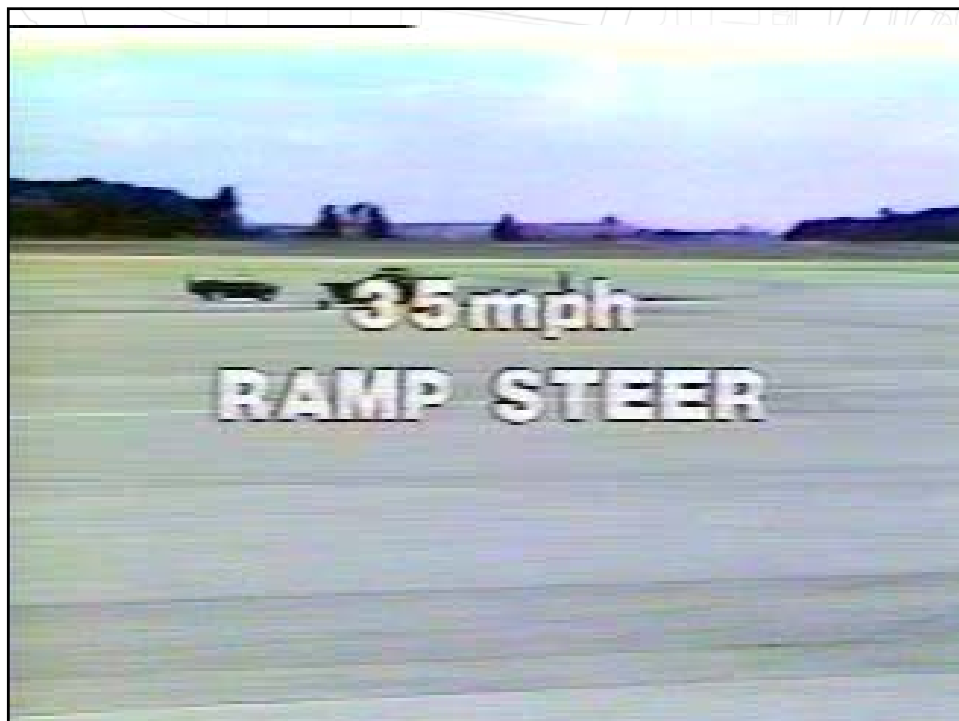


TRS - Trailer Roll Stability

Todd Bourque
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Braking Controls Division
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Accident Statistics



In 1998, there were over 22,000 rollover crashes in the U.S.

680 Fatalities (12.7% of total)
 7,858 Injuries (18.7% of total)
 \$2.1 - \$21 million in cost


In 2000, NHTSA reported for U.S. Large Trucks

453,000 Accidents
 5,362 Fatalities
 42,000 Injuries
 \$24 billion in insurance losses

Trucks overturning at exit ramps caused 5% of fatalities

The National Transportation Safety Board in the U.S. considers that some 4,000 of the 15,000 large truck rollovers could be avoided with advanced warning. (27%)

27% of 680 fatalities or 183 lives saved
 27% of 7,858 injuries or 2,121 avoided injuries
 27% of \$21 million cost or \$5.7 million cost avoided



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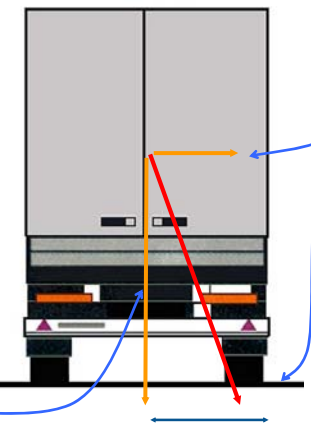
Why a Rollover occurs

Speed

Turning Radius

Height of Load

Track Width



Resolving moments

Vehicle stable if

$$m \cdot (v^2 / r) \cdot h < m \cdot g \cdot t$$

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Where does TRS come in?

TRS can not change the driving speed, turning radius, load position, tire profile, track width or road conditions.

TRS can brake the vehicle and *Slow It Down* using advanced braking technology called

TRS - Trailer Roll Stability

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TRS – Trailer Roll Stability

- TRS is a Trailer ABS system with the added function of Roll Stability for trailers with constant power and air suspensions.
- It operates independently of the towing vehicle system.
- It does not require the driver to apply the brakes. The system automatically applies the brakes to slows the vehicle down when a roll event is detected.
- It will reduce the chance of a rollover. Any vehicle may overturn in certain situations with or without TRS.

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Where used



Current Available Applications

- Single, Tandem, or Tri-Axle Semi Trailers, Full Trailers, and Canadian B-Trains
- Disc or Drum Foundation Brakes
- Air Suspension
- New Equipment (OEM Installed), or Used Equipment (Retrofitted)

Configurations

- 4S / 2M or 2S / 2M
- Side-by-Side

Technology used




New Technology

- Added 1 lateral accelerometer
- Added 1 brake apply solenoid
- Added 1 port to connect the air bags
- Added 5 pressure transducers

