

AXLE KNOWLEDGE



disc hub and the rear wheel hubs. Beam deflection is the bending of an element, like an axle, by applying some linear force, up, down, forward, back, or any combination, perpendicular to the length. By varying the steel alloy, the heat-treat tempering, and the wall thickness of each axle, they can deliver axles with a wide range of flexibilities, both torsionally and in beam deflection.

For most karters, the torsional stiffness of their axle is of little concern. The higher speed and higher weight machines might sense some improved stability under braking with a stiffer axle, but in most cases it will be undetectable. Beam Deflection, however, can be part of every chassis tuners bag of tricks. John Kozubik of

Today's axles offer endless tuning opportunities

By John Copeland, Fox Valley Karts

T There was a time when kart axles were pretty much all the same. Initially 1" in diameter and solid, axles eventually evolved into 1 1/4" and then, briefly, 1 3/8" tubular materials. The gains in torsional stiffness and flex control took advantage of emerging tire technology and opened the door for tire manufacturers to develop tires with even greater performance capability.

Since then, axles have not only continued to get larger, 40mm and now 50mm, but an entire subset of axles has emerged. Axles are available labeled "Hard," "Medium," "Soft," "Extra Soft," and "Extreme Soft." Couple that with Short, Medium, and Long rear hubs and you have 15 different combinations to try, each with its own performance characteristics. For the less experienced tuner, it can be a bewildering process. Let's look at each factor and how they affect chassis performance.

Axle manufacturers can tailor the dimensions and materials of their axles to provide a wide range of characteristics. The 2 biggest concerns to the tuner are torsional stiffness and beam deflection. Torsional stiffness is defined as the resistance of some element, in this case a tubular axle, to twisting between any 2 points along its length. In a karting context, it is the force required, for example, to twist the axle under braking between the brake

Kart Warehouse reminds us that the driver and engine on a kart are the "sprung weight" and represent the majority of the mass that goes across the scales. How that "sprung weight" puts leverage on the chassis and how the chassis responds to it is what determines how the kart handles. Let's imagine, for example, that you are entering a medium-speed right-hand corner. As you turn the steering to the right the caster and other front-

Beam Deflection:

The bending which a beam undergoes from pressure forcing the beam downward.



Size Comparison:

40mm and 50 mm axle ends illustrate the differences in diameter.

Photo by Ken Johnson

Torsion: A twisting action applied to an axle where each end has pressure going opposite directions.

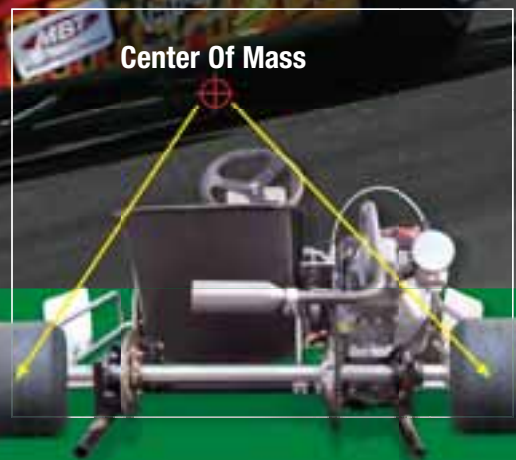
end geometry jacks weight to the left rear corner of the kart. Some of that force wants to "roll" the chassis to the left, putting a great deal of pressure on the left rear tire as it compresses on the track surface. The softer the axle is the more of that force gets absorbed in axle beam deflection. This lets the right rear tire unload even more without overloading the right rear. This makes the kart "looser" in the back and induces more oversteer. Conversely, a stiffer rear axle absorbs less of the beam deflection force and transmits more force to the left rear, making it "bite" more, making the kart "tighter" with less oversteer.

But, hey, doesn't this do exactly the same thing as moving the rear wheels in and out? Well, sort of. Moving the rear wheels in and out does change the nature of the understeer/oversteer equation, but in a different way.

