TIPPETS: HEAD TO HEAD

HOW THE IGFA TESTS TIPPET STRENGTH

NICK HADDAD

ON A BRISK MID-MAY MORNING ON BURT LAKE IN NORTHERN MICHIGAN, THE SUN ROSE ABOVE THE TREES, AND SPENCER MCCORMACK SCANNED THE SHORELINE FOR STRUCTURE THAT MIGHT HOLD PRE-SPAWN SMALLMOUTH. EQUIPPED WITH AN 8-WEIGHT FLY ROD, 27.5 INCHES OF 8-POUND-TEST MAXIMA ULTRAGREEN TIPPET, AND A FLY CALLED A LOW FAT MINNOW, HE WAS TARGETING A SPECIFIC FISH.

The International Game Fish Association (IGFA) 4-kilogram (8-pound) tippet class world record sat at 5 pounds, 9 ounces—a mark McCormack knew was attainable. He had done all the research, read all the rules, and was just waiting for the right fish. Sure enough, on May 21, 2020, that fish struck and he landed a beautiful 5-pound, 13-ounce smallmouth bass. He quickly motored to the shore, properly documented the weight of the fish (it must be done from shore or a fixed structure) and he released the fish to fight another day. There were now just a few small steps before securing his first world record. He needed to send in the application, photos, and a line sample to the IGFA to verify his catch for the 8-pound-test record.

He was ecstatic. All his preparation in tying the perfect fly, the hours spent studying water conditions to maximize his chances, the endless casts, the hard work, and the dedication had finally paid off.

As the IGFA's angler recognition coordinator, I handle all the world record applications. I received McCormack's application, which included the scale used to weigh the fish. Record catches either need to be weighed on a certified scale, or the scale must be tested and certified shortly afterward. I tested McCormack's scale and certified that it was accurate. At this point, McCormack had thought his record was in the books . . . after all, what else could go wrong?

I continued to process his application, which included examining the photos and video, measuring his class tippet, and entering all the required information into our records database. I paused for a second when I saw he listed 8-pound-test Maxima Ultragreen as the brand. Although at that time I had only been with the IGFA for about a year, I had tested this product before, and knew it might "over-test"—a term we use to describe line that tests higher than the advertised breaking strength of the line.

I prepared the line sample by cutting the class tippet off from the fly and rest of the leader, and the next day I put the tippet in a cup with tap water and soaked it for two hours. The IGFA testing procedure requires soaking lines in fresh water for two hours to simulate fishing conditions. Some lines, especially nylon monofilament, absorb water and as a result become weaker. We test the line five times with an Instron Model 5543 Tensile Strength machine. This machine is the cream of the crop when it comes to measuring tensile strength. The average of those five breaks determines the line's actual breaking strength, and the line class that a record catch will be placed in.

I placed McCormack's line sample in the Instron's grips and pressed run. In the first test, it broke at 10.75 pounds. At this point I already knew that the application for the 8-pound-test record would be rejected. Monofilament lines are too consistent

SPENCER MCCORMACK - PHOTOS

Spencer McCormack thought he had the IGFA 8-pound-test tippet record for smallmouth bass, but when his tippet was tested, it had an actual breaking strength of about 10.36 pounds. The problem, as McCormack discovered, is that the breaking strength printed on the label doesn't always match up to reality.

to bring the average back down to 8.81, the maximum allowed for the 8-pound tippet class category (the IGFA allows up to the kilogram conversion value, and 4 kg is 8.81 lbs). I proceeded to test the rest of the sample. Break two was 10.12 pounds, and break three was 10.21 pounds, for an average of 10.36 pounds. We typically do five tests, but with fly-fishing records, only 15 inches of class tippet is required. It takes about 7 or 8 inches of line to perform one test, therefore we can't always perform five full tests.

I returned to the record envelope and wrote: "Reject—line OT and NHE for 12-lb category" and signed my initials. This means the line over-tested (OT) for the 8-pound-test category and the catch was not heavy enough (NHE) for the 12-pound category. Although the men's 12-pound tippet category is vacant for smallmouth bass, the IGFA has a 1/2:1 minimum weight requirement, which means the fish must weigh at least half the line weight to qualify. This meant McCormack's catch was 3 ounces too light to qualify for the 12-pound tippet record.

