The Amazing Benefits Of
Howard Precision Steer Wheel Control

Controlling the unbridled behavior of heavy vehicle steer wheels makes a greater contribution in reducing driving fatigue than the development of power steering that only assists the driver when turning. Whereas, Precision Steer Wheel Control assists the driver when going straight, doing away with the repetitive driver steering corrections required to keep a heavy vehicle tracking straight and under control, which is the major source of driving fatigue.

The development of Precision Steer Wheel Control was considered a *Good Idea* that soon became a *Great Idea* when all of the surprising additional benefits were realized.

- Precision Steer Wheel Control solves the costly long standing steer wheel premature tire wear problem, saving heavy truck and bus operators millions of dollars in operating expense.
- Precision Steer Wheel Control advances the state of the art in heavy vehicle directional stability, thereby eliminating the inordinate amount of repetitive driver steering input required to maintain directional control that makes a corresponding reduction in driver fatigue.
- Precision Steer Wheel Control achieves an all new level of steer wheel tire blowout controllability, verified by over twenty documented steer wheel blowouts where drivers report easy vehicle controlability, without the customary steering wheel fight.
- Precision Steer Wheel Control makes a considerable improvement in crosswind drivability, by preventing the steer wheels from caster steering downwind, in response to the wind gusts.
- Precision Steer Wheel Control completely eliminates road wander that is caused by the unstable behavior of the steer wheels inherent to conventional state of the art steering geometry.
- Precision Steer Wheel Control does away with steering wheel pull on crowned or slanted roads, that is caused by steer wheel caster steering to the low side of the road.
- By reducing driver fatigue, Precision Steer Wheel Control reduces heavy vehicle accident potential.

For truck and bus operators, all of the above come at no extra cost, considering that the savings in steer wheel tire expense will pay for the Precision Steer Wheel Control System many times over.

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Bringing Heavy Vehicle Drivability into the Twenty-first Century

With the Exclusive Technology and Safety Features of

Howard Precision Steer Wheel Control

River City Products: The World Leader in advancing the *"state of the art"* in Heavy Vehicle Drivability

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Bringing The Curtain Down On Half Of A Century Of Unsolved Heavy Vehicle Drivability Problems

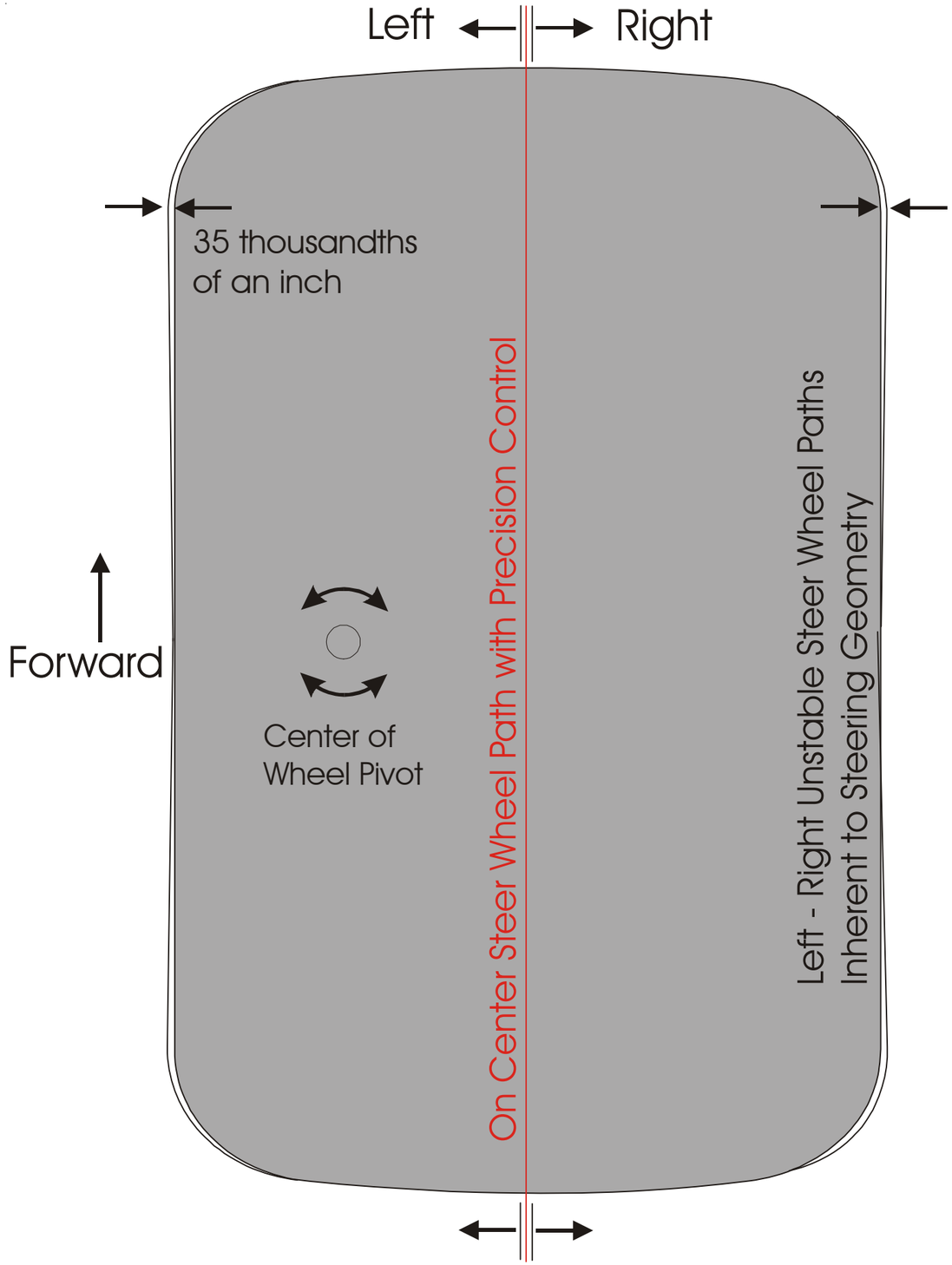
THE HOWARD PRECISION STEER WHEEL CONTROL SYSTEM

