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GLUES FOR WOOD IN ARCHERY USES

Glues are used (1) to splice billets for bowstaves, (2) to splice "footings" to arrow shafts, (3) to attach feathers to shafts, (4) to attach facings and backings of a variety of materials to bows, (5) to lay leather or other bindings on bow handles, (6) to laminate bows from layers of thin wood or wood with other materials, and (7) to attach nocks and points to arrow shafts.

Properties of Glues¹

The woodworking glues that are available to amateur archers may be grouped into several types based on durability of the resultant joint, conditions required in gluing, and cost. The following generalizations are given for the guidance of archers who do not wish to make a special study of the literature on gluing.

(1) No glue will produce joints of maximum strength unless the joint fits closely and unless the glue is prepared and used correctly. Directions for use are furnished by the manufacturer or supplier. Conditions that give best results in gluing with one type of glue may not give best results, or even fair results, with another type of glue.

(2) Generally high-grade glues of all principal types of woodworking glues will give equally high initial, dry joint strength on commonly used species when used under the most favorable conditions for that type of glue.

(3) Woodworking glues vary widely in their water resistance. In addition, the water resistance of the joint will vary according to the quality of the gluing and the effectiveness of the protective coatings.

¹The characteristics of various glues are described in greater detail in Technical Note Nos. 257, 258.

(4) Animal glues are characterized by high dry strength, low water resistance, and quick gelling. These glues are available in a series of grades, the higher grades gelling more quickly than the lower grades under similar conditions. Formulas have been developed to improve the moisture resistance of animal glue, but their use is not recommended for amateurs. Hot animal glues, prepared by the user and used as soon as possible after melting, give best results. Control of wood and glue temperatures and of assembly time, however, are critical with hot animal glue. Liquid animal glues appear to vary considerably from sample to sample.

(5) There are a number of kinds and grades of casein glue. For gluing wood used in archery, a water-resistant or "joint" grade of casein glue should be used. Casein glues are used cold. Because of their high alkalinity, these glues tend to stain woods containing extractives.

(6) Urea-resin glues (one type of synthetic-resin glue) set at 70° F. or above. They are generally available in local hardware and building supply stores as powders to be mixed with water before use. These glues are convenient to use, develop a high degree of water resistance, are colorless, and do not stain the wood. Their rate of strength development can be increased by heating the joint. The glue mix will set hard and insoluble in water within a few hours, so that it cannot be cleaned away or used after this hardening. The sensitivity of urea resins to long exposure at elevated temperatures should not be a significant limitation for archery applications. Special gap-filling formulations of urea resins are preferred by some archers.

(7) Resorcinol-resin glues are the most recent type of woodworking glue. These glues cure or harden at 70° F. or above, generally somewhat more slowly than urea resins. They are available in liquid form to which a separate powdered hardener is added before use. Resorcinol-resin glues produce a dark red or brown glue line, set hard within a few hours, and are the most durable of all room-temperature-setting woodworking glues. Generally excellent, durable bonds should be possible when they are properly used. At least one brand of resorcinol glue is available in retail shops, but the cost is higher than that of other glues.

(8) Various phenol-, melamine-, urea-, and other resin glues are available that cure at 240° F. or higher, but these are not generally feasible for the amateur archer.

(9) Polyvinyl-resin emulsion glues are supplied as liquids ready to use at room temperature. Since they lack the water resistance of casein

glues and other resin glues and are subject to some slippage and flow in joints under load, they are not recommended for most wood-to-wood joints in archery equipment. They may be very useful, however, for gluing leather, plastics, and other flexible materials to wood for trim where high stresses are not exerted on the joint and where their quick setting and colorless glue lines are distinct advantages.

(10) Nitrocellulose-base cements (pyroxylin) are particularly useful for attaching feathers to arrow shafts, plastic nocks or points to arrow shafts, and leather grips or handles to bows. Nonaqueous cements of the hot-melt type, such as DeKhotinsky cements, are often preferred for attaching metal points to shafts.

(11) A number of new adhesive-bonding procedures have been developed in recent years for bonding metals and plastics to wood in conjunction with the manufacture of aircraft and other specialized equipment; but many of these processes are still in the experimental stage and cannot be easily adopted by the typical archery enthusiast at this time. They will offer, however, to the archer with a technical interest a variety of opportunities to experiment with interesting new composite materials.² Interest in such materials has increased because of the increasing shortage of the most desired species and quality of wood for bows.

Special Use Requirements

(1) For fishtail splices in staves and for footing joints in arrows, high strength and water resistance are important. A good fit and a larger bearing surface affect dry strength more than the type of glue. In staves the bearing surface may be enlarged by keeping plenty of thickness under the handle. In shafts a sufficient bearing surface is assured if the length of the splice is at least 15 times the diameter.

(2) The choice of glue for attaching feathers to shafts depends on the degree of water resistance desired and on the rate of gelling of the glue for the particular mechanical method used for feather attachment. Animal glues have been used, but nitrocellulose-base cements (pyroxylin) now seem to be preferred and appear to have acceptable moisture resistance. Glues of the woodworking types, known to be more moisture resistant, are not generally convenient to use for attaching feathers because of their slow hardening under normal conditions.

²The bonding of wood to metal is discussed in Forest Products Laboratory Report No. R1768.

(3) Glues for attaching bow backings and facings must produce bonds that have high strength and high moisture and water resistance and that are able to bend with the bow without failure. Glue films applied to the wood for laying sinew, silk, or high-tenacity rayon fibers as backings and facings must bend without cracking. Animal and certain resin glues have been used for these purposes.

Gluing Properties of Archery Woods

Since a good glue joint is usually considered to be one that is stronger than the wood being bonded, the stronger high-density species require stronger bonds than the low-density woods. Therefore, more careful control of the gluing conditions is required to produce satisfactory joints in hickory than in spruce or pine. Oily woods, such as yew, osage orange, or lemonwood, that are commonly favored for bow staves may be more difficult to glue than woods of the same density but without oils, resins, or extractives. Oily woods may glue better when freshly machined than later. Sponging oily wood surfaces with a 10 percent solution of caustic soda, wiping off the excess, and drying before gluing often improves gluability with animal and casein glues. Since residual alkali is likely to interfere with the catalyst systems of many urea- and resorcinol-resin glues, this alkali surface treatment should not be used with these resin glues. Gluability with these resin glues may, however, be improved by the use of somewhat elevated curing temperatures -- 100° F. or so -- during the pressure period. Care must be taken to avoid excessive drying of the wood during such curing of the glue.