COMPARISON OF COLD-SETTING, UREA-RESIN GLUES WITH CASEIN GLUES FOR JOINTS IN AIRCRAFT ASSEMBLIES

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UNITED STATES DEPARTMENT OF AGRICULTURE
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COMPARISON OF COLD-SETTING, UREA-RESIN GLUES WITH CASEIN GLUES FOR JOINTS IN AIRCRAFT ASSEMBLIES[1]

Cold-setting, urea-resin glues can be used to advantage in the assembly gluing of typical wood aircraft parts, according to a series of tests made by the Forest Products Laboratory in cooperation with the Materiel Division, Air Corps, War Department and with a producer of wood aircraft for military use. The results of these tests justify the more extensive use of cold-setting, urea-resin glues in the gluing operations that are typical of the construction of wood aircraft.

In investigating the advisability of changing from casein glues, which have given satisfaction insofar as their dry strength is concerned, to cold-setting, urea-resin glues, which are known to be superior to casein glues in resistance to mold action and to water, the point that required demonstration was that sufficiently strong joints could be made with cold-setting, urea-resin glues on the species of wood involved without difficult changes in factory operations.

To establish this point, the principal glued joints used in the fabrication of a training plane were reproduced in quantity and tested, using glues of both types. In the construction of the plane considered in this study, there were nine principal gluing operations involved and many of them were typical of glue joints used in the construction of wood planes other than this particular model.

Several of the glued joints were of such a nature that they could be reproduced in quantity in the factory without serious loss of time or material. In such cases, several samples were glued by the personnel employed at the factory, using the equipment available there under the conditions that would normally exist in commercial operations. Since the main object was to compare one type of glue with another, approximately one-half the number of samples of each type of joint was made with the supply of casein glue then being used by the factory and the other half with a cold-setting, urea-resin glue. Examples of operations of this type were:

1. Laminating poplar for cap strips of heavy wing ribs and for gas tank supports (a pressure gluing operation).

2. Gluing plywood flanges to cap strips to form wing ribs (a pressure gluing operation).

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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 reported here are preliminary and may be revised as additional data become available.

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The testing of some of the principal joints in the construction, however, would have involved the destruction of large and completely fabricated units. In such cases, smaller samples of joints of similar construction were glued at the Laboratory under conditions that could be matched in factory operations. One-half the specimens were glued with a casein glue (F.P.L. formula 4B) and one-half with a cold-setting, urea-resin glue (Plaskon, type 201). Examples of operations of this type included:

3. Gluing wing ribs to spars (a nail-gluing operation).

4. Gluing plywood wing covers to wing ribs (nail-gluing).

5. Gluing plywood fuselage covers to bulkhead rings (nail-gluing).

In still other cases, test samples were obtained that were glued in the factory and other test samples were prepared at the Laboratory. Whether prepared at the factory or at the Laboratory, one-half of these samples were glued with casein glue and one-half with cold-setting, urea-resin glue. Operations of this type included:

6. Splicing individual laminations in spar caps by scarf joints (a pressure gluing operation).

7. Laminating spar caps of spruce (pressure gluing).

8. Gluing bearing blocks of walnut to spruce spar caps (pressure gluing).

9. Gluing plywood flanges to spar caps and braces to form box spars (pressure gluing).

In all, more than 1,800 specimens were tested. All joints were of high quality as shown (1) by the strength test values which indicated sound, high quality wood, and (2) by high wood failures which indicated that the joints were approximately as strong as the wood.

No significant difference in quality was developed between the joints made with the cold-setting, urea-resin and the joints made with the casein glues. All approached the maximum strength that could be obtained with the wood species used.

The conclusion was that the cold-setting, urea-resin glue used (Plaskon type 201) was capable of producing, under factory conditions, bonds whose dry strengths compared very favorably with those of casein glues in all the principal glue joints involved in the assembly of this plane. Considering their greater water and mold resistance, the more extensive use of cold-setting resins in place of casein glue in aircraft construction is justified.

The correctness of the conclusion was further demonstrated by tests on a complete unit constructed entirely by the factory personnel under only the supervision normal in plant operation. The complete unit, a vertical stabilizer, was tested statically and, after that test was completed, it was cut in such a way that joint test specimens were obtained from all the principal joints in its construction. High wood failures developed in the tests of all the specimens from this stabilizer, indicating joints of excellent quality that were about as strong as could be expected for the wood species used. It was recommended that cold-setting, urea-resin glue replace casein in the assembling of this plane.