Line over-testing is the number one reason that IGFA records are rejected. It is fascinating to learn the true breaking strength of line, and to know that many anglers are using line significantly stronger than what they think. This is not just a Maxima Ultragreen issue, but almost every major brand distributes lines that are actually stronger than what is stated on the spool. Is this just marketing, or do companies truly not know exactly how strong their line is? Whatever the answer may be, I don't enjoy breaking the news of a rejected record, and I know that applicants don't like receiving that news either.

McCormack was crushed and described it this way: "Those opportunities are sometimes few and far between. You wait all year for a certain day or certain week when conditions are right. And you think you have all your ducks in a row, and the line is not legit . . . it's a big disappointment really."

METHOD/PURPOSE

Part of my job is to test line strength to world record applications, but for consumers, there are many other important considerations, including diameter, consistency, abrasion resistance, knot strength, stretch, and packaging. The line strength is just one part of the story.

Most conventional fishing lines are simply labeled by their breaking strength in pounds, but in fly fishing, the diameter is often a more important factor, and manufacturers often use the "X system" to describe the diameter of the line. The label also includes the breaking strength of the line.

To provide some clarity on this issue, we wanted to test some of today's most common tippets to see how this X system correlates to breaking strength, and also see how close the advertised strengths are to the actual breaking strengths. I tested 21 different spools of today's most popular tippets in 2X, 4X, and 6X, using standardized IGFA world record testing procedures. Each spool was soaked for two hours, tested five times, and I carefully measured the diameter of each sample to ensure an apples-to-apples comparison.

All in all, these tippets performed fairly well when comparing the advertised strength to the actual wet breaking strength. The majority of tippets broke close to or below the stated breaking strength, with only a few over-testing significantly.

The diameter of 2X, which should be 0.009" or 0.23 mm, ranged between 0.22 and 0.25 mm. The strongest 2X tippet, Absolute Fluorocarbon Trout Supreme, broke at 11.71 pounds, and

WHAT IS THE X SYSTEM AND HOW DOES IT WORK?

In fly fishing, presentation is everything, and that includes both the delivery of the fly and how the fly appears to the fish we are trying to catch. In both instances, the breaking strength of the line is of little importance. Breaking strength becomes important when you're hooked into the fish of a lifetime, or when you're snagged on the river bottom and don't want to lose your fly, but when you are casting, mass is what matters.

Our ability to change the taper of a fly line determines how the line unfurls in the air, and we design leaders and tippets to be a continuation of that taper so our casting energy transfers along the length of the line and dissipates until the fly gently floats down to the surface of the water.

This is why leader material—from the butt to the tippet—is all labeled by diameter. This allows fly fishers to build leaders that begin with a diameter and a mass closely approximating the tip of the fly line and end with a diameter that allows the fly to float (or sink) freely and unencumbered by its tether.

The X system is something fly fishers inherited from our sporting forefathers—from at least the 18th century, when drawn silkworm gut was the best leader material available in the British Empire, and replaced horsehair leaders among the fly-fishing elites. "What is drawn silkworm gut?" you may ask? According to angling historian Paul Schullery, during this era there was a vibrant cottage industry made up of female workers who were trained to draw the entrails of this worm (literally the guts) through the gaps in their teeth to scrape and thin the material down to specific diameters. In their business, "X" was roughly equal to 0.011". 1X was one thousandth of an inch smaller or 0.010". 2X was two increments down or 0.009" and so on.

Today we use extruded nylon and fluorocarbon for our leader and tippet material, but the way we measure, label, and talk about this critical part of our fishing system is still the X system. You'll hear a fly fisher telling his buddy he's using 6X, but rarely hear that he's using five one thousandths of an inch—it's so much harder to say—and write!

- Ross Purnell

TIPPET SIZE	DIAMETER IN INCHES	DIAMETER IN MILLIMETERS
7X	0.004	0.10
6X	0.005	0.13
5X	0.006	0.15
4X	0.007	0.18
3X	0.008	0.20
2X	0.009	0.23
1X	0.010	0.25
0X	0.011	0.28

NICK HADDAD - PHOTO

Nick Haddad is the IGFA's angler recognition coordinator. He tested 2X, 4X, and 6X tippet samples on an Instron Model 5543 Tensile Strength machine, measuring the wet strength of each sample five times. The "actual breaking strength" shown in the tables on page 40 is the mean of those five tests.

the weakest, Maxima Ultragreen, broke at 7.74 pounds. The average breaking strength of all the 2X tippets was 10.48 pounds. If we remove Maxima Ultragreen, which seemed like an outlier on the low range when it comes to stated strength, all 20 other spools fell within the IGFA 6-kg (12-pound) tippet class category.