Existing ABS Technology

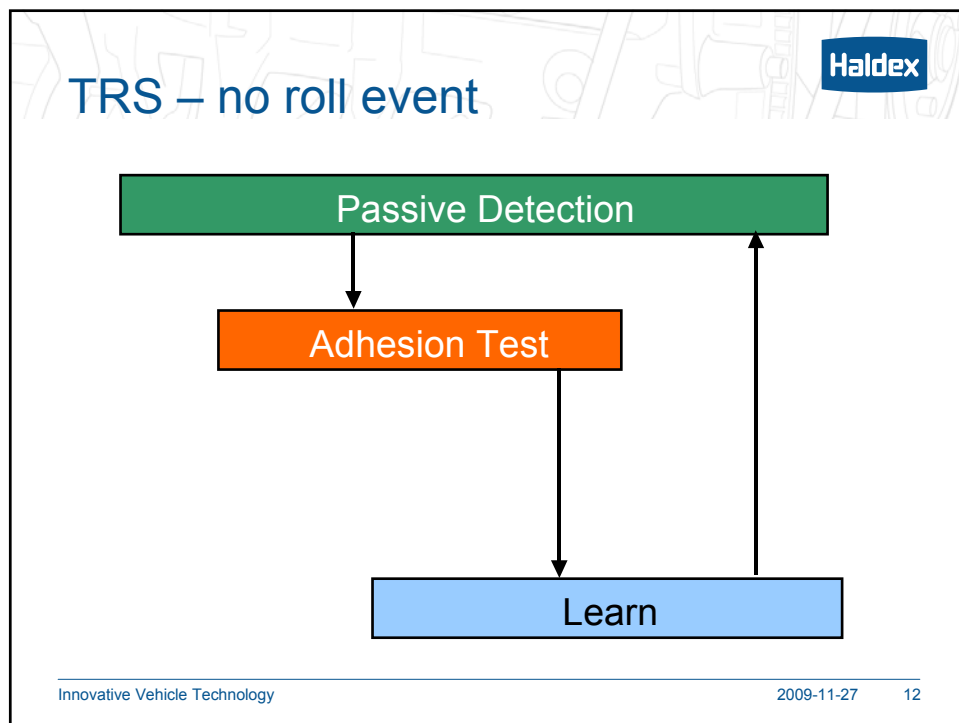
- Service brakes using standard relay pistons
- ABS using standard hold & dump solenoids
- Electronic Controller
- Electronic Odometer
- PLC



TRS Operation

Under TRS braking, the ECU receives input from the rollover stability accelerometer of an unstable vehicle condition. The ECU then looks at the trailer's wheel slip to determine if there is an impending roll event. Depending upon how the wheels are responding, the ECU will decide if the trailer's brakes need to be applied on the opposite side to **Slow Down** the vehicle combination.

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DIAG+ Software

The screenshot displays the DIAG+ Software interface with several key components:

- test.hdtc** window: Shows vehicle parameters such as Occurrences (1), Date, Odometer (395.32 Km), Voltage (24.40 V), Reservoir (5.15 Bar), Suspension (3.20 Bar), Speed (24.00 Km/h), ISO11992 CAN, Demand (0.00 Bar), and Time Since Startup (00:02:00). It includes checkboxes for Red Lamp, Yellow Lamp, Service Lamp, Lamp On Fault, Stoplamp Power, and BA Solenoid. A 'WHEEL SENSOR 1A CONTINUITY' indicator is shown at the bottom.
- DTCs, Lining Wear and Modification Reco...** window: Displays icons for various diagnostic tools and a green checkmark.
- Lining Wear Indicator** window: Features a 'Select LHM Hardware' dropdown menu with options: Haldex LHM, Haldex LHM, Haldex LHM Monitor, and Custom. It also includes 'Lamp Status' options for Service Lamp Flash and Continuous Flash.
- Vehicle Schematic**: Shows a hydraulic system with components labeled S1B, S1A, 1.4 Bar, and 2.0 Bar.
- ECU Ver : B921** and **Interface : G325** are displayed at the bottom.

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Fleet+

The screenshot displays the Fleet+ Software interface with four data analysis graphs:

- 1. Average Braking Time v Peak Demand Pressure**: A bar chart showing average braking time in seconds for different peak demand pressure levels.
- 2. Number of Brake Applications v Peak Demand Pressure**: A bar chart showing the number of brake applications for different peak demand pressure levels.
- 3. Total Braking Time v Peak Demand Pressure**: A bar chart showing the total braking time in seconds for different peak demand pressure levels.
- 4. Average Pressure v Braking Start Speed**: A bar chart showing average pressure in bar for different braking start speeds in km/h.

Annotations with arrows point to the graphs:

- Average Brake Time vs Peak Demand Pressure** (points to graph 1)
- No. Brake Applications vs Peak Demand Pressure** (points to graph 2)
- Total Braking Time vs Peak Demand Pressure** (points to graph 3)
- Average Pressure vs Braking Start Speed** (points to graph 4)

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Fleet+ **Haldex**

Number Brake Applications vs Braking Start Speed

Brake Applications vs Distance

ABS Events vs Distance

Distance vs Percentage Load

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Fleet+ **Haldex**

Stability Snapshot

Info	Filename	Vehicle Ident Number	ECU Data Saved At:
FleetPlus v1.5	FleetPlus xxx - 31012005-1034.asc	xxx	31/01/2005 - 10:34

The data shows the important parameters and settings that were present in the EBS when the Stability Event occurred.

Stability Snapshot	2 of 27	Date	Not Set
Stability Sensor Output	0.83 g	Time Since Startup (HH:MM:SS)	00:28:54
SYSTEM PARAMETERS		SYSTEM SETTINGS	
Odometer	12059 km	Red Lamp Signal	OFF
Voltage	27.6 V	Cab Lamp Signal	OFF
Reservoir Pressure	7.80 Bar	Service Lamp Signal	OFF
Suspension Pressure	2.75 Bar	Stop Light Power	OFF
Vehicle Speed	72 kph	Brake Apply	ON
ISO Demand Pressure	0.00 Bar		
Control Line Pressure	1.30 Bar		

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