

## Compound Bow Limbs – Laminated or Solid Glass/Graphite?

This is a question that I was asked many times while an archery sales rep for some of the best limb producers that ever existed. Each type has their inherent benefits, strengths and weaknesses. This info should weigh in your decision when it comes time to dropping \$500-1000 or more a new compound depending upon what its mission will be.

There are two choices when it comes to limb manufacture: Either the limbs will be **solid glass/graphite** or they will be **laminated**. Before you proceed further, recognize that most companies use proprietary processes to manufacture their limb and they are sometimes very secretive about specifics. This is a general overview from what I have witnessed first hand.

Solid glass/graphite limbs will either be **extruded** or they will be **compression molded**. Of the two designs, the compression molded limbs are definitely more durable and offer greater torsional strength than the extruded limbs. I will try to describe the manufacturing processes that I have seen so that you understand a little better why the compression molded design is superior....

Imagine a wall filled with racks of spooled fiberglass ribbon. This ribbon is actually of a finely woven design and the ribbons are quite thin/narrow. The ribbons come off the spools to several common points on a horizontal bracket and through a bath of epoxy, sometimes mixed with a carbon fiber. These epoxy soaked ribbons are then wound between two rods on a turret head. That turret head has a horizontal drive shaft and the two rods rotate, allowing the ribbon to be wound back and forth between the rods at several points. At the same time, the turret head will oscillate back and forth so that the ribbon is actually laid down across a 1.5-2.5 inch width at each point (there may be 1, 2, 3, 4 or 5 points, depending upon how many limbs the die will make. Once a specific number of ribbon wraps are placed between those two rods (a trial and error affair) they now have enough wraps to produce a limb of a given deflection at a given finished length.

The machine operator then cuts the ribbons and takes the soaking mass between the two rods and lays them into the press die. The press is then closed and after a specific amount of time, under a specific amount of pressure and at a specific temperature, the epoxy sets firmly. The semi-finished limbs are then removed from the press/die and allowed to cool to room temperature. As these limbs come from the press die, they are nearly ready to be placed onto a bow! Minimal machining is required to finish the exterior of the limb. The ends are machined, the area where the limb pivots are attached and the hole for the axle. That's really about it.

The benefits of this type of limb? They have fibers that run "Uni-Directional" because of the use of woven ribbon. Because of this, there is far more torsional stability in the end of the limb and they are less prone to having tippy wheels. If you heavily scratch the edge of the limb against a rock, etc, any resulting crack is far less likely to take a direction because the crack immediately hits fibers that lay at 90 degrees to the crack. These limbs

are like IRON and they have an unbelievably low failure rate. 1 Million cycles on a stress test are not unusual at all for compression molded limbs. You want dependability?? There are NO better that exist in the industry and I have witnessed their reliability for years.

**Extruded glass limbs** are made completely different. These limbs begin as chopped fiberglass and other materials (including graphite fibers) that are suspended in a molten epoxy paste. This hot paste is pushed under high pressure through a rectangular extrusion die which forms a long bar. This bar is then allowed to cool before the machining process to finish the limb begins. For the most part, the stock bar is of proper width and thickness as selected by the bower so that it fits the riser pockets properly and requires minimal machining or contouring to give the required deflection at a given length. Most manufacturers use this type of limb and although these types of limbs had high rates of failure in the past due to the amount of total deflection (based upon shallow limb angles, longer limbs, etc), the shorter limbs of today are very reliable. The newer parallel limb bow designs require shorter, stiffer limbs that see far less flex than the bows of the 80's and 90's and as a result will see lower failure rates.

The knock on extruded glass limbs was that they had less torsional stability because as fibers lay in one direction (linear) as they are forced through the extrusion die. As well, this fact allows any fracturing or cracks to “take a direction“, much like tearing a sheet of toilet tissue (try it and you'll see what I mean).

Both types of solid glass limbs are very durable as a rule. Lately, more warranty repairs seem due to how they are compressed in the consumers bow press than anything. Say what you will to the contrary, but the manufacturers have a very simple test (beyond a visual exam) to determine where the problem lies. They cut a section of the limb where any breakage occurs. The section is weighed very accurately and then the section is fired in a kiln. Once the epoxy is burnt away, they weigh the remaining materials and can see precisely what the epoxy content had been at the point of the failure. If it is within spec...they know who broke the limb ☺

Solid glass limbs are extremely stabile! It doesn't matter if the bow has sat inside a black car interior on a 100 degree day or if it's 50 below zero outside. *They do not gain weight...nada.* Over long periods of time, these glass limb do not lose weight either. Their mass weight is higher than that of laminated wood limbs and as a result, they “can” produce more shock in the system. With today's newer parallel limb bows, this is not nearly as much of an issue as it once was. If a person is going on a big \$\$\$ hunting trip, the glass limbs (particularly the compression molded limbs) offer the absolute highest amount of dependability. They are like iron and the slightly higher weight well offsets any benefit that a laminated limb might offer regarding shootability.

**Laminated Limbs:** Laminated limbs are kind of a lost art in today's market place. Because of the parallel limb designs that most hunters prefer, they are wholly unnecessary. Where the laminated limbs shine is when you are faced with a bow of more conventional design (longer ATA's as in 42+ inches and shallow limb angles). The laminated limbs are definitely smoother drawing because they flex over a longer portion of the limb. They weigh less (as a rule) and will produce less hand shock. This is why

many old-time target shooters prefer them. However, look at what is winning and limb design really doesn't seem to matter much.

The single biggest drawbacks to laminated limbs is that they many times use naturally occurring materials (wood) and each piece of the limb is glued together. Each piece of wood for the lamination is different from the next and nature has a way of making weaknesses that cannot be seen or are 100% predictable. Yes, wood laminated limbs have been around since God made dirt. Would you want to trust what nobody but God can see on a \$5000 once-in-a-lifetime hunting trip? Not this kid.

Wood or composition laminated limbs (of which the latter are superior in my view) are all made with laminations of specific thicknesses (to achieve the targeted deflection) and they are bonded with special epoxies in a press under heat. These press surfaces use "air bags" so to speak that allow equalized pressure all along the limb and the bag allows for any possible irregularities in the laminations. Once these laminations are bonded, minimal final finishing is required on the exterior of the limb. The limb is final finished with about the same amount of labor that is required to finish a compression molded limb.

Recognize that the integrity of a laminated limb also depends upon: even epoxy application by the maker on EACH lamination, good lot/batch of epoxy (this can be a crap shoot), raw material voids, moisture content in the wood laminations, etc, etc, etc.

Laminated limbs biggest enemy is heat! The epoxy used in these limbs is heat cured at a specific temperature range. Leave your bow in a hot environment and delamination can occur, particularly once the bow is shot.

**Commentary:**

As you can see, there are infinitely more possibilities of issues with laminated limbs compared to solid glass limbs. It is merely because of the greater number of steps required to make the laminated limbs, infinitely more components and the waaay greater chances for the limb encountering unknowns along the manufacturing process. For the hunter...the solid glass limb (molded or extruded billet) is the only logical option from a dependability standpoint. If the bow is of parallel limb design, the laminated limb is a viable option because it is not deflecting nearly as much as in a conventional bow design ...therefore it will have a higher likelihood of integrity.

For target or 3D shooting, the bow designs of today (that are winning most of the big events anyway) use 100% synthetic materials in the laminated limbs or they use solid glass limbs.