The 4X tippets, which should be 0.007" or 0.18 mm, ranged from 0.17 to 0.20 millimeters and averaged 6.57 pounds in breaking strength. The strongest without regard to diameter was Deceiver X Fluorocarbon at 7.84 pounds.

This specific diameter is where we start to see some crossover in IGFA tippet classes. Just about half (10/21) spools fell in the IGFA 6-pound tippet category (up to 6.61 pounds) while the other half fell in the 8-pound category. This is something to be wary of if you're using 4X tippet and think you might have a chance at a potential IGFA world record.

Finally, the 6X category, which should be 0.005" or 0.13 mm in diameter, ranged from 0.12 to 0.14 millimeters and averaged 3.63 pounds in breaking strength. Of the 21 tippets tested, all but one fell within the IGFA 4-pound tippet category, and that was Stroft FC1 Fluorocarbon at 4.97 pounds breaking strength. The diameter was on par with other brands, but it was simply too strong for the 4-pound category.

NYLON TIPPET IN PARTICULAR IS QUICKLY DEGRADED BY MOISTURE AND UV LIGHT, SO BE PICKY ABOUT WHERE YOU BUY IT. A DISPLAY RACK NEAR THE WINDOW OF A GAS STATION IS LIKELY A BAD PLACE.

So which line is best? Well, it is impossible to judge line performance across all possible scenarios. Maybe you want a strong, thin line to maximize strength while minimizing visibility. Perhaps you need a larger diameter for abrasion resistance and because it makes it easier to turn over the fly on the cast. Or maybe you want the thinnest diameter simply to dead-drift a fly in a stream. Fluorocarbon is denser, heavier, and has a light refractive index closer to water so it may be more difficult to see. Monofilament stretches more and could have a shock-absorbing effect.

The best tippet is not for me to decide, but rather for you to choose from the data provided. Tippet is the last connection between you and your trophy fish, so of course it's all important data, whether you're fishing for a world record or not.

Luckily for Spencer McCormack, he got his second shot and a third shot at an IGFA record fish. On August 6, he caught a 5-pound, 11-ounce smallmouth on Maxima Ultragreen 6-pound line, which broke at 7.46 pounds and set the new IGFA Men's 4-kg (8-pound) tippet class world record. Exactly five days later, he followed it up with a monster 8-pound, 1-ounce smallmouth to defeat his own previous tippet class world record. That smallmouth bass is more than 2 pounds heavier than any other tippet class record smallmouth, and it's one that may likely stay in the books for a very long time.

Nick Haddad grew up and learned to fish in a small town in Pennsylvania. He earned a B.S. in Marine Science & Biology at the University of Tampa, and a master's degree from Louisiana State University. His past research has included analyzing the gut content of invasive pike killifish in Tampa Bay, as well as examining post-harvest procedures in the Louisiana commercial shrimp industry. Haddad has been a fisherman for 20 years. His favorite type of fishing is light-tackle inshore fishing for trout, redfish, snook, and tarpon.

FLUOROCARBON	2X .009"= 0.2286000MM			4X .007"= 0.1778000MM			6X .005"= 0.1270000MM			MSRP M PER SPOOL / $ PER M
	DIA. (MM)	STS (LB)	ATS (LB)	DIA. (MM)	STS (LB)	ATS (LB)	DIA. (MM)	STS (LB)	ATS (LB)	
CORTLAND - ULTRA PREMIUM	0.23	10.90	11.36	0.18	8.40	7.36	0.13	3.90	3.83	$19.95+ 27M / $.74
FROG HAIR - IGFA / CLASS TIPPET	0.25	10.00	10.26	0.20	6.60	6.89	0.14	3.30	3.53	$13.95 27M / $.52
ORVIS - MIRAGE	0.23	8.70	9.95	0.18	5.50	6.33	0.13	3.00	3.27	$14.95 30M / $.50
RIO - FLUOROFLEX PLUS	0.25	12.00	11.56	0.18	7.00	6.56	0.13	3.60	3.46	$14.99 27M / $.56
SCIENTIFIC ANGLERS - ABSOLUTE FLUORO - TROUT	0.23	9.50	9.96	0.19	6.70	6.56	0.13	3.50	3.29	$14.95 30M / $.50
SCIENTIFIC ANGLERS - ABSOLUTE TROUT SUPREME	0.24	10.20	11.71	0.19	7.10	7.52	0.14	3.70	3.83	$29.95 30M / $1.00
STROFT - FCI FLUOROCARBON	0.25	11.00	11.43	0.18	7.00	6.87	0.15	4.00	4.97	$16.45 25M / $.66
TROUTHUNTER - FLUOROCARBON	0.23	10.40	11.24	0.18	7.10	7.31	0.13	3.70	3.75	$24.95 50M / $.50
UMPQUA - DECEIVER X FLUORO	0.22	11.00	10.24	0.20	7.00	7.84	0.14	4.00	4.21	$14.99 27M / $.56
UMPQUA - PHANTOM X FLUORO	0.23	11.00	10.36	0.19	7.20	7.12	0.14	4.00	3.99	$14.99 27M / $.56
VARIVAS - SUPER TIPPET - FLUORO	0.24	9.60	10.17	0.17	5.10	5.12	0.13	3.40	3.94	$16.00 30M / $.53

