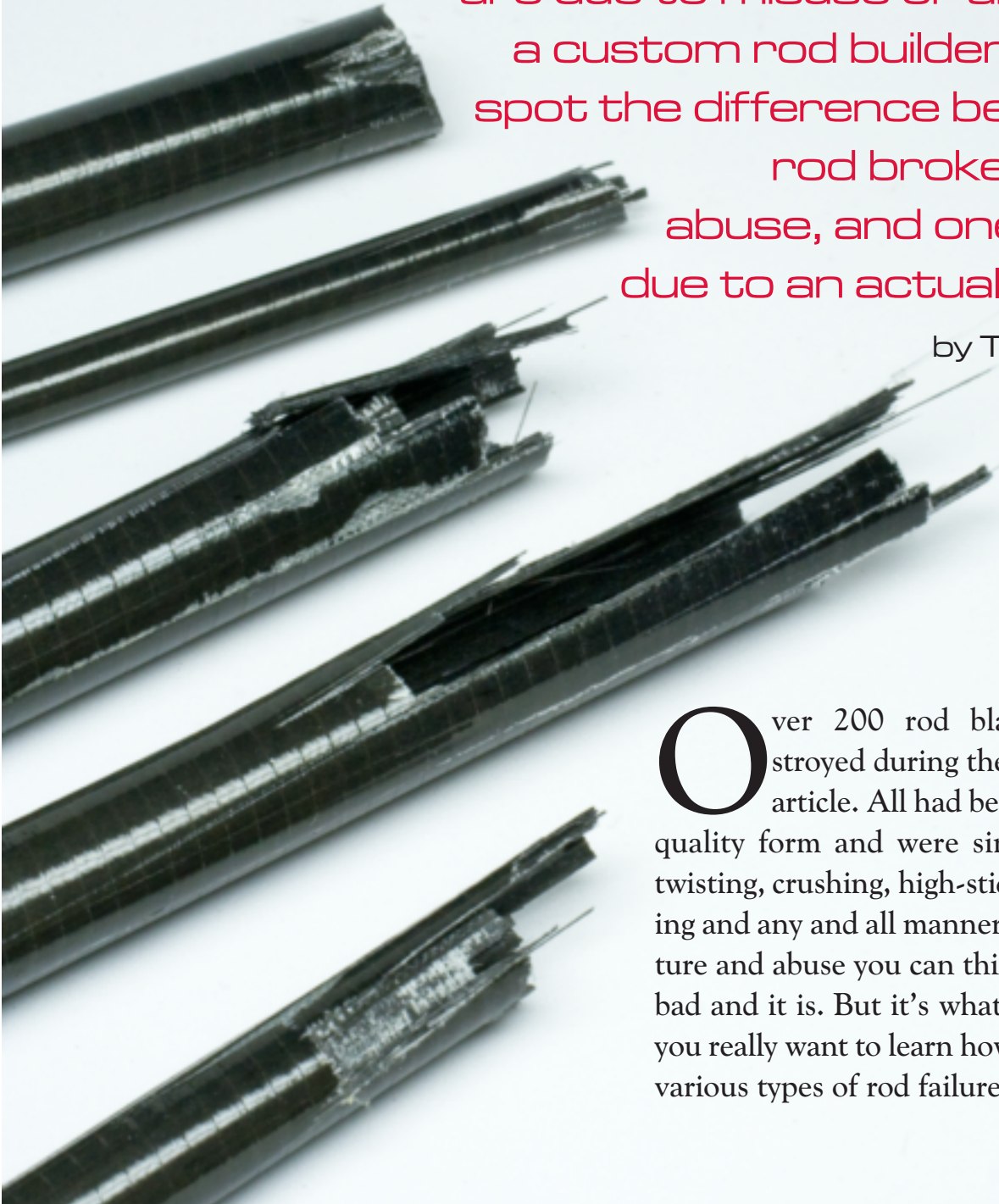


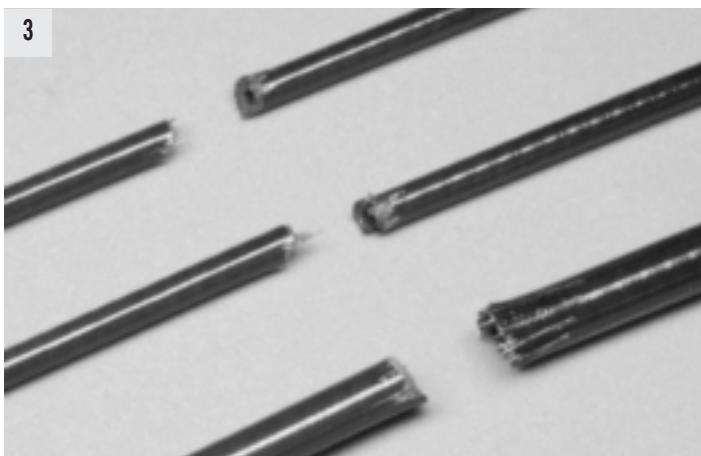
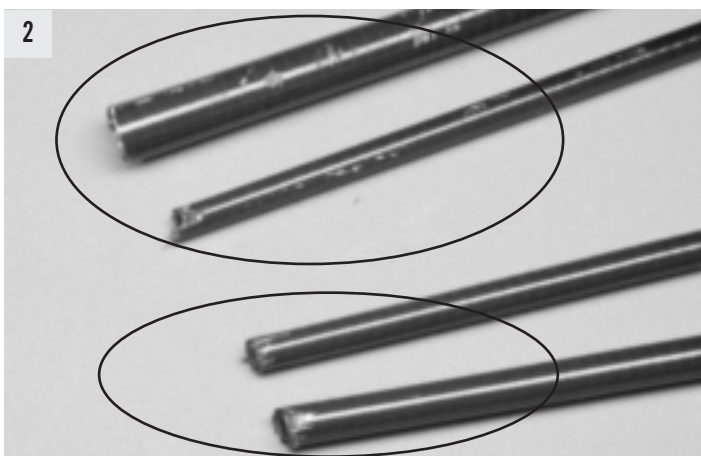
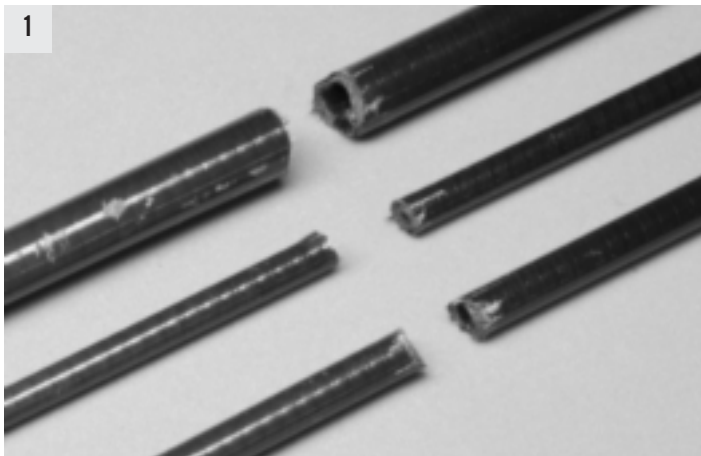
Rod Failure

Well over 95% of all rod failures are due to misuse or abuse. As a custom rod builder, can you spot the difference between a rod broken due to abuse, and one broken due to an actual defect?

by Tom Kirkman



Over 200 rod blanks were destroyed during the making of this article. All had been in perfect 1st quality form and were simply ruined by twisting, crushing, high-sticking, overloading and any and all manner of physical torture and abuse you can think of. It sounds bad and it is. But it's what you must do if you really want to learn how to identify the various types of rod failure.



Impact Failure

Rod blanks are incredibly strong provided their surface has not been compromised in some way. A perfectly sound rod blank that can dead lift 20 to 30 pounds can just as easily fail under a 1/2 pound load if the surface fibers of the blank have been fractured or bruised. Such damage or fractures are usually the result of some type of impact against the rod. The fisherman that slaps his rod on the boat's gunwale, or the guy who rips loose a snagged lure or weighted fly and has it zip out of the water and impact his blank, is very likely going to experience a failure either immediately or at some point down the road. How soon it happens is relative to how damaging the initial impact was and when the rod next experiences a test or load that suddenly reveals that earlier damage.

Failures due to impact are generally easy to spot - they're usually clean breaks with little to no lengthwise splitting of the blank in the area around the break (1). Imagine scoring a piece of glass and then giving it a sharp rap - it'll usually break cleanly along the scored line. This is very similar to how a rod blank that has suffered a surface fracture due to impact will fail.

There are other telltale signs to be on the lookout for whenever you suspect that an impact of some sort may be the cause of a failure. Check the area just fore and aft of the break and see if any visible marks from impact or abuse are apparent (2-top). Such marks in the immediate area of the break are additional evidence that the rod surface was fractured due to vibrating against a rigid surface or being continually rapped by a hard object. A single sharp impact can also cause a failure and in those cases where one sharp lick did all the damage, no additional marks may be present (2-bottom). But the break itself will be the same - clean and fairly straight with very little other disturbance of the blank's fibers.

