
TECHNICIAN
TRAINING
DORMAN
Training Seminar Series
Presents:
ABS For Commercial
Motor Vehicles
Part 1

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DORMAN
Aftermarket Innovators

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ABS

- Sulev “Swede” Oun
- O&K Truck Repairs Ltd.
- 350 Grand Island Blvd.
- Tonawanda NY 14150
- Tel: 716-874-5450
- okswede1@aol.com

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Your Instructor For This Webinar

Sulev “Swede” Oun

- **Owner, O&K Truck and Auto Repairs Ltd.**
- **ATTP Master Instructor, New York State**
- **Author, “Medium/Heavy Duty Truck Electricity and Electronics”**
- **Training provider for various Associations, industry and various NY State agencies**
- **Developed trainings that range from four hours to multiple days, specializing in brakes, electrical, regulations and many other subjects relating to our industry.**
- **Member of various organizations such as SAE, CVSA, TANY**

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Ant-lock Braking System

- **ABS is used on trucks, trailers, cars, motorcycles and aircraft.**
- **ABS concepts have a long history.**
  - **In 1908 J.E.Francis introduced "Slip Prevention Regulator" for rail vehicles.**
  - **In 1920 Gabriel Voisin (France) experimented with the hydraulic brake system on his aircraft brakes to reduce the risk of tire slippage.**
- **In the 1930, a braking system called Decelostat used direct-current generators to measure wheel slippage used in railroads.**
- **In the early 1950's, the Dunlop Maxaret ant-skid system was widely used in aviation in the UK.**
- **The first fully-electronic anti-lock system was developed in the 1960's for the Concorde aircraft.**
- **The modern ABS was invented in 1971 at Fiat by Mario Palazzetti**
  - **It is now standard in most cars.**
  - **Originally called Antiskid**
  - **Till the patent was sold to Bosch and renamed it ABS**

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Ant-lock Braking System

- **In 1976 "WABCO" began developing anti-lock braking system on commercial vehicles.**
- **The following are some of the first commercial vehicle industry's important innovations:**
  - **1981- First ABS**
  - **1986 – First electronically controlled air suspension system**
  - **1986 – First automated manual transmission**
  - **1996 – First electronic braking system (EBS)**
  - **2001 – First electronic stability control system (ESC)**
  - **2007 – First collision mitigation system (CMS) with active braking.**
  - **2008 – First autonomous emergency braking system (AEBS)**
  - **2012 – First hydraulic ant-lock braking system with electronic stability control**
  - **2012 – First electronic braking system (EBS) for hybrid-driven trucks and buses**

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ABS HISTORY

- Required in 1975 (FMVSS 121)
- Indirect Requirement
- Many Problem
- Courts Overruled In 1978
- Systems Disappeared In U.S.
- ABS Returns (Via Europe)
- All Digital Control (Second Generation)

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ABS HISTORY (Con't)

- NHTSA FLEET STUDY (1988)
  200 Tractors
  50 Trailers
- ABS OFFERED AS OPTION BY ALL MFGRS.
- MARCH 1st 1997 ABS MANDATORY ALL TRACTORS
- MARCH 1st 1998 ABS MANDATORY ALL STRAIGHT TRUCKS, TRAILERS AND BUSES
- MARCH 1st 1999 ABS MANDATORY ALL HYDRAULIC BRAKE VEHICLES 10,001LBS OR HEAVIER

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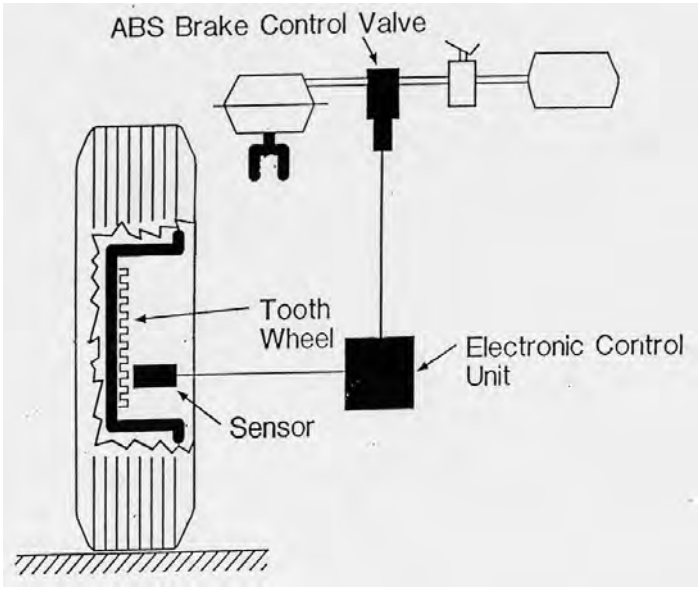
BASIC SYSTEM



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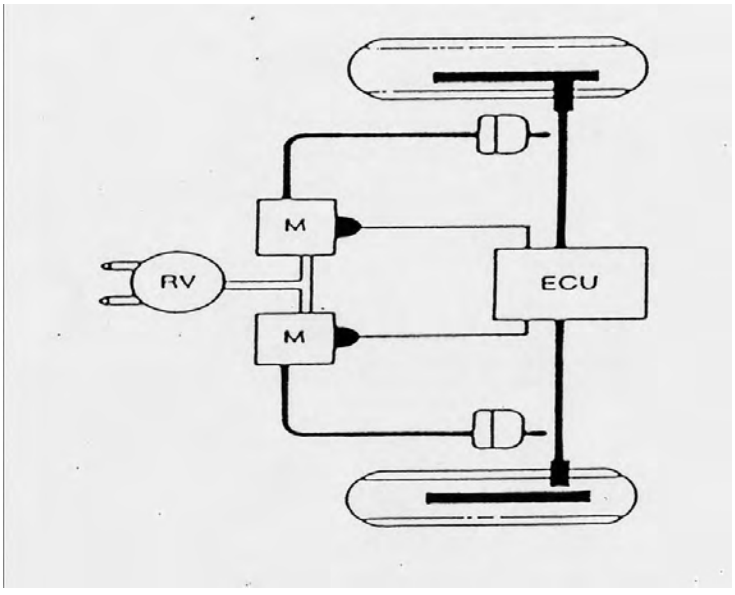
WHEEL-BY-WHEEL CONTROL



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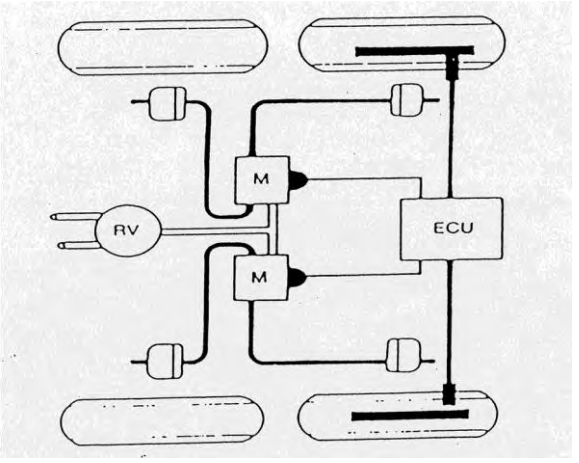
SIDE-CONTROL

