KITCAR- CHAPTER THREE

TIRES, WHEELS, and BRAKES

It seems to your author that many people think that the chassis starts with the framerails and works outward. It does not. It starts with the tires and wheels and works inward. Think about what we have previously learned about givens and blanks. The overall tire size is specific to the car but we have some flexibility in locating framerails. This is a rare case where flexibility and framerails may be used in the same sentence.

As a matter of fact, tires and wheels are our very first given. It also seems to your author that there are a number of forum postings that a build is "Complete except for finding some tires and wheels". How was the suspension designed? What is the ride height? What do the fenderwell offsets and clearances look like? What is the wheel offset, will the wheels they find make the tire stick out of the fenderwell or is it swallowed by it? Does it need longer or shorter suspension arms to compensate? They are an important first element and warrant extensive detailed discussion rather than to be relegated to an afterthought.

So what do we know? On a Countach the front wheel was 15x8 and the tire was a 205-50-15, making for an overall width of about 8 ½ inches and a relatively short overall height of just over 23 inches. The rear was 15x12 with a 345-35-15 making an overall width of 13 ½ inches and again a relatively short overall height of just over 24 ½ inches. This is the overall size that we need to make it look right with the body. We can increase it slightly but need to be cautious about fender rub and footbox clearance.

Research on wheel selection has produced several interesting items. First it should be no surprise that the stock wheel or any copy of it is expensive, if even available at all. This is not really a problem as remember the intention of the build was to update the look. In searching for a wheel that advanced the design while still retaining the iconic five-hole pattern, the "Oval" design by Centerline Wheel was discovered. It fits the bill perfectly, at least aesthetically. Luis Sanchez is the National Sales Manager and the man to see at Centerline.

Second, whether it is Centerline or another manufacturer, the stock sizes are a maximum of 9 ½ inches wide. Beyond this the availability goes way down and the price goes way up. A quick reference of the tire charts at discounttire.com shows a similar problem for tires. The only available wide tire is the Pirelli, which originally came on the Countach, at a price of $689 each. On the other hand, there are a number of choices in the $150 range for an 11 inch wide tire that fits nicely on the 9 ½ inch wide rim. That extra 2 ½ inches of rear tire is a several thousand dollar proposition, or put another way almost 8% of our total projected budget. 11 inches is plenty fat and suddenly looks even fatter, and our first tire and wheel decision is made.

The next decision is wheel height. In keeping with our theme of upgrading, we want a wheel that is a larger diameter than the dated looking 15 inch, but not so tall that the tires look like rubber bands on them. This is a difficult balance considering again the short overall height of the tires. By much trial and error on discounttire.com, we have arrived at 18 inch tall wheels with 215-35-18 tires on the front and

275-35-18 for the rear. That makes the overall height of the front about ½ inch taller than original and the rear almost an inch taller, but keeps the proportions correct and is within our perceived allowable size difference. The 18 inch wheel should do nicely esthetically and the tire sidewall size gives the desired proportion. We have several choices of tire brand in this size and the prices are agreeable. We are going to stick with Goodyear because Chad Fletcher, their Nascar Account Manager, can help us with this.

As a fringe benefit the desired width front tire is recommended for a 7 inch wide rim instead of 8. 7 is 87% of 8 and 9 ½ is 80% of 12, thus our proportion of width stays reasonably consistent. We have now sized the tires and the wheel height and width. The only thing left is the wheel offset and if it was not confusing enough already, this gets complicated.

We need to know several things to begin with here, especially exact definitions. Offset is a term used to describe the relation of the inside wheel face (where the hub bolts) to the centerline of the wheel. Inset is when the mounting face is outboard of the centerline and outset is when it is inboard. Now here is when it gets confusing. Backspace is another term used to describe this relationship. It is more commonly used by wheel manufacturers and it is determined by laying a wheel flat on it's back and measuring up to the mounting face. You would think that an 8 inch wheel with zero offset would have a 4 inch backspacing. It does not. The 8 inch reference is to the width of the tire mounting surface and does not take into account the wheel bead or lip which most wheel manufacturers, including Centerline, have standardized at ½ inch. Thus an 8 inch wheel is actually 9 inches in overall width, and when backspacing is measured on 8 inch wheel with zero offset, it is actually 4 ½ inches.