"Hi-Sticking"

Astute rod builders are aware of the dangers of pointing the rod butt to the sky while there is a fish on the other end. Graphite rods do not like being bent beyond a 90 degree angle to any applied load and the guy who uses his rod to lift a fish into the boat or pulls the rod around double while attempting to free a snag can easily put the upper half of a rod into a full 180 degree bend.

A high-stick situation doesn't guarantee a failure, but any time you flex a graphite rod to such an extreme a failure isn't at all unlikely. Although they seem fairly clean and straight (3), a closer look will reveal that the edges of the break are slightly irregular and distressed fibers are apparent (4). In fact, high-stick failures very closely mimic an overload failure except that they almost always take place in the upper 1/2 of the rod.

Marks or blemishes on the rod's surface in the area of the break are more indicative of some sort of impact and do

not necessarily point to a high-stick failure. But one thing is for certain, any sort of damage in the top half of the rod, such as due to impact or fracture, will quickly and almost certainly rear its head if the rod is high-sticked.

Crush Failures

Rods are easily damaged by any type of crushing force. Stepping on a rod, sitting something on a rod or falling against a rod can easily fracture the structure. It may break immediately or the break may happen later when the rod is put under load. Astute fishermen and rod builders can usually spot damage from a crush prior to the actual failure - if they're looking for it. There will be telltale lengthwise splits along the rod in the area of the crush. If these are subtle enough, they may go unnoticed until the rod is put under load at which time a failure is almost certainly going to result.

A crush failure is fairly easy to spot. The rod may or may not be totally severed but in nearly all cases there will be long, lengthwise splits bordering a very irregular break (5). Close inspection may also reveal damage to the rod's surface stemming from the initial crushing force.

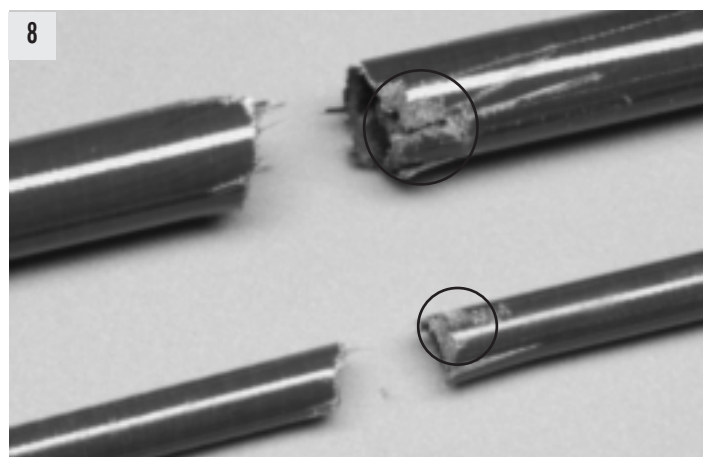
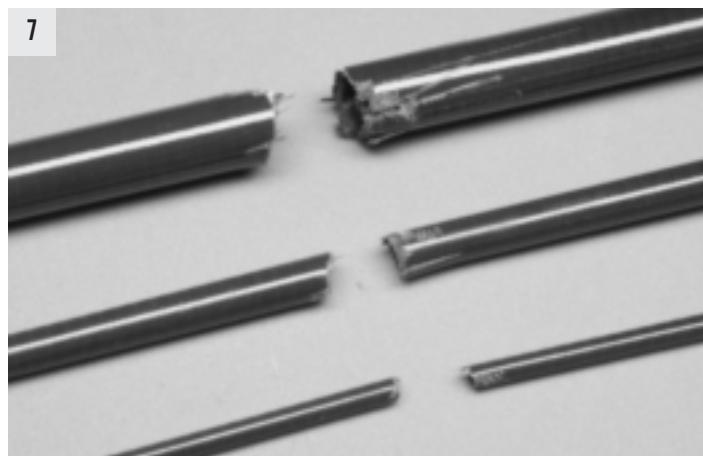
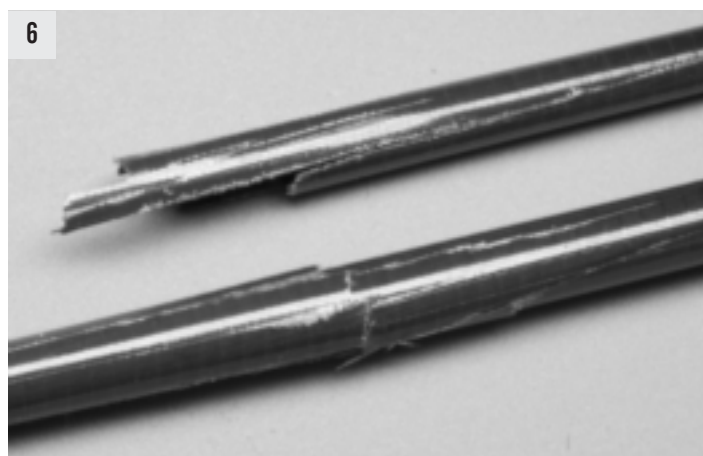
When you encounter a break that exhibits lengthwise splits and which isn't entirely severed, you're likely looking at a crush failure. The reason this type of damage doesn't always result in a complete severing of the rod is due to the fact that severe crush failures will result in collapse at the first hint of any load. In such cases there is very little force being applied and almost no sudden shock. Therefore the rod folds over, but remains intact (6-bottom).