- **This 2S/2M and also a 4S/2M configuration uses one ECU/dual modulator valve assembly, and 2 or 4 wheel speed sensors. ABS sensors are mounted on one or two axles only. The curb and roadsides of the trailer are controlled separately.**



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2S / 1M Basic System

- Single relay valve
- 4x2 electrical connections (2)
  - Electrical connection for solenoid is external
  - Combination power / diagnostic connector
    - Optional power / diagnostics cable or power-only cable
    - One generic I / O available
- 3/8" control port vs. previous model 1/4"
- Serviceability
- Elimination of LED on top of ECU
- Bracket mount or tank mount

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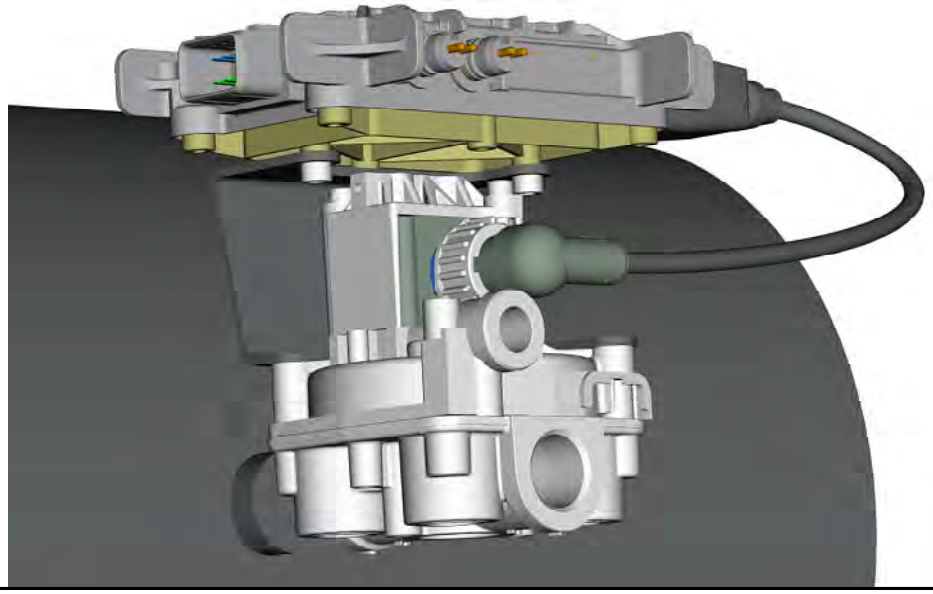
2S / 1M Basic System



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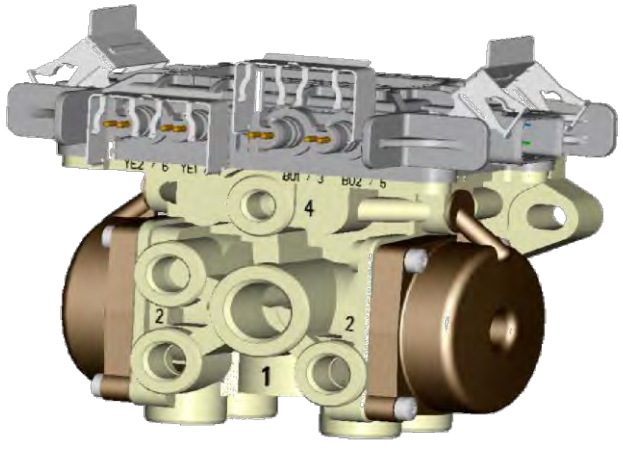
2M ABS Relay Valve w / ECU



Note: A 2S/2M Standard valve has only two sensor outlets and cannot be upgraded.

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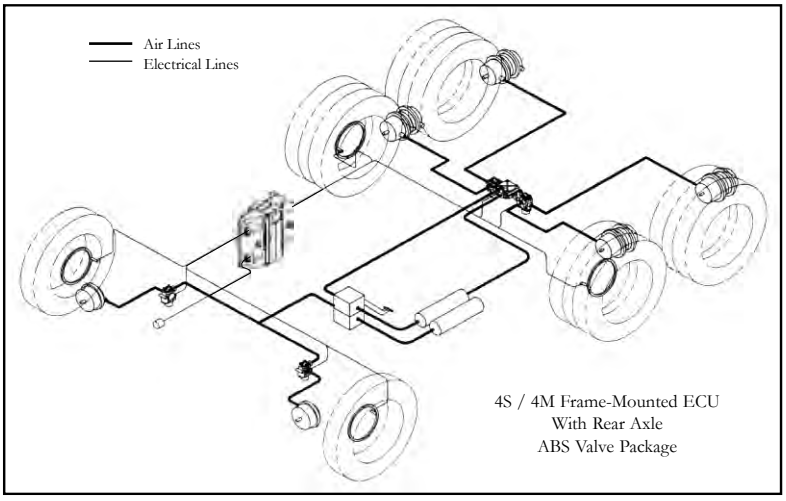
4S / 4M ABS



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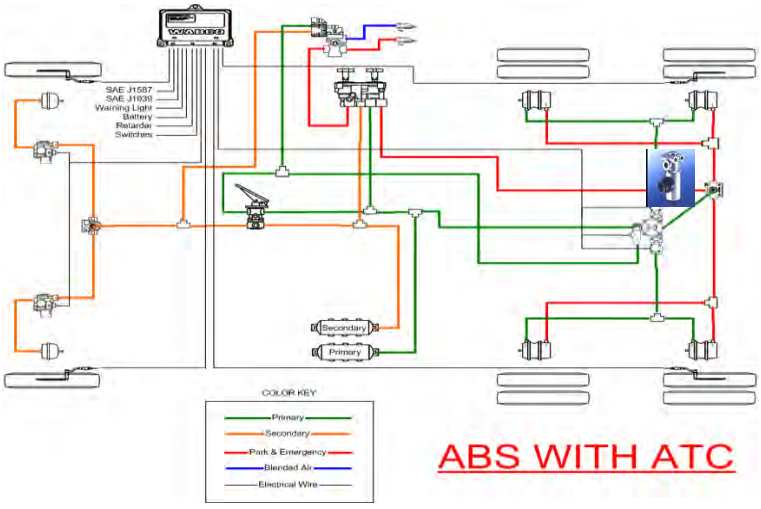
ABS Configurations



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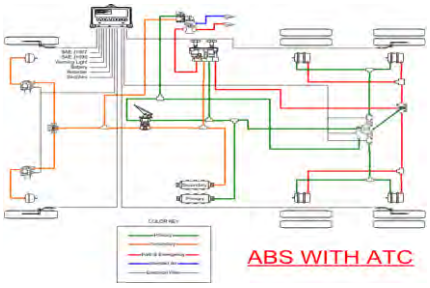

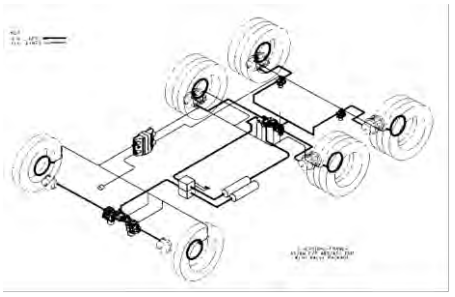

An "Active Brake Valve" is installed to the base ABS system.
When it is part of the rear valve package, the active braking valve is attached to the relay valve.
On individual modulator valves, the active braking valve is mounted on the frame or crossmember, near the rear of the vehicle.
Note: A vehicle with ATC installed will have an indicator lamp on the dash or instrument panel marked accordingly such as ATC, ASR or Stability Contfol dependent upon the application.