In the formative years, as the size and weight of heavy over-the-road vehicles increased, the need for technology to improve drivability was thought to have been accomplished with the development of power steering to assist the heavy vehicle driver when turning. It is evident that, over the many years, not much thought was given to developing directional stability technology to assist the heavy vehicle driver when going straight, wherein the repetitive driver steering corrections required to maintain directional control of a heavy vehicle lacking in directional stability, is the primary cause of driving fatigue. For well over a half of a century, lacking a better method, heavy vehicle designers have endeavored to improve the quality in heavy vehicle drivability by changes in the steering geometry, with disappointing results. The on-center unstable behavior of the steer wheels inherent to conventional steering geometry, therefore had to be controlled by repetitive steering input from the vehicle driver, to maintain control of the vehicle.

The brilliant Albert Einstein had unkind things to say about those who keep doing something the way it has always been done and expecting different results. Considering the many technical advancements that have been made in the design of heavy over the road vehicles in response to consumer needs, it is incredible how the very creative heavy vehicle design community has, for over a half of a century, overlooked the critical need to advance the state of the art in heavy vehicle directional stability by improving the on-center directional stability of the steer wheels.

Over the many years, after-market providers have attempted to make the obviously needed improvements in heavy vehicle steer wheel directional stability, with low-tech simple-fix products that fell short of the requirement. The bad example set by such low-tech products further confused the issue, giving rise to a thumbs-down response from the heavy vehicle designers who resisted making changes in the long standing conventional methods that were accepted as normal by the consumers. It is understandable that the need to control manufacturing costs has discouraged product development except to satisfy consumer demand. It can be reasoned that consumer demand will be forth-coming when the heavy vehicle operators become aware that the savings in operational cost will more than pay for the many surprising advantages of the new technology, the most surprising of which is that Precision Steer Wheel Power Centering solves the puzzling excessive steer wheel tire wear problem that happens on heavy vehicles with conventional steering geometry. With Precision Power Centering the steer wheels are made to track in the on-center position with the same perfection as a fixed non-steering rear wheel, therefore the same smooth tire wear pattern and extended service life happens, in contrast to the costly irregular wear pattern that happens due to the unstable behavior of the steer wheels inherent to conventional steering geometry.

Precision Steer Wheel Control solves an amazing number of other serious drivability problems, such as the dreaded crosswind controllability problem, road wander driving fatigue, and the dreaded steer wheel tire failure controllability problem. Precision Steer Wheel Control does away with steering wheel pull on slanted and rutted roads.