Fracture

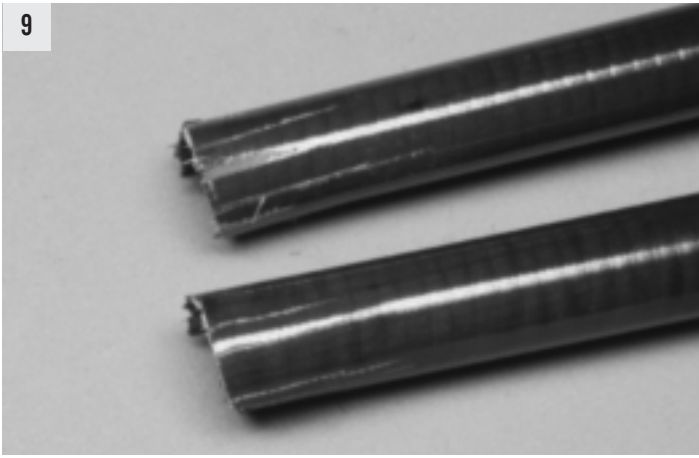
Almost any sort of impact or crushing force will result in a fracture of the rod's surface. But there is a particular type of fracture that stems from a "dig" or cut into the rod's surface. Such a fracture can result from something that has managed to cut or scrape into the rod, or perhaps a well meaning rod repairman has accidentally sliced into the rod while removing an old guide. The break that eventually results from these type fractures (7) will look much the same as those breaks caused by impact. However, close inspection of the break will usually reveal a deep or obvious "dig" or depression in the blank's surface (8).

Overload Failures

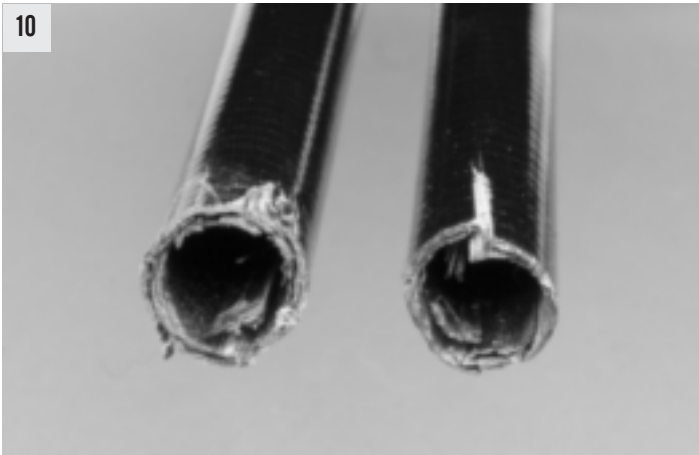
Assuming a rod blank is in perfectly sound condition, and assuming the fisherman isn't "high-sticking" or otherwise abusing it, a rod can and will still fail at some point when the applied load exceeds that of the structure's design limits. In the case of graphite rod blanks, when the load limit is reached and exceeded, the fibers on the bottom of the rod, which are in compression, will blow inward. At that point,