NYLON	2X .009"= 0.2286000MM			4X .007"= 0.1778000MM			6X .005"= 0.1270000MM			MSRP $ PER M
	DIA. (MM)	STS (LB)	ATS (LB)	DIA. (MM)	STS (LB)	ATS (LB)	DIA. (MM)	STS (LB)	ATS (LB)	
CORTLAND - NYLON TIPPET	0.23	12.90	9.83	0.17	8.40	5.48	0.13	4.20	3.46	$9.95 46M / $.22
FROG HAIR - HIGH PERFORMANCE TIPPET	0.25	11.10	10.88	0.18	6.20	6.94	0.13	3.70	3.69	$7.95 30M / $.27
MAXIMA - ULTRAGREEN	0.25	6.00	7.74	0.19	4.00	4.91	0.14	2.00	2.60	$3.99 25M / $.16
ORVIS - SUPERSTRONG PLUS	0.23	9.80	10.16	0.18	6.00	6.42	0.12	3.30	3.05	$4.95 30M / $.17
RIO - POWERFLEX PLUS	0.23	12.00	10.58	0.18	7.50	7.01	0.13	4.00	4.16	$9.99 45M / $.23
SCIENTIFIC ANGLERS - ABSOLUTE CLEAR - TROUT	0.23	11.20	11.12	0.18	7.40	7.10	0.13	3.50	3.49	$6.99 30M / $.24
STROFT - GTM MONOFILAMENT	0.25	11.00	11.13	0.19	7.00	6.91	0.14	4.00	4.02	$8.45 50M / $.17
TROUTHUNTER - EVO NYLON	0.24	9.90	9.52	0.18	7.30	6.34	0.13	3.50	2.93	$9.95 50M / $.20
UMPQUA - PERFORM X NYLON	0.25	11.00	11.37	0.17	7.00	6.28	0.13	3.50	3.17	$4.99 27M / $.19
VARIVAS - SUPER TIPPET - NYLON	0.23	9.10	9.45	0.17	5.10	5.14	0.13	3.50	3.50	$14.75 50M / $.30

NOTE: Each tippet was soaked in water for two hours and tested a total of five times to calculate the actual tensile breaking strength (ATS) based on the mean. The highlighted brands have the strongest actual tensile breaking strength (ATS) compared to other lines with the same diameter.

- **STS** (LB) = Manufacturer stated tensile breaking strength.
- **ATS** (LB) = Actual tensile breaking strength.
- **MSRP** = Price of a standard spool, and price per meter.

STRONGEST ATS COMPARED TO THE DIAMETER OF THE LINE

IGFA does not officially endorse any product.

INTERPRETING THE RESULTS

The IGFA test as described here determines the tensile breaking strength of the material using a standard methodology. When you peruse the data, you'll see that most manufacturers are fairly close to their advertised breaking strengths—a few are just a little under their advertised strength, many are actually stronger than their stated breaking strength, and there are significant differences between some brands.

You may notice that on average, fluorocarbon is stronger than nylon monofilament. This is a wet test, and nylon is more porous and absorbs water, which can significantly weaken the material. But nylon is limper. It allows your fly to move more freely in the water, so you get better drag-free drifts—whether you are fishing with nymphs or with dry flies. Because it is softer, it knots better and is less prone to knot failure due to slippage. My friend and mentor Lefty Kreh always said "No knot breaks before it slips." And while fluorocarbon is a hard, slick, nonporous material, nylon is naturally "grippier." TroutHunter actually adds an organic coating to their EVO Nylon tippet that enhances this no-slip effect, so that knots stay put once they are seated. (The coating also helps prevent the material from absorbing water.)