Moving the rear wheels out changes the angle that the force from the chassis exerts on the contact patch of the tire without changing the amount of that force. Changing the axle stiffness increases or decreases that force without changing the angle of the force. The results are similar, but the feel is entirely different. Some drivers describe the change in axle stiffness as more "transitional." Changing from a harder to a softer axle may help the kart rotate into the turn with less understeer while not sacrificing grip from the middle of the turn to the exit. In contrast, widening the rear track, while it might help initial rotation, reduces grip throughout the turn and might induce oversteer. Mark Dismore Jr. describes it this way:

"Adjust the rear width to get the kart to feel the way you want, then use axle stiffness and hub length to get the level of grip you need." It's a tricky balancing act, but the dedicated and well-prepared tuner can get the best from using both adjustments.

One more thing about axles: what's better, 40mm or 50mm? That's the subject of plenty of debate. Lots of chassis manufacturers and their dealers will tell you that 50mm axles are dramatically better than 40s. Certainly there are karters out there winning at the



Center Of Mass: The weight of the driver exerts force at the ends of the axle (the tires) during cornering.

▶ OVERSTEER

- > After the initial turn in, the kart over rotates.
- > Also known as Loose.
- > Happens at mid corner to corner exit.

CAUSE::

Not enough rear grip or too much front grip.

UNDERSTEER

- > When turning the steering wheel, the kart wants to go straight ahead
- > Also known as Push.
- > Happens at mid corner to corner exit.

CAUSE::

Not enough front grip or too much rear grip.

you can change the effective axle stiffness by moving the hub in or out. Moving the hub in makes the axle effectively shorter and, thus, stiffer. Moving out makes the axle effectively longer and softer. But what if you want to stiffen the axle slightly without changing the rear width? What if you like the way the rear end transitions between grip and breakaway but you want to move that point a little more towards the grip side of the equation? Changing to a longer rear hub shortens the distance between the bearing and the hub, making that part of the axle effectively stiffer, without changing the location of the contact patch of the tire and the resulting force angle acting on it. Pretty nifty, huh?

Finally, a word about axle materials; right now WKA mandates that axles be made of steel alloys. And as we said, most manufacturers produce axles of varying stiffness by adjusting the alloy, temper, or wall thickness of the tubes. But at least one manufacturer is using thin-wall tube axles with changeable inserts to adjust the stiffness. Another manufacturer is promoting carbon fiber composite axles using the same insert approach to change stiffness. Be sure to check with your local sanctioning body to make sure you don't invest in an axle (or axles) that you can't legally run.

Properly used, different axle stiffness and different rear hub lengths can be another valuable tuning tool for the karter intent on getting the most out their set-up. But, as with so many things, just buying the pieces and trying them "on the fly" won't get you very far. The best approach is to devote plenty of dedicated testing time to learn what each change does. You won't get that kind of time on a race weekend. You'll have to get out there by yourself when you can commit enough hours to learning what these tools can do for you. Once you have a grip on how each change affects your kart's handling, then you can use them on race weekends to put your very best package on the grid. See you next time.

NKN

highest levels with 50mm axles, but are they winning because of the 50mm axles, or would they be winning anyway because they are on the latest and greatest rides? From a materials standpoint, it shouldn't matter if the axle is 40mm or 50mm. There are tiny torsional stiffness increases in a 50mm tube versus a 40mm tube of the same wall thickness, alloy and temper. And, again from a materials standpoint, there isn't anything in beam deflection stiffness that the manufacturers can do with a 50mm axle that they can't do with a 40mm one. Experienced racers have reported that the larger axles ride a bit smoother, particularly over bumps. Most likely the 40mm vs. 50mm debate is like necktie widths or skirt lengths. It's hot, it's trendy, and it sells more new karts. That's not to say that the new karts, with their 50mm axles, aren't better than the older karts. Improving technology and development makes everything better, including karts. But it may be that the 50mm axles are not what make them better.

Hub Sizes:

Rear hubs come in short, medium, and long sizes and can be a valuable tuning tool.



Earlier we mentioned rear hub lengths as a tuning tool related to axle stiffness. How does that work? If you think about the axle being able to deflect between the bearing and the point where it is encased in the hub, then you see that

MOUNT IT

- NON-BINDING
- FULLY ADJUSTABLE
- RUBBER SHOCK MOUNT
- SUPER STRONG
- ANODIZED FINISH

ROTAX PIPE MOUNT

ICC SILENCER MOUNT

THE ORIGINALS & STILL THE BEST

PROSPEED COMPONENTS

PH 508:399.5377 FAX 508:399.8313

view our dealer list at www.PROSPEEDKARTSPORTS.com