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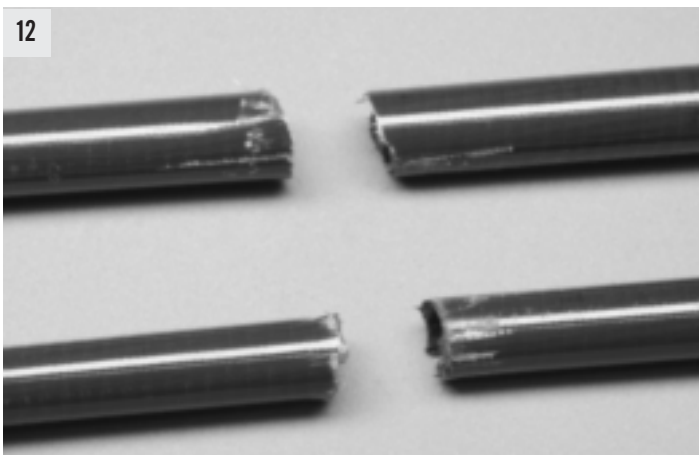
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you no longer have a tube and a catastrophic failure is the result. Load limit failures are easy to spot. This type of break will always take place in the bottom half of the rod, usually just forward of the handle or the fisherman's furthest point of effort (the rod hand). The break will be slightly irregular with jagged edges and short lengthwise splits and tears (9). Looking at the inside of an overload failure you'll note great distress in the walls of the blank both inside and out (10).

Another interesting facet of a load limit failure is that it's often accompanied by more than a single break (11). The initial break will take place just forward of the handle or point of effort, but the resulting shock of that break will almost simultaneously cause additional breakage further up and along the rod. The most common points where these additional breaks take place are several inches ahead of the first break and fairly near the tiptop. These subsequent breaks do not always take place, but when you do see them coupled with that jagged/irregular break just forward of the handle, you're almost certainly witnessing the result of a sound rod blank that was simply loaded beyond its design limits. The sudden shock from the overloading and breaking of the otherwise sound rod blank causes the additional breaks in many such cases.

Shear Failures

Rod blanks are intended to be loaded over their entire lengths. Anything that a fisherman does to create a sudden stop or shear area along the blank can and often does result in a shear break at that point or just forward of it. Shear breaks are fairly easy to spot because they are relatively clean breaks (12). Although they may seem to resemble load limit failures, a closer inspection reveals that most shear breaks show very little distress of the fiber ends, particularly on the inside of the blank (13).

Always check the area just to the rear of any suspected Shear failure. If the rod has been repeatedly rested on a rail or gunwale, you may spot a blemish or worn spot in the rod's finish in the area just behind the break.

Spiral Failures

We've all seen it - conventional casting rods with the guides on top, twisting under a heavy load. Although this might seem like murder to a fishing rod, blanks are designed and constructed to withstand a good deal of torsional stress. A simple 180 degree twist over the full length of a rod blank isn't likely to result in failure, but it can happen. And, the situation is exacerbated if there is other damage already existing somewhere along the rod.

Breaks due to twist or torsion are easy to spot. They closely resemble crush failures with long lengthwise splits on both sides of the break. But those lengthwise splits will be spiraled rather than straight (14).

Combination Failures

Sometimes it takes more than one incident of damage or abuse to cause complete failure. Many of the rods broken during the research for this article were “high-sticked” to a point that put the top half of the rod into a full 180+ degree flex. And yet, most held up to such abuse unless and until they were carrying a fairly hefty load in that position. Similarly, many rods with minor impact damage didn’t fail even with a fairly heavy load placed on them. This was particularly true when the damage was confined to the upper half of the rod. As the applied load increases, the flex in the rod moves beyond the tip and onto the more powerful mid and butt areas, allowing even lightly damaged areas in the upper half of the rod to remain intact. However, combine even light impact damage or a shallow fracture in the top half of the rod with a “high-stick” and you are guaranteed to have a quick and total failure on your hands. High-sticking a rod that has suffered even light damage anywhere in the upper half of the blank will result in failure at the point of that prior damage.

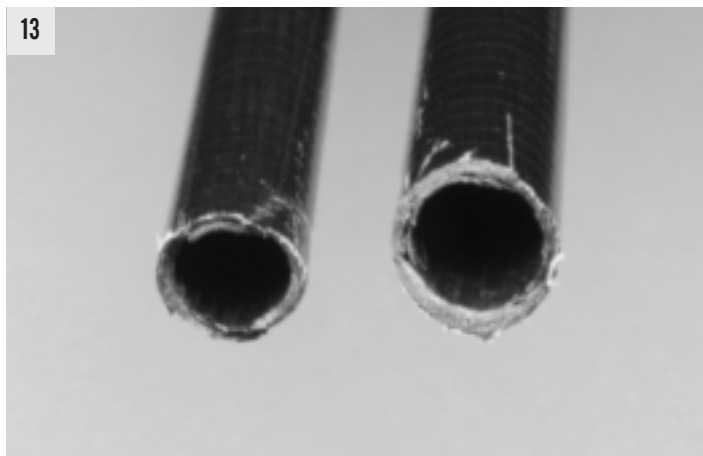
Another common combination failure is a simultaneous crush and shear action. Car doors, SUV lift gates, rod locker lids, etc., will easily crush a rod but will not exactly resemble standard crush damage/failure. When broken along a small diameter area, the break may appear like any other shear break - clean and straight across (15 bottom). When broken further towards the larger mid or butt areas, evidence of the crushing force will be present (15 top). Crush/Shear breaks in the lower half of a rod are often easy to spot by looking at the broken cross section head on. There will be some lengthwise splitting, the rod tends to break fairly clean at the point of the shear and will be left somewhat oval in profile (16). This is a common type of break and builders would do well to study these clues well. They do not mimic any other type of break and are almost never the result of an overload failure nor manufacturing defect.