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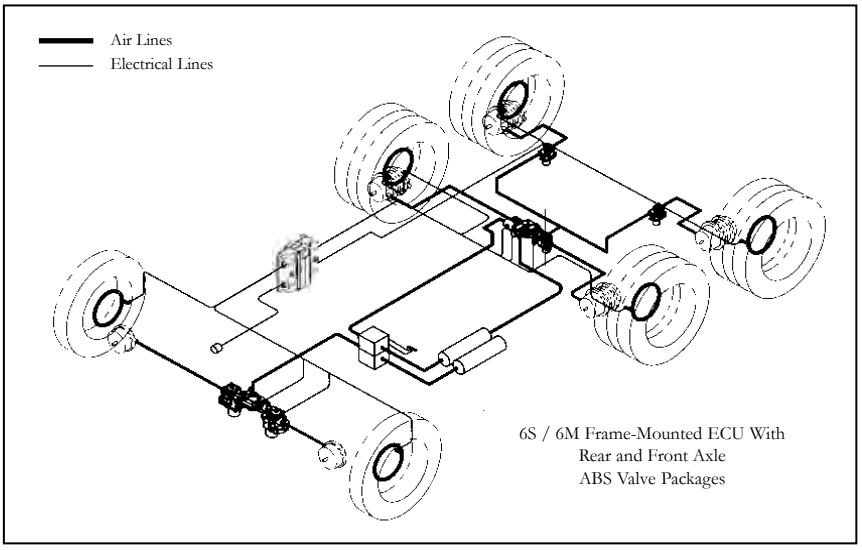
6S / 6M ABS with ATC



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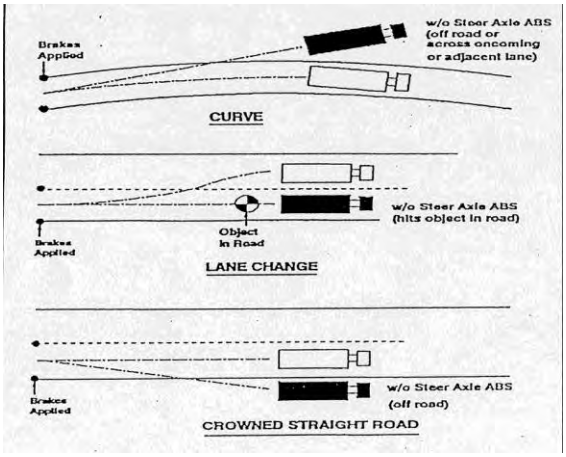
VEHICLE RESPONSES WITH/WITHOUT ABS STEERING AXLE



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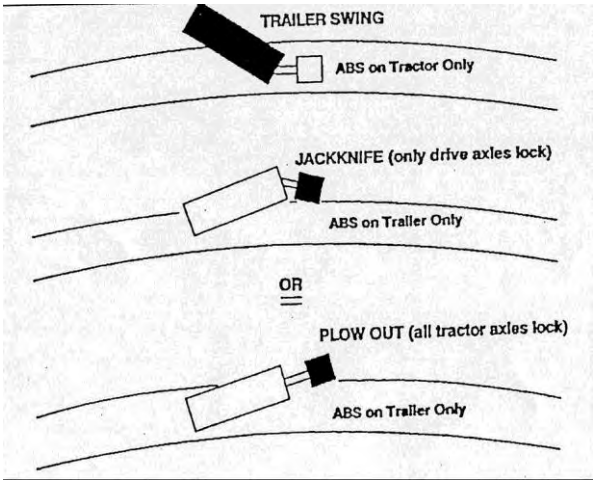
ABS ON TRACTOR OR TRAILER ONLY



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TRAILER ABS ELECTRIC POWER CONTROVERSY

- **Stop Light Circuit (7- Way Connector)**
- **Full Time Power From 7th Pin**
- **Separate Dedicated Connector and**
- **Circuits (known as ISO connector in Europe)**

- **All three approaches are being used.**

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MINIMUM VOLTAGE AT LAST AXLE
(Worst Case Electrical Loads)

	ABS	ISO	7 – Way
Doubles	**2S/1M**	**10.5**	**9.0**
	2S/2M	**10.0**	**8.0**
Triples	**2S/1M**	**9.5**	**8.0 ***
	2S/2M	**8.5**	**7.5***

*** ABS on last two axles not working. Voltage would have gone lower if ABS continued to cycle.**

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This is an example of some issues in the real world. The trailer ABS light on trailer has been on for several years. The trailer was bought from a dealer and had passed inspection for a few years. Came to our shop for inspection and PM. Noticed sensor wires cut, but ABS light comes on and stays on when powered up. Also, wouldn't blink any codes. Someone at onetime has been screwing around with it. Notice the white/green wire. That wire belongs to the light. Someone had at one time hooked the blue wire to ABS light.

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ABS REQUIREMENTS

The ABS on tractors and full trailers must control the brake pressure to at least one front axle and one rear axle.

The ABS on semi-trailers and dollies must control at least one axle of the vehicle. In addition, the ABS on tractors must control one of the axles with two modulator valves so that the brake pressure on one end of the axle is independent of the brake pressure on the other end.

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ABS REQUIREMENTS

- **March 1, 1997- Newly built tractors must provide constant electrical power to the tractor-to-trailer electrical connector(s) for powering trailer ABS(s)'**
- **As of the date vehicles are required to be built with ABS, the vehicle's ABS malfunction lamp must be in clear view of the driver. It must light-up when:**
  - **a. The ABS malfunctions.**
  - **b. The ignition is key is switched "on" for a short bulb check.**

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ABS REQUIREMENTS

- **March 1, 1998- The ABS malfunction lamp on trailers must be yellow and mounted on the left side of the trailer, near the rear red marker lamp. On dollies it must be located on the left side where it can be seen by someone standing about 10 feet in front of the lamp. The lamp must light up:**
  - **a. When the ABS malfunctions.**
  - **b. For a short bulb check when the vehicle is stopped and the ABS starts receiving electrical power. This lamp will no longer be required after February 2009.**

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Roadside Violations ABS

Data from FMCSA's Motor Carrier Management Information System (MCMIS) **Filtered from calendar, year – 2019 to 2023.**

393.55E: No or Defective ABS Malfunction Indicator Lamp for trailer manufactured after 03/01/1998

225639 Violations

"Definitely an easy Hit"

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ABS
NOTICE:
If the ABS indicator lamp comes on *and* stays on when you apply the brakes to a *moving* vehicle, the trailer ABS is not working properly. The ABS must be serviced as soon as possible upon completion of your trip to ensure full anti-lock braking capability.
TP-95172
MERITOR WABCO
Rev. 7/01

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Indicator Lamp Note:

When replacing the bulb, use an incandescent type DOT – approved lamp, or a LED with integral load resistor to ensure correct lamp operation.

