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AN ENGINEER'S PERSPECTIVE

by *Chuck Aulgur*

Aluminum wheels normally used in single applications were discussed at a recent GMC Motorhome gathering. When they are mounted on the front of a GMC Motorhome, they will widen the track to about the same width as the rear track. I believe this could cause a serious safety problem that should be brought to the attention of all GMC Motorhome owners. Also, there are several other items relating to GMC Motorhome safety that I feel, as an engineer, should be mentioned.

One of the wheels being put on the front of the GMC Motorhome is a new Alcoa light-truck wheel that is designed for single applications. It has similar construction to the popular Alcoa Classic wheel that is designed for dual applications, including the half-dual application on the GMC Motorhome. The difference between the wheels is significant. The single wheel has 0.250 inches inset, and the half-dual wheel has 4.530 inches. The original half-dual steel wheel has an inset of 4.675 inches. Wheel inset is the distance from the hub mounting face to the center of the rim.

The centerline of the front-wheel bearing set is 4.264 inches inboard from this same hub mounting face. The centerline of the front tire on an original half-dual steel wheel is 0.411 inches inboard of the centerline of the front-wheel bearing set (4.675 - 4.264 inches). This offset causes the inner bearing to carry a major portion of the static wheel load.

When a new single wheel is installed, the center line of the front tire is now 4.014 inches outboard from the center of the front wheel bearing set (4.264 - 0.250). This positions the front tire approximately in line with the rear tires.

Some people think that lining up the front tires with the rear tires would improve the "Wiggle Wagon" phenomenon encountered when driving on a rutted highway with radial tires. I'm sure it would; however, it is my opinion that making just this wheel change will cause a serious safety problem, which may be a front wheel coming off the motorhome at highway speeds.

Doing a simple static load balance calculation, with a front steel wheel loaded to the maximum specified limit of 2,680 pounds, shows that the inner bearing carries 93 percent of the load, or 2,490 pounds. The outer bearing carries only 7 percent, or 190 pounds. Both of these loads are pushing up on the bearings.

When the 0.250-inch inset wheel is installed and loaded with the same 2,680-pound load, each bearing carries an equal load of 11,190 pounds! The outer bearing is being pushed up and the inner bearing is being pushed down, because the wheel load is now cantilevered from the bearing set. This is a 450 percent increase in bearing loads, which are already at their maximum load carrying capacity. If a GMC Motorhome with these wheels were going down a road and hit a large pothole, the loads on the front-wheel bearings and the steering knuckle would increase even more. If the motorhome was braking hard when this happened, the knuckle would probably fail and the front wheel would come off. This cantilevered load would also cause a tremendous increase in the loads on the upper and lower control arms, upper and lower ball joints, tie rod ends and all other steering and front-end components.

The front end of a vehicle is designed so that an imaginary line drawn through the upper and lower ball joints (steering axis inclination) intersects a line through the center of the tire, near the point where the center of the tire contacts the road. This time-honored design is what makes a vehicle go straight down the road with almost no steering input. Moving the front wheels out 4.014 inches on both sides totally destroys the critical relationship between steering axis inclination, caster angle and camber angle.

On a related matter, some have suggested that aluminum wheels degrade braking performance on GMC Motorhomes. That defies logic. Aluminum conducts heat approximately 4.75 times

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