Breakage Due To Defects

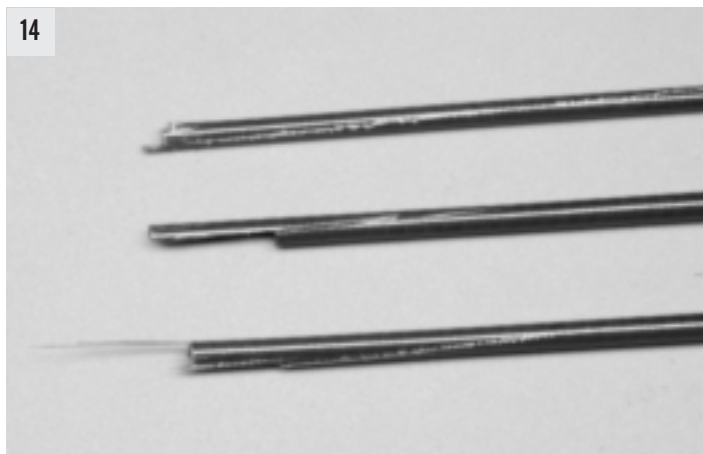
Yes, defective rods do slip out pass the manufacturer’s quality control departments from time to time. This doesn’t happen nearly as often as most fishermen seem to think, but bad rods do indeed manage to get out to the dealers’ racks. A rod with a serious manufacturing defect or which has been constructed from defective material will tend to fail within the first few uses. Any time a customer has a rod fail for unknown reasons early on, a manufacturing or material defect can indeed be the culprit.

Most defects, fortunately, are quite obvious to the trained eye and very few defective blanks ever make it beyond a good quality control department. We spoke with some folks that have a pretty good idea what can go wrong during the manufacturing process and what they look for before allowing a blank to go out the door.

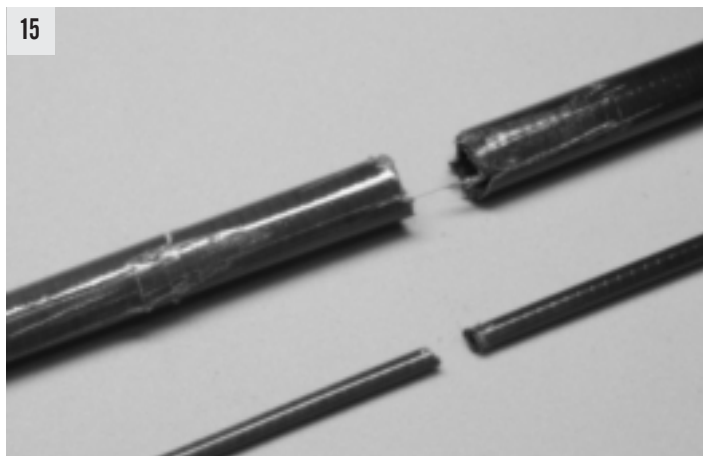
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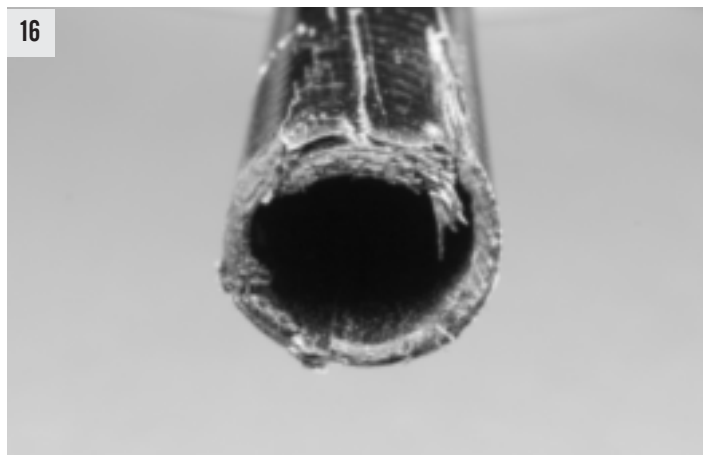
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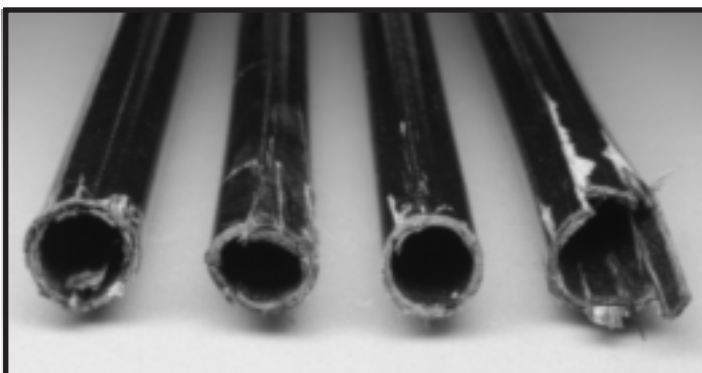