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Indicator Lamp Operation (Trailer)

Indicator lamp operation is dependent on whether the ABS is powered by the stoplight or constant power.

- **A trailer manufactured prior to February 28, 1998, or manufactured outside of the United States, the ABS may be either stoplight or constant powered.**
- **A trailer manufactured March 1, 1998, or later and was manufactured in the United States, will have constant power capability.**
- **This is mandated by Federal Motor Vehicle Safety Standard (FMVSS) 121.**
- **Most ECUs manufactured prior to September 1997 requires all sensed wheels to detect a 4-mph signal to shut off the ABS indicator lamp.**

Note: This does not indicate a faulty ABS system. However, if the indicator lamp stays on when the brakes are applied to a moving vehicle, the ABS system needs servicing.

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ABS REQUIREMENTS

New vehicles must be capable of receiving and sending signals to turn on the malfunction light inside the towing vehicles cab.

Trailer and dolly ABS will have the capability to send an ABS malfunction signal to the towing vehicle. Towing trailers must also be able to relay an ABS malfunction signal from the vehicle it is towing to the vehicle towing it.

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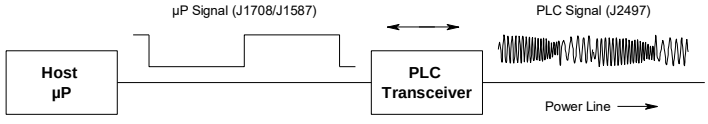
Power Line Communications in Heavy Vehicles

What is PLC?

- **A method of multiplexing information and power on the same set of wires.**
- **Information is converted to RF signals and placed on the power line**



- **Co-exist same way that different radio and television signals co-exist in the air**
  - Occupy different frequency ranges:
    - Power (DC) = 0 Hz
    - PLC = 100 K to 400 KHz.

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Power Line Communications in Heavy Vehicles

Why PLC?

- Provides a means to communicate trailer ABS malfunction indicator status to the tractor (light a light)
- No more positions available on the standard J560 connector
- Solution chosen by the industry
- Defined SAE J2497 recommended practice

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Technical Bulletin

TP-1764
Issued 05-17

Update to Disable the PLC Gateway in E-version ABS ECUs Using TOOLWrench 2.27.1

Hazard Alert Messages

Read and observe all warnings and caution hazard alert messages in this publication. They provide information that can help prevent serious personal injury, damage to components, or both.

⚠ WARNING
To prevent serious eye injury, always wear safe eye protection when you perform vehicle maintenance or service.

Park the vehicle on a level surface. Block the wheels to prevent the vehicle from moving. Support the vehicle with safety stands. Do not work under a vehicle supported only by jacks. Jacks can slip and fall over. Serious personal injury and damage to components can results.

How to Obtain Additional Maintenance, Service and Product Information

If you have any questions regarding the material covered in this bulletin, or for information about the Meritor WABCO product line, please contact the Meritor OnTrac™ Customer Call Center at 866-668-7221 or visit our website: meritorwabco.com.

Update Procedures

This update requires you to install the following two files in your laptop:

A. The Tractor ABS ECU TOOLWrench software version 2.27.1

B. The J1939Diag_UDS.dll file

NOTE: The update process consists of two different procedures. Procedures must be performed in the order presented in this publication. Please review all of the following instructions carefully first before proceeding...

Install the Software and Supporting Files

When you receive the software TOOLWrench_Disable_PLC Gateway.zip file from Meritor WABCO, perform the following:

1. Create a specific folder in your laptop desktop.
2. Extract the two files from the .zip file and put them into this newly created folder. Make sure both files are in the same folder.
3. Right-click on the file "TOOLWrench 2.27.1 E44b Disable PLC Gateway" and choose "Rename" from the drop-down box that is displayed.
4. Select the file name and change the file extension from .XEX to .EXE. When finished, the file name will be TOOLWrench 2.27.1 E44b Disable PLC Gateway.exe. Figure 1

Figure 1

Run the Update

1. Turn the vehicle ignition switch to OFF.
2. Connect the computer to the vehicle's SAE J1939 Off-Board Diagnostic Connector using a diagnostic interface.
3. Turn the vehicle ignition switch to the ON position.
4. Go to the folder you created in your laptop desktop...
5. Double-click on TOOLWrench Version 2.27.1.exe to run the program.
6. When installing the software, verify you are using the correct diagnostic adapter and protocol. If you are not sure, use the selection screen for diagnostic interfaces by selecting the "Adapter Selection" menu in the top taskbar of the TOOLWrench application. Figure 2.

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Figure 2

7. From the "Vendor" pull-down list, select the device name for your specific diagnostic interface (e.g. NEXIQ or NOREGON).
8. From the "Protocol" pull-down list, select J1939.
9. From the "Adapter" pull-down list, select the appropriate adapter for your device. Refer to the example shown in Figure 3.

Figure 3

10. Once all of the adapter selection settings have been made, click "OK".
11. Click on the "Start ECU Configuration" button. Figure 4.

Figure 4

12. When the parameter update has been completed successfully, the notification shown in Figure 4 will be displayed. Click "OK".
13. Cycle the ignition to complete the update.

MERITOR WABCO

Meritor WABCO Vehicle Control Systems
2135 West Maple Road
Troy, MI 48084-7121 USA
866-2mTrac1 (866-728-7221)
meritorwabco.com

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Printed in USA

TP-1784
Issued 05-17
(16578)

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Driving Mixed PLC and Non-PLC Vehicles.

- **If a tractor is equipped with PLC and the trailer is not, or vice-versa, the in-cab ABS indicator lamp will not illuminate. However, ABS will continue to function as normal.**
- **In that situation, the ABS indicator lamp mounted on the trailer should be utilized to ensure trailer ABS is working properly.**
- **A tractor with one manufacturer's PLC hooked up to a trailer with a different manufacturer's PLC will be compatible.**

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ABS Components

- Wheel speed sensing equipment
- Electronic Control Unit (ECU)
- Brake pressure modulator valves
- Electric harnesses, switched, relays and lamps

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HOW DOES ABS WORK ?

ABS consists of one or more of several key components:

Wheel speed sensors to constantly monitor wheel speeds and send wheel speed information to the ECU.

