Bushing Alternatives

Rubber

Rubber is actually a great all-around bushing material. It can support all kinds of joints, from single axis pivots to complex multi-axis joints without binding or extra stress on the suspension arms and pickup points. It's moderately damped so NVH is minimal. And they have long maintenance intervals. Rubber bushings get harder as they get older, so on a performance oriented car you can basically just keep running them until they start to tear or crack (sounds funny, but I'm dead serious).

The downside is that the only way to get compliance out of rubber bushings is either by using a softer rubber or by building voids / indentations into the material. This means that the rubber joint is never going to be as stiff as the other types in the directions that you want it to be stiff. Rubber bushings also require more care during installation and when torquing them down. Rubber insert bushings tend to be round, but they almost always need to be oriented a specific way for them to work properly (yes, those tiny 2 mm gaps do serve a purpose). You also need to make sure that the joint is in a neutral position (in the middle of its normal travel) before you torque them down. So for suspension bushings, for example, you need to lower the car on the ground (or on ramps) with the weight of the car on them before you torque them down.

Despite all this, I like hard rubber bushings for street / dual duty cars. If they're available, I always look at them before looking at any other bushing material.

Polyurethane

The ubiquitous polyurethane bushing is often a good replacement for stock rubber joints, but it isn't the cure-all bushing that some bushing manufacturers might lead you to believe. Poly does well in joints which operate primarily on a single axis. It can also support some movement on one or two secondary axes as well. The material is generally stiffly sprung and stiffly damped, so while there's less compliance in the joints, there's also very little NVH absorbtion.

As you probably already know, the major drawbacks to using poly bushings are the stiction issues from a lack of lubrication and binding from trying to make the joint work on too many axes. Polyurethane

bushings need to be well lubricated so they can freely rotate inside their sleeves. Brand new poly bushings come with a teflon coating, but once that wears off it exposes a grainy, sticky surface that doesn't slide smoothly against metal. This happens with both the regular and graphite impregnated black bushings. While regularly greasing the joints helps, a more elegant solution (devised by the brilliant guys here at MotoIQ) is to put a thin layer of teflon tape between any surface where polyurethane and metal meet. Even then, you should clean and grease the joints every so often to keep them rotating smoothly.

I think the biggest problem with polyurethane bushings is that people try to use them in places where they don't work well. First example that comes to my mind are those aftermarket bushing kits for damper top mounts. Energy Suspension sells polyurethane bushing kits that replace the rubber bushings that connect the top hat to the damper shaft. Problem is, those joints need to rotate, swivel, and squish as the suspension goes through its range of travel - and poly bushings don't do all three at the same time. What ends up happening is that those forces are transmitted directly to the relatively delicate damper shaft and end up bending your nice expensive dampers. For those types of joints, you'll want to stick with rubber or go to a spherical bearing.

As long as you occasionally maintain them and are careful with what joints you install them in, polyurethane is a good compromise for both street and track cars.

Delrin

Delrin is a bit of a specialized bushing material - On cars, you can really only use it in joints which rotate on one axis. Delrin is an extremely rigid material. It's so hard it's literally on a different hardness scale from rubber or poly. Yet its threshold of plastic deformation is so low that if you manage to bend or dent it in any measurable way, it won't spring back - it'll just stay dented. Delrin is also unique in this crowd as it's self-lubricating. This means you don't have to keep regreasing them as you would a poly bushing, nor do you have to replace them as often as any of the other bushing materials here.

These characteristics make the stuff great for pivots that only need to rotate on one axis. Good places to use Delrin would be in control arm pivots on a double A-arm car (e.g. Miatas) and the shifter pivot bushings on cars with cable shifters. Just make sure that the joint

really does operate on one axis before you install them. Don't, for example, put any Delrin at the front end of any double A-arm Honda. All of the joints in those setups operate on at least two axes (many of which are designed for high misalignment), and it will gouge the hell out of your nice new bushings.

Although you don't need to do it often, regular maintenance is crucial with Delrin bushings. Delrin joints need to be periodically disassembled and cleaned (once a year or so). The reason is that moisture tends to get trapped between the Delrin and the metal sleeves and you get surface rust between the two. This causes the metal to stick to the bushing, which, if left alone, will cause the joint to seize. Sanding all of the surface rust and lightly coating the bushings with marine grease helps fend this off, but this is something you do need to stay on top of.

Between the maintenance and the NVH (which will be transmitted right through the bushing), you probably won't want to install Delrin suspension bushings on your street car. On a track car / race car though, it's a great material that, if used in the right places, works better than polyurethane and saves you a ton of money over spherical joints.

To expand upon this slightly. Delrin is also hygroscopic. It absorbs moisture, and when it does, it swells up. Whatever tolerance you had before it got wet will change. So if you had, let's say .002" of clearance between the delrin bushing and the inner pivot sleeve when dry, you might end up with zero clearance when the bushing gets wet. At that point, the bushing will bind and will often delaminate/crumble from the stresses.

For this reason and for reasons of self-lubricity, I prefer 'Delrin AF' (teflon impregnated) for situations where moisture might be an issue, such as suspension bushings on racecars in the northeast where rain is a reality. I've also noticed that the AF variety does not cold-flow as badly as regular delrin.

Spherical / Metal Bearings

If performance is what you're after, metal bearings are the hot ticket. They're only compliant in the directions you need them to be, they're easy to access, and easy to maintain. NVH absorbtion is nonexistant, but race cars sound like rattlecans on the inside anyway. You won't notice.

What you will notice is that they are EXPENSIVE. Converting a production car to all spherical joints can easily cost 2000~10,000+ USD depending on the chassis. The joints don't need to be greased, but they need to be protected from dirt/water and cleaned on a regular basis. And when they start to show any signs of wear, they have to be replaced. As you might expect, this gets very expensive in the long run, but it has to be done. Even the best spherical bearings on the market have a finite service life, and you don't want to exceed them.

Don't let this deter you from getting metal-on-metal bearings for your car though. In joints that do a lot of swiveling or need to operate under low friction conditions, metal-on-metal bearings make a lot of sense. Those strut top mounts and Honda front radius rod bushings that didn't work well in polyurethane are both excellent candidates for spherical bearing conversions. Just make sure that you buy a few replacement bearings so you can replace them as soon as they start clunking or start showing signs of failure.