**Chapter 14: Tips, Details, and Background**

**Ackerman –** Also called the Ackerman Principal, is the science of making the front wheels of a vehicle steer at different angles to reduce rolling friction. (*More complete explanations are available online.*) When a vehicle is going around a corner, the inside wheel is traversing a smaller circle than the outside wheel. Therefore, the inside wheel must turn more sharply. If you use the exact dimensions in the drawings of the Pittman arm and spindles, the Ackerman angles are preset for cars with a 58 to 60-inch wheelbase.

**Caster and Camber** – Caster is the angle that the kingpin leans forward (negative) or back (positive) when viewed from the side. Positive caster helps the car want to go straight ahead. Camber is the angle that the kingpins lean inward (negative) or outward (positive) when viewed from in front of or behind the vehicle. The Silver Bullet cars are built with 7 degrees positive caster to aid steering and 7 degrees of negative camber to reduce strain on the spokes.

**Gear Ratio** – Calculating the optimum gear ratios for various tracks can be a mystery for beginners. The wrong ratio can cause your car to not have enough speed to keep up with the others in your class (too low) or run your batteries down faster than expected (too high). The best way is if you have some idea what your fastest speed will be on any track and then work backwards from there using wheel RPMs. Ask other teams if they have run that track before and, if so, what was their terminal speed on the longest straightaway. Calculate the wheel RPM to go that speed and then divide the wheel RPM into the maximum RPM of the motor. The answer to that will be the gear ratio you need. Pick the sprocket that will get you closest to that ratio.

**Spoke Wheels, good or bad?** - There is an ongoing disagreement between the teams who use spoke wheels and those who use cast “Mag” wheels. Everyone hates having to replace broken spokes. Back in my second season in Electrathon I was still using wheels from my local bike shop. They had ordinary 14-gauge spokes. Every race I was replacing multiple spokes. I once broke 9 spokes in one wheel and it was wobbling so bad that I was black flagged. Finally, I switched to 12-gauge spokes. I still use them and I still have a broken spoke occasionally, but it’s never more than 1 or 2 and usually after several races on that wheel. Spokes are about a dollar apiece. A broken cast wheel is usually in the range of $100 and they usually give no warning that they are about to break.

**Lacing Spoke Wheels** – Unless you have a bicycle shop as a team sponsor who will lace wheels for you for free, it will behoove you to learn how to lace wheels. There are numerous tutorials on YouTube that show how it’s done. Even if you have a benevolent bicycle shop, most of them won’t lace your wheels with 12-gauge spokes. Why not? Because using the heavier spokes requires that the holes on the hub and rim be enlarged and that will “void the warranty”. I have also experimented with 10-gauge spokes, but some hubs don’t have enough material to safely drill the holes out that big.

**Welding EMT Conduit** – One of the questions/comments that I get frequently concerns welding the thin wall tubing. How do I weld this stuff without blowing massive holes in it? The trick to welding thin material is *not* running a continuous bead. I weld the frames together using overlapping stich welds. I use a MIG welder with flux core wire instead of gas shielded MIG. I have tried both.

**WARNING – Do not breathe the fumes from welding galvanized material.**

**Who is Jim Robinson and what does he know about racing?**

Jim Robinson is a retired Technology Education teacher with a lengthy background in various types of racing. He began racing in go-karts in 1961 when he was 13 years old. He has been involved in some type of racing ever since. He built his first stock car in 1969 while he was attending Indiana State University, majoring in Technology Education. He raced stock cars, on and off for 35 years with an occasional foray into drag racing. He has been a driver, a mechanic, a designer, a builder / fabricator, and sometimes just a pit crewman. He is an experienced welder and machinist. Jim and his family relocated from Indiana to Florida in 1980.

Jim got involved with Electrathon in 2002 while teaching Engineering Technology at Astronaut High School in Titusville, Florida. The on-track success of Jim’s “Silver Bullet” Electrathon cars led Florida Power and Light, in 2023, to tap them as the car they wanted to use to recruit high school racing teams. With Jim’s blessing, FPL has had 25 frames built and car kits developed. So far (at this writing) they have recruited 25 new teams. Besides Electrathon cars, Jim also builds hot rods. He is currently the Florida Board Member to Electrathon America and says he might have “a few years left” before he retires completely from Electrathon racing.