When wheel speed changes indicate impending wheel lock-up, the ECU signals the modulator valve(s) to reduce brake application pressure to wheel(s) in question.

The ECU adjusts pressure, seeking one which gives maximum braking without risking wheel lock-up.

When the ECU acts to modulate the brake pressure, it will also (on most vehicles) turn off any retarder until the risk of lock-up is over.

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HOW DOES ABS WORK

The ECU continually checks itself for proper operation. If the ECU detects a malfunction/failure in the electrical/electronic system, it will shut down that part of the ABS affected by the problem – or the entire ABS – depending upon the system and the problem. When this happens, the ABS malfunction lamp lights up.

ABS modulates brake pressure much faster and accurately than can drivers. It's faster because:

* electronic controls are very fast, and;
* ABS modulator valves are physically closer to the brakes than is the trucks foot brake valve.

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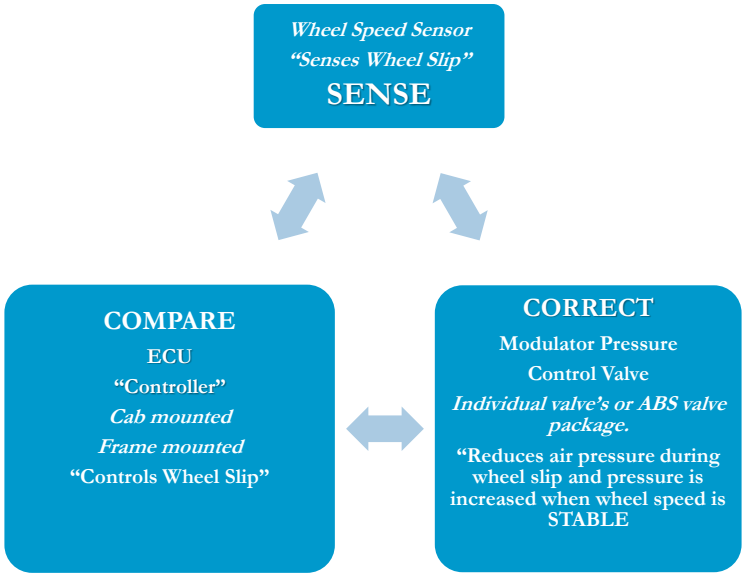
CLOSED LOOP



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TRACTION CONTROL

Some vehicles also use a traction control system in conjunction with ABS. Traction control helps ABS improve vehicle traction by minimizing drive wheel slip. Should a single drive wheel start to slip, the traction control system automatically modulates air pressure to the wheel, transferring engine torque to the wheels with better traction. Should all the drive wheels start to slip, the traction control system improves vehicle traction by reducing engine torque.

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DRIVING AN ABS EQUIPPED VEHICLE

- **What you might have learned about hydraulic ABS does not apply to air ABS.**
- **Important concepts to remember:**

  a. Unless certain that the entire combination vehicle has working ABS, don't stomp on the brakes in a panic situation. One or more axles could lock and the vehicle could jackknife. Brake as if no ABS was present.

  b. Don't expect to feel brake pulsing or hear strange sounds when the ABS activates.
- **Operate mixed combination vehicles (with and without ABS) the same way one would operate totally non-ABS combination vehicles.**

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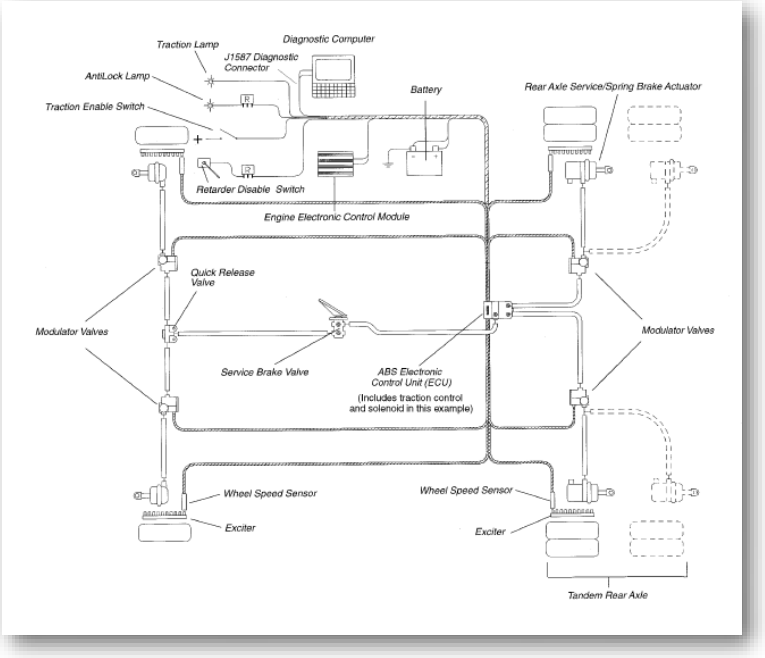

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ECU

- **The "ECU" processes all ABS information and functions. It receives and interprets wheel speed signals from the wheel speed sensors and uses this information to determine:**
  - *** Impending wheel lock-up.**
  - *** when and how to activate the ABS modulator valves.**
- **The following ABS components are connected to the "ECU":**

  Wheel speed sensors, ABS modulator valves, power source, ground, warning lamps, blink code switch, J1587 diagnostic connector, and retarder control device (usually by relay or the J1922/J1939 data link). The ECU also makes self-diagnostic checks during normal operation.

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ECU

During braking, the ECU uses the voltage pulses from the wheel speed sensors to determine wheel acceleration/deceleration rates. If the ECU determines that the deceleration rate of the sensed wheels suggest imminent lock-up, it commands the ABS modulator valves to modify brake pressure as needed to provide the best brake possible.

The ECU sends signals to the ABS warning lamp or blink code lamp to communicate ABS faults. It also sends signals to the retarder control in cases where use of the engine brake on low friction surfaces might lock the drive wheels. When the ABS stops modulating the brake pressure, the ECU permits retarder use once again.

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How does the ECU get activated?

- In a constant power system, the ECU activates and then begins a self-diagnostic check of the system when the ignition is turned on.
- In a stoplight-powered system, the ECU activates when you apply the service brakes.

IMPORTANT! All trailers manufactured on or after March 1, 1998, are equipped with ABS that has constant power capability with the stoplight power used as a back-up.