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Points to Remember

- Rods do not suddenly become defective after several seasons of use. True defects in materials or workmanship generally show themselves via a failure within the first few uses. A rod that has given good service over many fishing trips and then suddenly fails is almost always the result of some type of damage or abuse by the customer.
- Fishermen who swear that their rod broke while setting the hook on a 10 inch fish may actually be telling you the truth. However, the ultimate cause of such failure was prior damage that only revealed itself during subsequent use and which the fisherman had most likely forgotten about or not noticed at the time it occurred.
- Fishing rods are not unbreakable. A well made, sound fishing rod is designed to withstand a certain amount of load and flex. Take it beyond that design limit and it will break. Such failures generally occur in the lower half to lower 3rd of the rod and show great distress of the fibers both inside and outside of the blank.
- Always pay careful attention to the overall condition of any rod which is returned due to breakage. A rod that appears battered and beaten has likely suffered some type of damage to the rod blank itself. Whenever you see nicks, dings or deep scratches in the immediate area of the break, you should suspect that the failure was the result of impact or fracture.
- Get in the habit of regularly checking your rods for damage. While light nicks or scratches may not necessarily result in eventual failure, deeper fractures and crush splits will nearly always cause a rod to fail. Spot them early enough and you may be able to enact a repair that will save the rod before it is too late.
- The longer a fishing rod is in service the greater the chance it will suffer some type of damage which leads to either immediate or subsequent failure.



Now that you've had access to the photographs depicting what the various types of specific breaks look like, let's have some fun! Study the 4 broken rods above and write down what you think caused each respective break. The answers are on page 34.

Bad Tack - The graphite prepeg pattern is tacked to the mandrel prior to being rolled around it. According to Jason Brunner, head blank engineer at St. Croix Rods, if this "tack" comes loose during the rolling process, the fibers will become misaligned and will create severe waviness or a corkscrew effect along the blank particularly in the upper half of the rod. In the lower half of the rod, a Bad Tack, or "Broke Loose" as Jason calls it, will manifest itself by a very out of round appearance.

Loose Roll - Graphite prepeg is rolled onto the mandrel between two platens moving in opposite directions. This is done under pressure. In the event that the pattern is not rolled under sufficient pressure and remains somewhat loose on the mandrel, the subsequent tape wrap made on the blank will create obvious spiral indentations in the blank's surface. This is much more than the common residue left from the resin/tape after the blank has been cured. According to Jason Brunner, "This should be obvious to the builder as you can see and feel the spiral effect left by the tight tape wrap over the loosely rolled pattern." Jason also mentioned that these indentations may not occur over the entire length of the blank, but in short portions. Gary Loomis, who's been around the block a few times when it comes to rod blank design and manufacturing, added a similar comment "If the laminate is not well-compacted, it will be weaker, thus more breakage."

Dents and Bumps - Prior to the oven curing of the rolled and taped rod blank, it's important that the blank not receive pressure in small areas. "Dropping or leaning the blank against solid, rigid surfaces can cause the part to take on dents which can be seen after the part is cured," said Jason Brunner. He went on to add that imperfections in the resin application results in just the opposite - bumps which are visible when the blank is cured.

Dry Spots - Any areas where the resin has not been evenly or completely applied will result in an odd "skewed" appearance that shows some fibers out of alignment to the rest. Generally it gets caught in the tacking process as dry areas won't easily tack and stay put on the mandrel.