Two other required definitions are track and hubface. Track is the distance from the centerline of the tire and wheel to the opposite centerline as measured across the axle. Hubface is the distance from mounting face to mounting face across the axle. Track is fixed where hubface can be adjusted with wheel backspacing, or even wheel spacers, but those things are a despicable band aid so let us get our geometry right the first time.

Did we just say that track was fixed? Let us consider something. The rear track at 63 inches makes the 12 inch wheels look correct in the wheelwell, but we have decided to use 9 ½ inch wheels. We want the outside face of the tire and wheel to remain in the same position and the difference to be taken from the inside, otherwise the wheelwell would swallow the tire. In order to do this we need to increase the track to 65 ½ inches.

Now, knowing that the 18x9 ½ wheel is available in 4 ½, 5, 5 ½, 6, 6 ½, and 7 backspacing, we can determine that our hubface can be anywhere between 61 ½ inches and 66 ½ inches. Do not make the classic mistake of not taking the ½ inch lip off of the backspacing when using it to determine offset! Offset is the dimension you need to relate it to track and you have to convert apples to oranges. We told you it got complicated. Maybe graph paper is better than a calculator here. Typically we would want a shallow backspacing on the rear to give the appearance of a massively deep rear wheel. In our circumstance where we have made the wheel thinner, so we would especially want a hubface closer to the 61 ½ dimension to give the illusion of a fatter tire and wheel.

Before we make a final determination on the rear backspacing, let us consider the front. We went from 8 inch wide wheels to 7 inch wide ones so we need to adjust our track from 60 ½ inches to 61 ½ inches. This is for the same reason, to make them look correct in the wheelwell. Now, knowing that the 18x7 wheel is available in 3 ½, 4, 4 ½, and 5 inch offset, we can determine that our front track can be anywhere between 60 ½ inches and 63 ½ inches.

The front hubface wants to be as wide as possible, opposite from the back. There are several reasons. First, an important design consideration on the steering tires is called the scrub radius. It is determined by drawing a line down to the ground plane through the centerline of the tire. Then a second line is drawn from the upper ball joint through the lower one and further extended to the ground plane. The distance these two lines are apart at the ground plane is the scrub. It should be kept to a minimum and a deep offset helps this.

Second it puts the brake caliper and rotor inside the wheel and it just looks better. Be aware that there is a possible downside of excessive offset, and that is bearing failure. However, using the offsets made by Centerline and without the dreaded spacers, we should be fine. Third, by making our front wheel a deep backspacing and our rear a shallow one, we can improve on the illusion of a fatter rear tire.

Now that we have backspacing narrowed down, let us consider another influencing factor. If the front and rear hubface can be the same width, possibly we can use the same suspension arms on the front and rear. Standardization of parts is a sound economic principle. As a bonus, if the mounting points on the chassis for the arms are at the same location front and rear, the roll centers are much easier to visualize and predict. There will be much more about this later. For now let us just be aware that what we decide now may have a great impact on this later. With this in mind, the overlap in the front and rear hubface is from 61 ½ to 63 ½ inches and we can narrow our backspacing to this. Not a bad piece of crossword work but let us not make a final determination until we get deeper into the suspension component design.

Moving inward from there, let us address the brakes. They do not have much influence on chassis design but they influence the suspension components which greatly influence the chassis design. After much research, we can make some observations and categorize the potential candidates.

Our first observation is that there is a huge range of performance, pricing, and selection here. Keeping with our theme of not gold plated but correct, some tough choices are going to have to be made. This could easily eat up 20% of our budget if we let it. Let us eliminate the exotics and the six piston stuff as just not necessary. Even though we are expecting a respectable horsepower, we are also expecting a relative light weight which should help our requirements.