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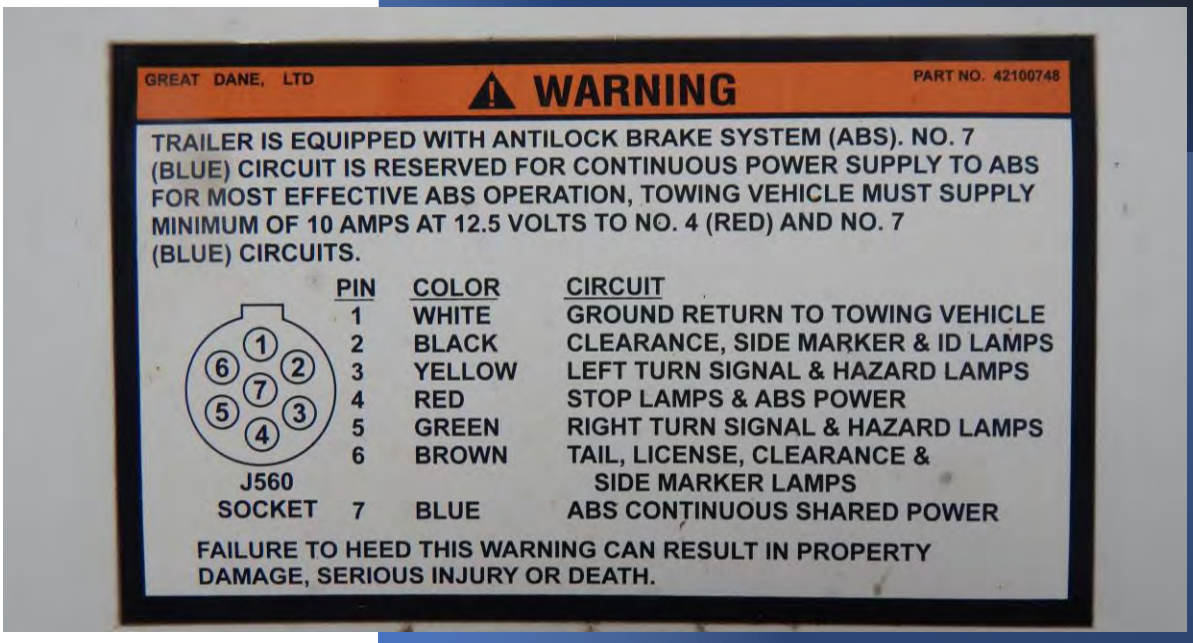

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Bendix Chuff Test

- All ABS systems go through an initial self-test when powered up. Basically, it is a bulb check and test for any issues with the ABS system. That typically takes 2.5 or more seconds depending on the system (how many modulator valves etc.)
- So, for example, a Meritor system, you will hear clicking coming from the modulator valves.
- With all systems if the bulb goes out, there is no issue.
- Up to this point , that's as simple as it gets.

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Bendix Chuff Test

- **Bendix however has another test you can perform for diagnostics called a "Chuff Test".**
  - **On constant powered systems, with the ignition on, air fully charge, and service brakes applied, their system energizes the modulator valves in a specific manner to allow (via the air puffs) a technician the opportunity to verify they are operating properly.**
- **If there are any issues from the first initial test indicated by active DTC/DTC's, this stop lamp cross-check portion of the chuff-test will not be carried out until all DTC's are fully diagnosed and corresponding repairs are successfully conducted.**
  NOTE: This test cannot be performed if wheel speed sensors indicate motion.
- **If performing just an ABS check, make sure you are not applying the service brake. It could lead you to a wrong conclusion.**

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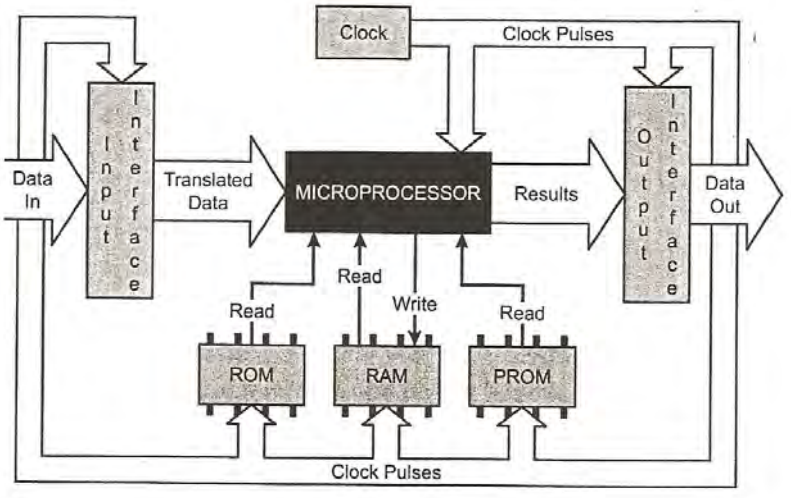
ECU



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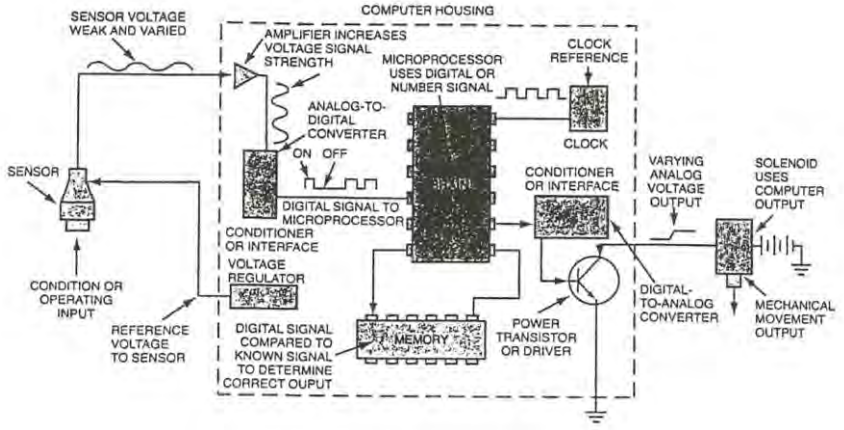
ECU



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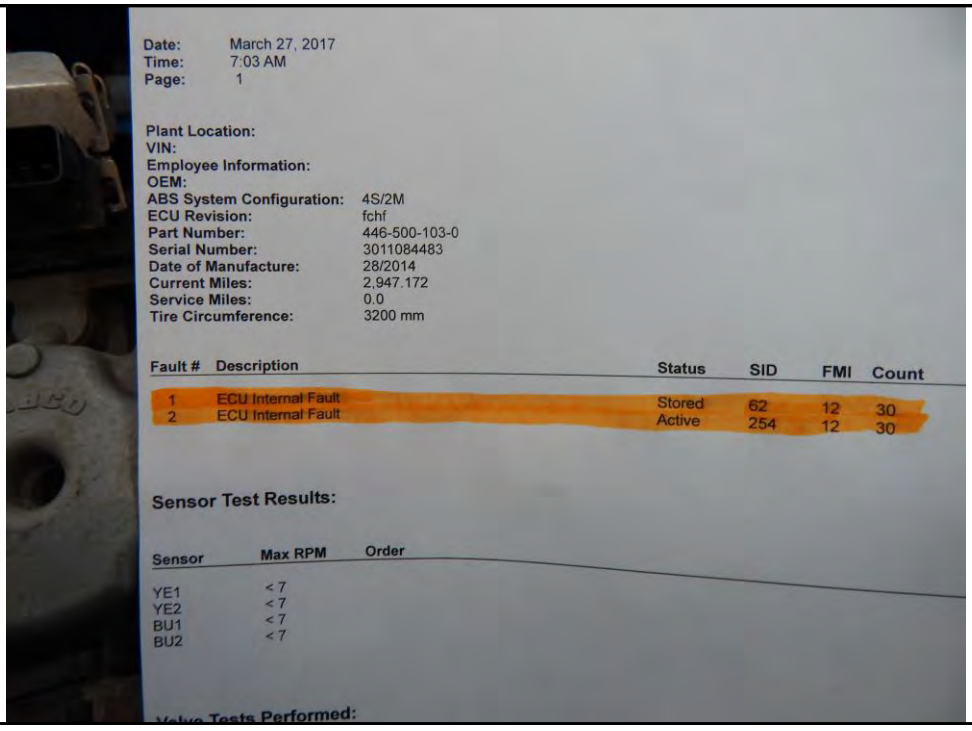