Actual Size of Footprint of the Test Vehicle

Heavy Vehicle Steer Wheel Tire Footprint Test Verifies Unstable Behavior Of The Steer Wheels Inherent To Conventional Steering Geometry

Heavy vehicle steer wheel footprint tests were conducted using a highly accurate method of measuring and recording steer wheel activity while driving. The illustration shown is the full size of the actual steer wheel footprint of the test vehicle that represents the average size of most heavy vehicle steer wheel tire footprints. During the test, the experienced test driver made a concerted effort to minimize the corrective steering input to only the amount required to maintain directional control. Any of the test data that was influenced by inadvertent driver over-steer was not used in this report.

The information in this report was recorded at fifty-five miles per hour on a non-windy day on a smooth highway. Therefore, the information in this report is a best-case scenario.

During adverse road and wind conditions, the unstable steer wheel activity increased substantially, requiring a corresponding increase in driver steering input to maintain directional control. The footprint illustration shows that the left and right corrective driver steering input necessary to control the unstable behavior of the steer wheels goes beyond the on-center position by thirty-five to forty thousandths of an inch. When the test driver held the steering wheel steady instead of making the left and right steering corrections and the speed was increased to 65 m.p.h., it only required the steer wheels to be off-center ten one thousandths of an inch to make a lane change in ten to twelve seconds.

The tests were repeated on the same vehicle when equipped with The Howard Precision Power Centering Steer Wheel Control System. When the system was activated, the steer wheels tracked straight with no deviation from the on-center position, and required no corrective steering input from the test driver to maintain directional control.

The heavy vehicle industry has made amazing progress in advancing the state of the art in heavy vehicle design with the exception of recognizing the critical need for inherent directional stability. For over a half of a century, driving the unstable heavy vehicles has required an inordinate amount of corrective driver steering input to keep the vehicle going straight and under control. The lack of heavy vehicle directional stability is the major contributor to driving fatigue.

Glossary Of Terms and Functional Explanation

ERGONOMICS: The study of the problems of people in adjusting to their environment; especially the science that seeks to adapt work or working conditions to suit the worker.

LONG-STANDING HEAVY VEHICLE ERGONOMIC DESIGN OVERSIGHT: From an ergonomic standpoint, drivers find heavy trucks and buses to be generally acceptable, with the exception of the repetitive driver steering corrections required to keep heavy vehicles that are lacking in directional stability, going straight and under control. This long-standing ergonomic oversight exists because of the lack of directional stability that is inherent to conventional steering geometry. Therefore, the unstable behavior of the steer wheels must be controlled by repetitive steering corrections from the vehicle drivers. The lack of heavy vehicle directional stability is the primary cause of driving fatigue and related highway safety problems. The developement of Howard Precision Steer Wheel Control Technology does away with the long-standing ergonomic drivability oversight that is the primary cause of driving fatigue.

STEERING GEOMETRY: Descriptive mathematics concerned with the properties of and relationships between points, lines, planes, and figures. Principally used by vehicle manufacturers to establish specifications for performing maintenance on vehicle steering systems.

The *Steering Geometry* is mistakenly assumed to imply advanced steering system design, when in reality, the design of heavy vehicle steering systems are primarily influenced by the empirical knowledge gained over the many years of experimentation. Therefore, the g*eometry* of heavy vehicle steering systems is a descriptive engineering reference pertaining to the relationship of the articulating parts of the system, and has no bearing on the quality of the system it describes.

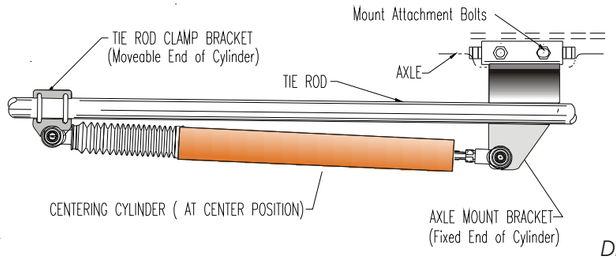
STEER WHEELS: The wheels that steer a vehicle in response to steering input from a vehicle driver.

DIRECTIONAL STABILITY: A vehicle that is designed to track inherently straight without requiring corrective steering input from the vehicle driver to maintain directional control is considered to be *Directionally Stable*.

PRECISION STEER WHEEL CONTROL: Heavy vehicle directional stability can only be accomplished by advancing the state of the art in achieving precision on-center control of the steer wheels.

Conventional heavy vehicle steering geometry does not provide the precision on-center steer wheel control required to achieve directional stability. Therefore, repetitive driver steering corrections are required to control the unstable on-center behavior of the steer wheels to maintain directional control.