Over Sanding - When the cured blank comes out of the oven, the tape wrap is stripped away and the blank is generally sanded to a smooth surface. This is a critical process and the folks who do it are very skilled. Still, it sometimes happens that a blank will be oversanded resulting in a thin area that results in a weak point. Seeker Customer Service Representative Jim Upton says that this is one of the three main manufacturing defects that he's seen, "...bad tacks, dry spots and over sanding are the three most common defects." He also says that in the rare event that blanks with these defects do make it out the door, they're easy to spot when they fail. "Breaks due to oversanding will exhibit a

much thinner wall on one side than the other.”

Gary Loomis concurs saying, “Sanding - over sanding - can cause breakage issues. You want to sand just enough to take the outer resin off, but not get into the material, especially in thinner wall areas.”

Fiber Wash - This is one of the things that can certainly cause a rod to fail and depending upon its severity, it may or may not be caught during the quality control process. If the fibers are misaligned from the intended alignment you'll end up with weak spots in the rod blank. Fiber wash can result from bad material or poor manufacturing steps. In more severe cases, the defect is obvious to the eye, “Appearing in a snake like pattern on fairly short distances on a blank out of alignment with the remaining fibers,” said Jason Brunner. In less severe cases, blanks with fiber wash might just slip out of the manufacturer's quality control department and make it to your dealer's racks. Such blanks are very, very weak and generally fail right out of the box within the first use or so.

All the designers and makers we spoke with are in agreement that rod blanks which are truly defective either in materials or workmanship will fail within the first few times the rod is used, unless it's simply not put to much of a test. But the rod that has served a fisherman well for a many trips, landing large fish and doing all that's asked of it, doesn't suddenly fail due to an inherent defect later on down the line.

Fortunately, most material and manufacturing defects are rather obvious and for this reason very few defective rod blanks ever make it beyond a premium blank manufacturer's quality control department. This isn't saying that a few don't get out now and then, but it's far more rare than most fishermen would think. Jim Upton remains convinced, “The vast majority of rod breakages remain due to customer misuse - setting drag pressures higher than the design rating of the blank (over-lining) and /or any action that has the same effect as “high-sticking” the rod.

The bottom line - most broken rods are the result of mishandling or abuse at some point after the blank has left the manufacturer's facility. And now you know how to spot and identify that abuse. 🐟

Blank Designer Comments

Jason Brunner - St. Croix Rods

True manufacturing defects will reveal themselves very early in a blank's life. How early depends on how the blank is actually being used and how often.

A builder can do very simple visual inspections on a blank before building on it. I would first focus on the tip area as this is the section of a blank that is most vulnerable to defects. Inspect the tip visually looking for wrinkles and other obvious imperfections. Secondly, rub two fingers over the blank several times feeling for any imperfections. A good blank should feel smooth and straight. Also, bend the blank by hand in several locations using common sense not to exceed the blank's ability. The blank should also be flexed from tip to butt... again not exceeding its ability. Finally, visually inspect the entire blank looking for the defects I mentioned in the article.

I would say that general mishandling of rods is the #1 cause of failure. Well designed carbon fiber blanks are very durable when used properly, but when mishandled they are prone to breakage. General mishandling can be anything from being stepped on, something dropped on it, cramming the tip into a rod locker, chattering against hard objects and the list goes on and on. Other factors that I also rate high on the list are high sticking, aggressive hook sets on objects other than fish and improper techniques for lifting fish into boats.

For sake of just stating it, I treat my \$300 rod the same way I treat my \$300 rifle. I clean it. I store it properly. I don't drop it. I baby it!

Gary Loomis - North Fork Composites

Most failures are usually a matter of abuse more than an issue of manufacturing defects. A weak area or defect should show up within days or a couple of weeks of the first use of the rod. Breakage after that time frame usually indicates an abuse of some type - whether the angler was aware of it or not. This can include hitting the rod against an edge, hitting a rod with a lure, etc. Sometimes the event that leads to breakage simply goes unnoticed while fishing, but the rod then fails sometime later.

There are a few things that rod builders can do to limit the amount of rod breakage they see. First, in the tip section, a builder can look for a broken tack-point that shows as twisted fiber. This is easier to do in uncoated blanks, of course. Then you want to look for blanks that are straight or which have an overall slight sweep, versus blanks that show a dogleg or strong twist along their length. Look for areas that might indicate over-sanding or just poor sanding quality. Again, this is easier to see in an uncoated blank. And the builder can flex test a blank and put it under a full fishing load to be sure that there are no immediate issues that might arise.

Finally there is one thing that is sometimes overlooked and ends up being very important - simply making sure that the end user and his or her angling situation is really right for the blank in-hand. If the end user wants or is expecting a certain performance level, they need to be sure that they truly get the right blank. This is where the custom rod builder's expertise is so very important if the angler is to get what he wants and have it perform the way he expects it to. 🐟