Date: March 27, 2017
Time: 7:03 AM
Page: 1

Plant Location:
VIN:
Employee Information:
OEM:
ABS System Configuration: 4S/2M
ECU Revision: fchf
Part Number: 446-500-103-0
Serial Number: 3011084483
Date of Manufacture: 28/2014
Current Miles: 2,947.172
Service Miles: 0.0
Tire Circumference: 3200 mm

Fault #	Description	Status	SID	FMI	Count
1	ECU Internal Fault	Stored	62	12	30
2	ECU Internal Fault	Active	254	12	30

Sensor Test Results:

Sensor	Max RPM	Order
YE1	< 7	
YE2	< 7	
BU1	< 7	
BU2	< 7	

Valve Tests Performed:

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ECU

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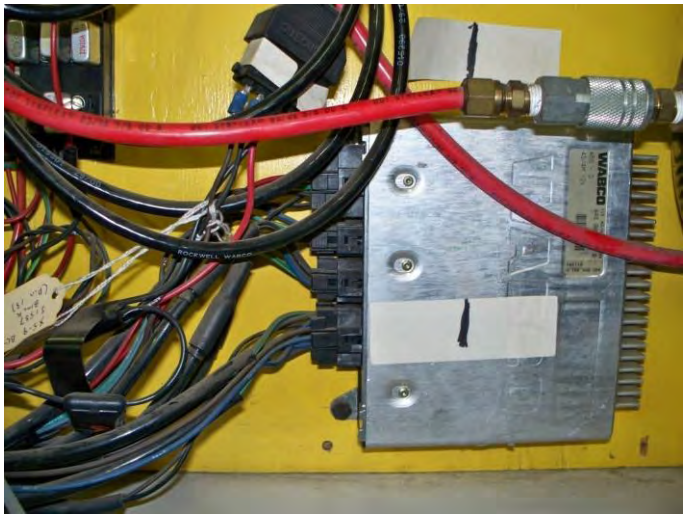
ECU

57

ECU



58

MODULATOR VALVES

ABS modulator valves regulate the brake application pressure to the ABS controlled brakes. When not receiving commands from the ECU, the modulator valve allows air to flow freely and has no effect on the brake pressure. The ECU can typically command the modulator valve to:

***Reduce the brake application pressure.**
***Hold the existing pressure, or:**
***Allow the pressure to increase.**

"HOWEVER," It can't Increase the brake pressure above that applied by the driver.

59

MODULATOR VALVE(S)

The modulator valve typically contains two solenoids. If the ABS controlled brakes are controlled by a relay valve, the modulating valve may be incorporated into the relay valve and control the input to the relay. The modulator valve may also be a separate valve inserted into the air line to the brake chamber(s) itself.

When the modulator valve is a separate valve, it has to control air flow, and therefore, includes two larger diaphragm valves which are controlled by the solenoid valves. It usually has three ports:

*** The supply port receives air from the brake or relay valve.**

*** The delivery port sends air to the brake chambers.**

*** The exhaust port vents air from the brake chamber(s).**

60

MODULATOR VALVE(S)

Typically, when an ECU controlling a separate modulator valve detects impending wheel lock-up, the solenoids activate to close the supply port and open the exhaust port. When enough air is vented to prevent wheel lock-up, the exhaust valve will close and the ECU will depending on the situation, either:

*** keep the supply port closed to maintain existing pressure, or;**

*** open the supply port to allow brake application pressure to increase and repeat the cycle.**

61

MERITOR WABCO

ABS Modulator Valve

- Used for steer axle and drive axle
- Is mounted between the relay / quick release valve and the brake chamber
- Two diaphragm design
- Controls the air pressure in the brake chamber during ABS control (supply, hold, release)

62

This is an ABS External Modulator Valve used in conjunction with a ECU/dual modulator valve on a 4S/3M premium configuration.

- Controls air pressure to the brake chambers where it is plumbed.
- During ABS mode, this valve adjusts air pressure to the brake chambers to control braking and prevent wheel lock.

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ABS activated during roadside inspection

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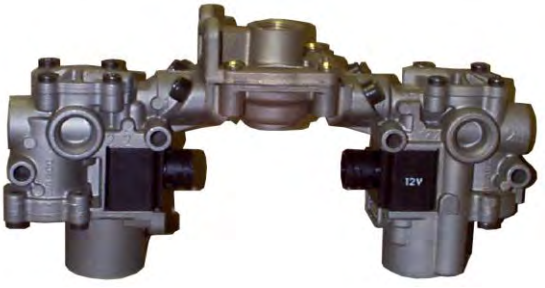
ABS Front Axle Valve Package

- **Package Includes Quick Release Valve And Two ABS Modulator Valves**
- **Installation Significantly Simplified**
  - **Mounts On Forward Crossmember**
- **Serviceable**



69

ABS Rear Axle Valve Package

Package Includes Relay Valve And Two ABS Modulator Valves

- **Relay Valve Determines Crack Pressure**

Two Delivery Ports Per ABS Valve (One For Each Brake Chamber)

Serviceable

70

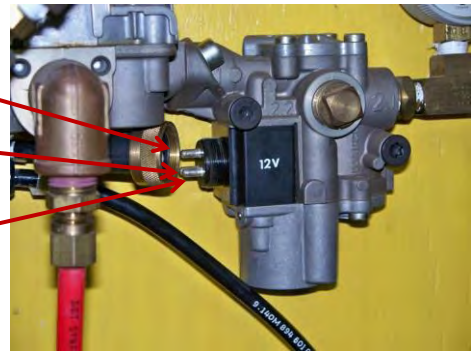
TESTING RESISTANCE OF MODULATER VALVE SOLENOIDS

Resistance can be measured across the ABS valve solenoid connector terminals. When measured between the common pin (1) and either of the solenoid pins (2 or 3), the resistance should be between 4 and 8 ohms.