The development of *Precision Steer Wheel Control Technology* advances the state of the art in heavy vehicle directional stability to a high level of perfection. The new technology achieves precision on-center steer wheel control, dramatically reducing the repetitive driver steering input required to maintain directional control. The new technology achieves the ultimate in driver friendly steering and reduction in driver fatigue.



Power Steering Pressure Monitoring Switch

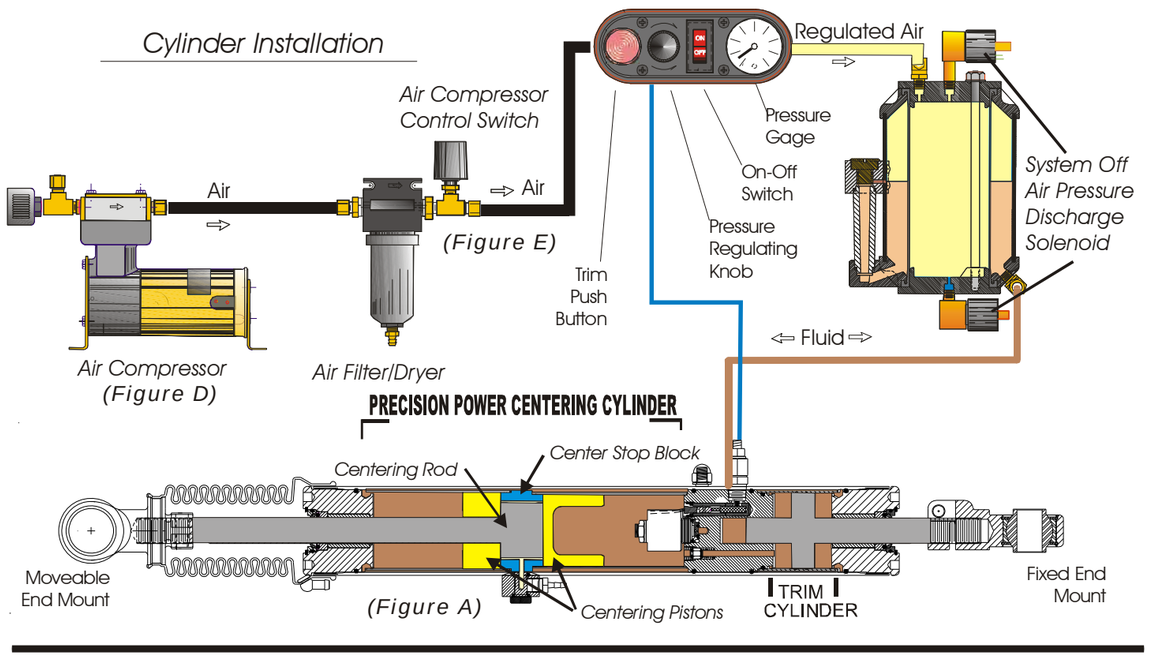
(Figure F)

(Figure C)

Driver's Control Panel

(Figure B)

Cylinder Installation



(Figure E)

Air Compressor
(Figure D)

Air Filter/Dryer

(Figure A)

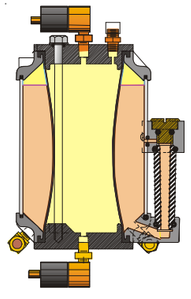


Figure 2a

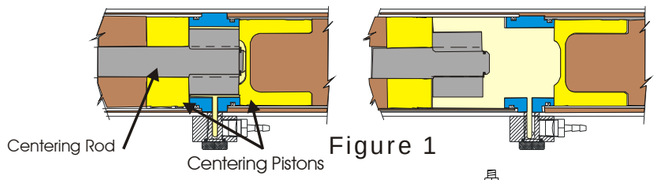


Figure 1

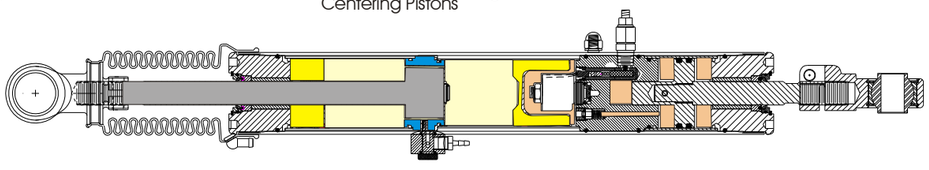
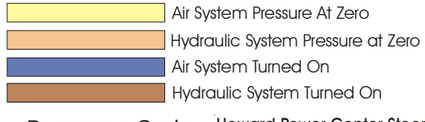


Figure 2: System Turned Off, with Pressure at Zero. The Centering Pistons become Inactive until the System Pressure is Re-Activated when the System is Turned On.



