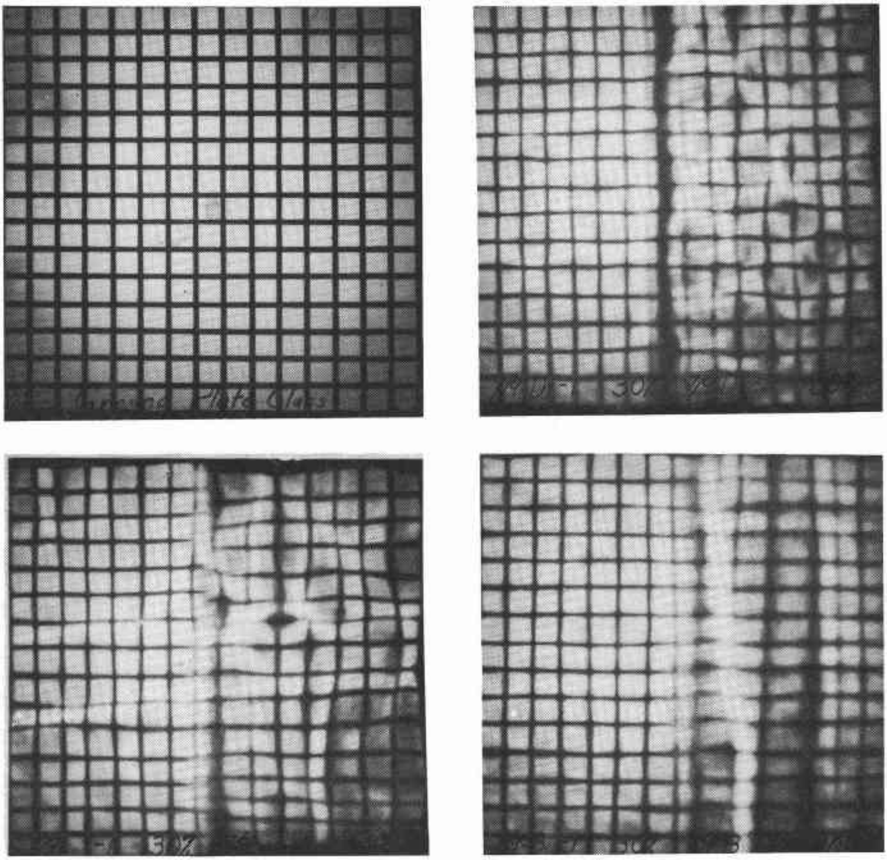

Figure 4. --FPL Show-through Comparator photographs of four typical surfaces. Upper left is that produced by reflection of master grid from ground plate glass surface. Upper right is typical particle board core. Lower left is typical of plywood core underneath a decorative laminate. Lower right is typical of lumber core.

The lower right hand grid of figure 4 is typical of a lumber core, again the left half after being exposed to 30 percent and the right half to 80 percent relative humidity for 2 months. Lumber cores usually produce waves in one direction, parallel to the grain of the lumber core, and therefore are usually described as a "wavy pattern."

Reading the grid patterns produced in this apparatus is somewhat analogous to reading X-rays, in that one must train himself to look for the distorted lines and pay no attention to the general lightness or darkness of the overall grid. A dark spot, associated with lines bent around the dark area, designates a bump on the surface, whereas a light spot with the lines being bent slightly towards the spot indicates a dent in the surface. Along dark streak (such as that shown on the lower right hand grid of figure 4) denotes a ridge on the surface, and conversely the long light streak (shown on the same grid) denotes a valley in the surface. Crossed light and dark streaks, such as shown on the lower left hand grid of figure 4, denote crossed valleys and ridges usually typical of plywood cores.

Although the grid used at the Forest Products Laboratory is shown in this technical note, others who have duplicated the technique report that with certain conditions a grid composed of white lines on a black background appears to be more effective. This may be true with certain colors of test surfaces. In using the grid proposed here, a high-gloss black decorative laminate is preferred over a light decorative laminate as there is less "flash-back" of light to the translucent screen. Limited tests have also been made at the Forest Products Laboratory with different grids, one composed of twice as many lines, (the lines being half as wide) and the other composed of an equal number of lines with the lines being one-half the width of the standard grid shown. Both of these variations may have their applications, particularly on surfaces that are approaching perfection. However, it has been found that the grid shown appears to be more generally satisfactory for the usual variation in surfaces produced by particle board, plywood, or lumber cores.

It is of interest to note that the technique described evaluates the surface irregularities due to show-through of core characteristics regardless of the color or polish of the surface, within reasonable limits. This suggests the modification of the equipment so that it can be used as a portable apparatus to evaluate and record the surface of a piece of furniture, perhaps as it leaves the factory and after certain known conditions of use.