BULK TRANSPORTER

Power Center Steering System Promises Less Driver Fatigue

Bulk Transporter
Wed, 1997-10-01 12:00

DRIVING is becoming less fatiguing for drivers at Coastal Transport, a tank truck carrier based in San Antonio, Texas. New longhaul tractors are being specified with the Howard Power Center Steering System.

Coastal has been testing the system for the past four years, and managers report virtually no problems once drivers catch on to the way power centering performs. The test units on the Coastal tractors have accumulated millions of miles in over-the-road longhaul operations with no major problems or failures.

"We've heard a lot of talk about the need to reduce driver fatigue, but not enough action is being taken," says Rich Atwell, Coastal Transport chairman. "The Power Center system is a positive step forward, and we believe tractor manufacturers should offer it as a factory-installed option."

Initial driver nervousness has been the only real problem with the system, according to Grady Purtle, Coastal vice-president of safety. Generally, it takes two to three hours for a driver to learn how to adjust the system and begin to feel comfortable with the way it performs.

Heavy Truck Market The Power Center Steering System was developed by Dee Howard, and production began in 1992. Over 2,000 vehicles have been fitted with the system. While recreational vehicle owners have been the primary customers to date, Howard believes the system is ideal for heavy trucks.

Currently sold as an aftermarket add-on, the Power Center Steering System costs about $2,000 and takes approximately half a day to install. It works in conjunction with a truck's power steering to improve directional stability.

Achieving heavy vehicle directional stability has eluded designers since the first heavy-duty truck rolled down the road, according to Howard. He defines directional stability as "a tendency of a vehicle to remain in a steady state under the influence of destablilizing forces or to return to that state when momentarily disturbed from it."

Controlling a heavy vehicle that is lacking in directional stability places an undue burden on the vehicle operator. Keeping a heavy truck rolling straight is no easy task. It is a significant factor in the driving fatigue problem, Howard says.

The conventional method of dealing with the lack of directional stability has been to make the steering components more user friendly. Steering problems were made more manageable. However, it was still solely up to the driver to provide directional stability.

Excellent progress in automobile directional stability has been achieved through improved tire technology. Unfortunately, similar achievements are not possible with heavy truck tires, according to Howard. The load-to-tire-width ratio of heavy truck tires makes it impossible to achieve the same benefits as with automobile tires.

Steering Geometry A number of factors contribute to the tendency of a heavy vehicle to wander while in motion. Steering geometry is one. "It is mistakenly believed that slanting the kingpin (referred to as caster angle) is the best method for dealing with heavy vehicle directional stability problems," Howard says. "However, this is not the way it works out. As road conditions change, castering the steered wheels creates an opposite effect."

One of the main benefits of caster angle is to help steered wheels return to center after turning a corner. As the steered wheels reach the on-center position, the centering force reverses from right-to-left and left-to-right, resulting in weak and

indecisive steered wheel centering.

Where positive directional control is needed most-in the straight-ahead position-it is the least effective and contributes very little to directional stability, Howard says. Additionally, with each degree of positive caster angle, there is an increase in caster offset that has a destabilizing effect on heavy vehicle steering as road conditions change.

Caster offset is the distance from a line drawn through the kingpin (pivot point) and the center of where the tire contacts the road. Because the contact point of the tire trails the pivot line of the castered wheels, side forces such as crosswinds and the gravitational pull on a slanted road cause the steered wheels to turn in the direction that force is being applied.

For this same reason, caster offset allows a vehicle to freely turn to the low side on a slanted or crowned highway, creating "steering wheel pull" that requires counteractive driver steering input to keep the vehicle from leaving the road. One only has to consider the many millions of miles driven on crowned and slanted highways each year to appreciate the amount of driving fatigue that is directly caused by caster offset, Howard says.

However, the most fatiguing aspect of driving a heavy truck is controlling the crosswind steering input. The amount of adverse steering input caused by crosswinds is directly related to the amount of caster offset.

"It's a classic example of trading good for bad," Howard says. "The small amount of stability gained from castering the steering wheels on a nonwindy day is paid for many times over when driving in a crosswind."

Power steering helps optimize driver controllability. However, it is not the design function of power steering to make heavy vehicles directionally stable, according to Howard. Power steering plays only a secondary role in heavy vehicle directional stability.

The power assist function of the steering gear becomes active when steering input reaches a predetermined level. When driver steering input is released, the power assist is no longer active and allows free return to the direction determined by the castering effect of the steered wheels.

Steering Improvements The Howard Power Center Steering System solves the castering problems and much more, according to Howard. The system stabilizes the steered wheels and prevents road wander, slanted-road steering wheel pull, steering over-control, crosswind steering effect, and steering-induced dynamic sway. Coastal Transport drivers also report improvements in steering on rutted roads.

The system is designed to work with the truck's power steering and will shut down automatically if the power steering fails. A control panel on the truck dash makes it easy for drivers to change settings to adjust for varying road conditions.

System components include a zero-backlash hydraulic centering cylinder that is attached to either the steering gear Pitman arm or the steering tie rod. The cylinder has two pistons working toward a center stop that holds the piston rod captive in the on-center position.

As the steered wheels are turned away from center, one of the pistons is displaced. When the driver releases the steering wheel, the piston returns the piston rod to the on-center position. The pressure on both sides of the captured piston rod keeps the steered wheels on-center, tracking with accuracy that cannot be achieved with the steering geometry and mechanical components that make up a current heavy truck steering system, according to Howard.

The hydraulic power source is an air-over-hydraulic reservoir accumulator. Air pressure is regulated by the controls on the truck dash. The accumulator has a neoprene diaphragm that keeps air from coming in contact with the hydraulic fluid.

Pneumatic Valves Dual fail-safe electric pneumatic valves-one on the top and one on the bottom of the accumulator-dump the air pressure when the system is turned off. The pressure is recharged each time the system is activated.

The hydraulic centering cylinder incorporates a separate trim cylinder that can be driver-adjusted for different driving conditions, including crosswinds. When trimming the system, the driver steers straight.

The tolerance for backlash in the trim cylinder is held to less than one-thousandth of an inch. This is achieved with check valves that allow only bubble-free hydraulic fluid to enter the cylinder. During operation, fluid exiting the cylinder flows to the pressure accumulator through a different return line.