Pressure Code

Howard Power Center Steering system is made under U.S.Patent Number 5,536,028. Other Patents granted and pending.

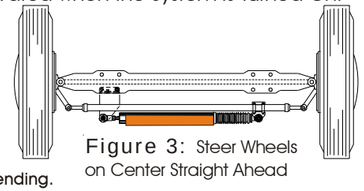


Figure 3: Steer Wheels on Center Straight Ahead

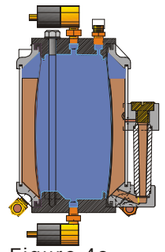


Figure 4a

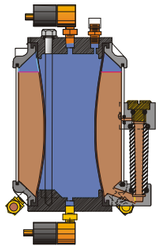


Figure 5a and 6a

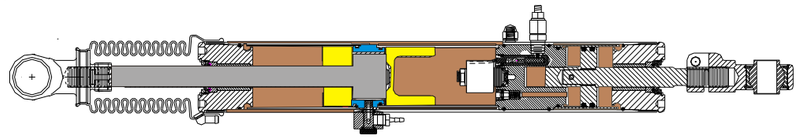


Figure 4: Cylinder in the Straight Ahead On Center Position (with System Pressure On)

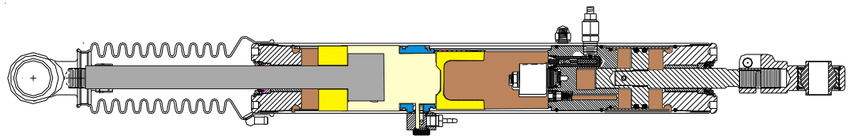


Figure 5: Cylinder in the Left Turn Position (with System Pressure On)

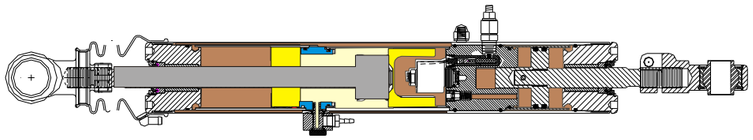


Figure 6: Cylinder in the Right Turn Position (with System Pressure On)

The Precision Steer Wheel Control System consists of two primary components, the Hydraulic Power Centering Cylinder (figure A), and the Air Activated Hydraulic Pressure Accumulator (figure B). The normal operation of the system is automatic and requires very little attention from the vehicle driver. A conveniently located Driver's Control Panel (figure C) allows the vehicle driver to increase or decrease the effectiveness of the system. The Driver Control Panel consists of an On/Off Switch, a System Pressure Gauge, a Pressure Regulator Control, and a Push To Trim Button that allows the vehicle driver to re-center the Power Centering Cylinder to a perfect on-center straight-ahead position, should a minor adjustment be necessary.

The source of hydraulic steer wheel centering pressure comes from the Air Activated Hydraulic Accumulator. The air and fluid chambers in the accumulator are separated by a flexible membrane that serves as a diaphragm, whereby the air and fluid pressures are always the same but do not mix. The desirable hydraulic pressure is achieved by adjusting the air pressure. The system is turned off by releasing the air pressure in the accumulator (see figure 2 and 2a).

When the air pressure in the accumulator is exhausted to the atmosphere, the system hydraulic pressure will drop to zero and the system will be turned off and will have no effect on the vehicle's steering. While the vehicle is being driven with the system turned off, the left and right centering pistons will be displaced away from the on-center position by the activity of the centering rod, where they will remain until the system hydraulic pressure is again activated with air pressure in the accumulator.

The vehicle power steering is more effective than the power centering cylinder, therefore the return of the steer wheels to the on-center position only occurs when the driver releases the steering wheel after turning and the power steering is in the on-center bypass mode. The utmost care has been given in the redundant failsafe design of the Howard Steer Wheel Control System. For Example, in the event of a failure or interruption of the vehicle's power steering pressure, the steer wheel power centering system will automatically turn off and therefore, will have no adverse effect on the steering effort required to manually steer the vehicle. The system can also be turned off manually by the vehicle driver should it be desirable to do so.