Let us also eliminate the Corvette stuff for the same expense reasons that the other suspension parts were nixed. There is also a second reason, and that is that they do not have a combined mechanical parking brake. Instead a separate drum brake is used and that item alone is over $600 per set. A third problem is the ABS system and the computer and pedal needed for it to function correctly. Let us keep

it low tech and focus our search on systems with a built-in parking brake and sufficient performance for the price.

That narrows it to two. One of them is the G.M. “metric” brakes. They are used extensively in street rods and racecars and therefore readily available. Because of their popularity, different hubs and hardware is also readily available. They have a parking brake and the price is right, but they have some drawbacks. They are on the edge of our performance requirements and the calipers are ugly castings rather than pretty billet pieces showing through our polished Centerline wheels. That may seem petty but it is not our concept of a correct car. The final straw is the fact that these brakes were designed for 15 inch wheels and when that rotor goes into our 18 inch wheels, it looks like a go-kart brake.

Let us make an educated decision to spend a little more money, go to our buddies at Wilwood, and solve all of our brake dilemmas in a one stop shop. Jason Aquino, the Wilwood Technical Consultant at the factory, can answer any questions. We use their brakes in Nascar but that sophisticated a system is just not needed. Their Combined Parking Brake Caliper with a Forged Billet Dynalite Caliper for the front solves our problems and meets our needs. This is the combination that Wilwood recommends for Mustang replacement brakes as well as kitcar and Cobra applications. That should make it adequate for our power and weight combination. It has eliminated the expense and effort of a separate parking brake and drum, and more good news, the cable actuated system works with standard cable ends, such as are found on the Lokar emergency brake system. More on that later but for now know that our systems are compatible and we will have no expense later making them work together.

The billet calipers are available in red powder coat, giving the desired visual effect, and the price is acceptable. To finish our brake selection we need to now determine a disc diameter and width, and a disc hat offset. We know from Centerline that we have about 15 inches inside the 18 inch wheel for brake clearance. We know from the Wilwood chart that the Dynalite Caliper can be used with up to a 12.19 disc diameter which requires right at 7 inches of radius to clear the caliper. Using this diameter disc we have about ½ inch of clearance between the wheel and the caliper, just what we wanted to fill up the wheel and make the brakes look proportionally correct.

According to the Wilwood chart, the rear caliper may be used with up to a 13 inch rotor diameter, including the 12.19. Quick calculations determine that anything over the 12.19 is too big to fit in the 18 inch wheel, so let us settle on 12.19 front and rear. The two calipers may be made to accept either a .81 or a 1.00 inch rotor width. When we examine the rotor selection, and eliminate all of the exotics, we find that our only option for this diameter is .81. There we have it, 12.19x.81 rotors front and rear, again economy of design.

The final step is determining the hat offset. The hat connects the rotor to the wheel hub and determines the alignment of the rotor in relation to the centerline of the tire. We know from Centerline that the wheel dishes in 1.375 inches from the face and we know from Wilwood that the brake calipers are 1.71 inches and 1.58 inches wide outboard of the rotor, therefore we need a hat at least .335 inches deep. We find one at .88 inches which works nicely. This leaves .545, or ½ inch of clearance, between the wheel and caliper, and our brakes are done.

There is another benefit from using Wilwood brakes. Their pedal assembly and master cylinders, both industry standards, are designed to complete the system. They are on every Nascar car that we have built as well as the three Cobras. A totally compatible complete system is a rare design luxury and we will take advantage of it. It also does not hurt that the price is reasonable and the installation simple. The engineers at Wilwood will help you pick exact cylinder bore sizes and brake system designs for your particular application. If someone more knowledgeable can fill out part of our crossword puzzle, let them!

And now a final thought for this chapter. We have selected our tires, wheels, and brakes but notice that we have not yet given any part numbers, purchased them, or added their cost to our ledger. That is because we are a long way from needing them for the build. Our current goal is to acquire enough design data to continue on with the chassis, which we have just done. Whether we want straight or directional vanes on our rotors is not an issue now, but it may be later. Let us delay ordering them until just before we need them so that any future design considerations which may influence this can be considered. It is inevitable on a project like this that parts will be ordered which do not find their way onto the final build, but this strategy will keep that to a minimum.

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