AIRCRAFT NAIL GLUING

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AIRCRAFT NAIL GLUING[1]

Effective nail gluing of flat aircraft parts with a cold-setting resin glue (Plaskon Type 201) has been successfully demonstrated in a series of recent experiments conducted at the Forest Products Laboratory in cooperation with the Materiel Division, Air Corps, War Department. Results were uniformly as good as those obtained with casein glue, which was used for comparative purposes.

The tests showed that the chief function of nails in nail gluing is to hold the parts in intimate contact while the glue sets, producing pressure sufficient to insure an even distribution of the glue between the surfaces. The variety of nail sizes used emphasizes this: very thin, small nails produced joints approximately as good as did thick, comparatively heavy nails. Additional corroboration was obtained by the use of plain nails, cement-coated nails, and chemically treated nails; all of which, for practical purposes, produced good joints, with little indication that their differences in holding power influenced the strength of the joints.

Using cap-strip joints typical of a wing assembly and specimens glued with casein and resin glues, the experiments covered such questions as proper temperature range, assembly periods, spacing of nails, plywood thicknesses, nail sizes, nailing strips, and the relative merits of yellowpoplar and spruce cap strips.

The specimens used consisted of mahogany-poplar plywood 3/32-inch thick glued to a cap strip 3/8-inch thick -- except in the plywood thickness tests, where 1/16-inch mahogany-poplar plywood was also used.

Spacing of Nails

The Laboratory tests sought to determine how widely nails may be spaced without seriously affecting the quality of the glued joint.

Good results were obtained with spacings of nails in nailing strips as great as 5 inches although a 3-inch spacing seemed to be a safer limit. Manufacturers who are now using shorter spacings should be very cautious about increasing them, however, without making extensive corroborative tests.

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[1]This mimeograph is one of a series of progress reports issued by the Forest Products Laboratory to aid the Nation's defense effort. Results here reported are preliminary and may be revised as additional data become available.

Nailing Strips

Two species, white pine and birch, were tried as nailing strips. Strong glue joints were obtained with both species. With both species resin glue gave somewhat stronger joints than casein, but both glues worked well.

Assembly Periods

Two types of assembly, the "closed" and "modified open", were used in tests of effective assembly times. The modified open type is regarded as more similar to standard shop practice, and its results therefore are of more practical significance. It consisted merely of applying the glue to the cap strip, laying the plywood upon it without pressure, and permitting various times to elapse before hammering the nailing strip down. In general, for the modified open technique of assembly it was found that assembly periods as long as 17 minutes produced good joints but there was some reduction in quality when the assembly period was increased to 30 minutes. Good joints were made in shorter periods.

Using the closed assembly technique -- in which some pressure was applied when the plywood was laid on as soon as the glue was spread on the cap strip, with the nailing strip hammered down later -- good joints were produced even when the period between initial pressure and final nailing of the strip was considerably extended, but it would be wise to avoid long periods in practice.

Both light and heavy spreads of resin and casein glues were included. It was found that light spreads of either kind of glue should be avoided. Gluing temperatures ranged from 60° to 105° F., with good results obtained in all cases, providing heavy spreads of glue were applied.

Plywood Thickness

High quality joints were produced with both 1/16-inch and 3/32-inch mahogany-poplar plywood on spruce cap strips in a brief experiment which included No. 20 gage cement-coated nails, nail spacing up to 3 inches, and an assembly period of 10 minutes.

Types of Nails

Thickness, length, and surface treatment were involved in the comparison of different types of nails in these experiments. Largest nails tested were 16 gage, the smallest 22 gage. Nos. 18 and 20, now in standard use, were found best adapted to nail gluing. The thickest, No. 16, exhibited a tendency to split the cap strip, while the smallest, No. 22, bent unless carefully hammered into place. Nail lengths of 1/2-inch and 3/4-inch were used with like success. Plain, cement-coated, and two types of chemically treated nails all gave good results in this type of cap strip joint. The question remains unanswered, however, whether with a curved joint the increased holding power of cement-coated and chemically treated nails would make them better fitted for gluing than plain nails.

In conclusion, it should be emphasized that the foregoing results were based entirely on tests with flat-surfaced specimens, and their interpretation is limited therefore to flat joints. In aircraft, however, curved joints are very common. Data on nail gluing of curved specimen joints must await further experiments with such joints.