Fluorocarbon has a light refractive index closer to that of water, so it has been theorized that it is it less visible to fish.

Knot strength is obviously important when you are fishing, so why didn't we test knot strength? The idea for this story came from Spencer McCormack's experience where he was rejected, and then subsequently earned an IGFA tippet class world record. We recognized that the IGFA is the world leader in testing tippet strength. They have decades of experience with this subject matter, but they usually test just one sample at a time. IGFA agreed to test the breaking strengths of all major brands at one time, using their standards with the same equipment, same methodology, and the same person (Nick Haddad) doing the testing.

We tested 2X, 4X, and 6X material because it was too overwhelming to test 0X through 8X of every brand, and felt that 2X, 4X, and 6X would provide a snapshot of breaking strengths across a range of diameters for different applications.

While fly-fishing consumers still use the X system, we are a long way from the days when women drew silkworm gut through their teeth to produce leaders in increments of a thousandth of an inch. The factories in Japan and Germany that extrude this material can achieve far more exacting metric measurements. They produce monofilaments in diameters of 0.13 mm or 0.15 mm and label it as 6X or 5X, respectively, but this still leaves a great deal of wiggle room.

For instance, lines that are 0.15 mm or 0.16 mm are 0.0059" 0.00629" respectively, and with proper rounding, both are .006" diameter and both could logically qualify as 5X tippet. This is one place where manufacturers can fudge a little, because while 0.15 mm is closest to 5X, 0.16 mm is close enough and will prove stronger. You would expect a line that is a little larger in diameter to have slightly greater tensile strength, and a tiny bit more abrasion resistance, but it would also more likely impede the natural movement of the fly. Manufacturers could also manufacture and label a 4.5X tippet, which is about halfway between 4X and 5X. That's exactly what some manufacturers do. Stroft, TroutHunter, and others have tippet material in half increments in acknowledgment that modern technology is more accurate and exacting than the old "worm through the teeth" trick, but it is hard to see how in actual fishing conditions why you need to carry 4X, 4.5X, and 5X.

No half sizes were tested for this article, but you'll see in the results that not all 2X tippets are true to size. The strongest 2X tippet in any fly fisher's mind should be the tippet that tests strongest, and is also true to diameter. There's no question that a 1.5X or 1X tippet is stronger than a true 2X, so the strongest 2X tippet in any apples-to-apples comparison must be an actual 0.009" or 0.23 mm. A true 4X is 0.007" or 0.18 mm and 6X is 0.005" or 0.13 mm. You will see on the table to the left that we've highlighted (in yellow) the strongest materials in these diameters.

We asked all manufacturers to send new tippet material directly from the factory so we could test the freshest material possible. A bad knot will lose a fish quickly, but a bad spool of tippet is worse, because it will lose many fish. We made sure not to use old material that had been sitting on a retail shelf for a long period of time, and you should do the same.

Nylon tippet in particular is quickly degraded by moisture and UV light, so be picky about where you buy it. A display rack near the window of a gas station is likely a bad place. Most fly shops don't have a vault or darkroom for their tippets, but TroutHunter has solved this issue. Their EVO nylon and fluorocarbon tippets are sold in individual sealed, waterproof, and UV resistant packets so you won't buy a product already damaged by the sun, humidity, or other factors.

The "best" tippet for you may also be the one that dispenses neatly and easily. That saves time, and more time equals more fish. It seems that a decade ago, manufacturers intentionally made poor tippet tenders so you'd waste yards of material and come back for more. Thankfully, modern tippet dispensers are much more thoughtful and economical—an important consideration since fluorocarbon tippet can cost $50 for 100 meters.

Forget the frustrations of those old-fashioned hair ties or elastic dispensers with metal rings. The best tippet tenders today are silicone or rubber and they fit snugly to protect the tippet from UV light and moisture. Since you'll most likely be locking the spools together, you need tippet tenders that are at the very least color coded. It's more practical and convenient to have the tippet size printed right on the silicone tippet tender the way both Scientific Anglers and Umpqua do it. You should also be able to easily pull the tender away from the spool in case you lose the end—both SA and Umpqua tippet tenders have large pull tabs.

- Ross Purnell