Pin 1 "Common"

Pin 2 "Inlet Solenoid"

Pin 3 "Exhaust Solenoid"



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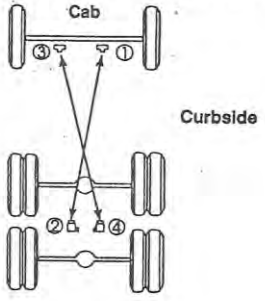
Easy Listening Tip!

To make sure the ABS valves are working — just listen!

1. Turn on the ignition.
2. Wait for the ABS light.
3. Listen to the valves cycle one by one, then together diagonally, as follows:

   Valve Cycle Order: 1 – 2 – 3 – 4 – 1 & 2 – 3 & 4



73

ABS Wheel Speed Sensor and Tooth-wheel

- Stamped or machined tooth wheel
- Fourth generation sensor in production
- Inductive sensor
- Stainless steel housing
- Sensor head completely over-molded
- Over-molded connector
- Delivers wheel speed information to ECU
- Self adjustable air gap due to clamping bushing

74

WHEEL SPEED SENSORS

There are two main components needed to make the wheel speed sensor functional. "The exciter and the Pickup".

- Exciter – Is a ring with notched teeth. The most commonly used exciter has 100 evenly spaced teeth, but that number can vary. Also called sensor ring, tooth wheel, tone ring.
- Sensor Pickup – Is commonly called the wheel speed sensor.

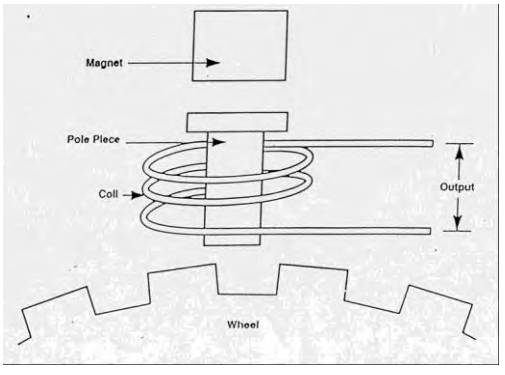
75

WHEEL SPEED SENSORS

The sensor contains a wire coil/magnet assembly, which generates pulses of electricity as the teeth of the exciter ring pass in front of it. The ECU uses these pulses to determine wheel speed and rates of acceleration/deceleration. The strength of these pulses are dependent upon the "GAP" between the pick-up and the exciter.

76

VARIABLE RELUCTANCE SENSOR



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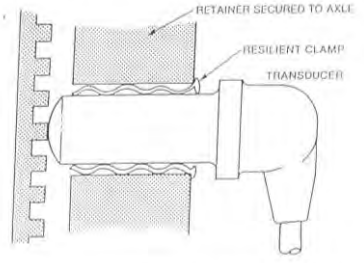
WHEEL SPEED SENSORS

Sensor location can vary. It can be located anywhere on the axle.

The sensor pickup is a sealed unit and typically features one of two designs; elbow or straight.



Automatic gap setting sensor arrangement

78

Sensor Adjustment

- **Self adjusting**
  - **Push sensor in until you have contact with tooth wheel**
  - **Wheel end play will push sensor away from tooth wheel**
  - **Required gap of .040 or less**
- **Wheel bearing adjustment must be within spec (0 to .005 run-out) to maintain proper sensor adjustment**

79

WHEEL SPEED SENSORS

The sensor arrangement used on most ABS air-braked vehicles have a pickup located in the mounting flange on the wheel end.

The tooth wheel is either mounted on or integrated with the hub wheel.

Since the output of the pickup decreases so rapidly with slight increases with the "GAP", it is important that the wheel end and sensor gap be properly maintained

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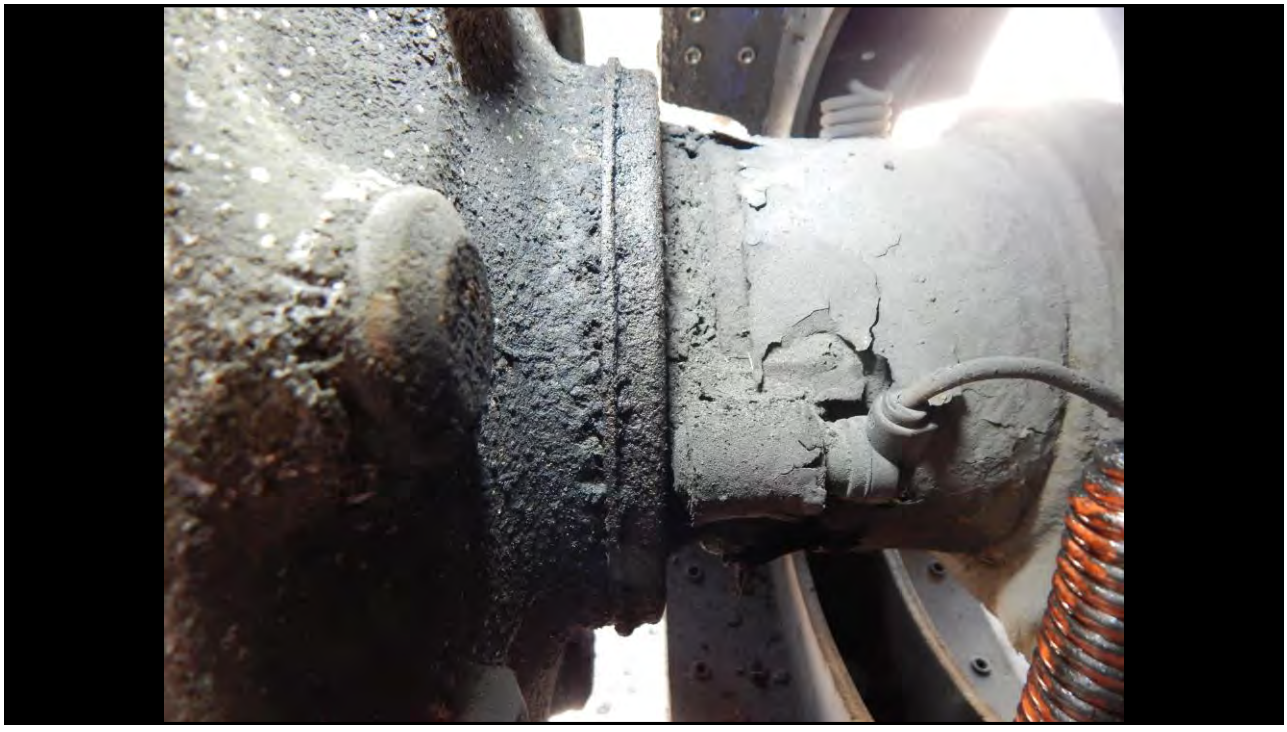

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WHEEL SPEED SENSORS

When the wheels of one tandem axle has wheel speed sensors, the sensors are usually placed on the axle whose wheels are most likely to lockup first during braking.

On a tandem axle with spring suspension, the sensors are generally on the lead axle.

On a tandem axle with air suspension, the sensors are generally located on the trailing axle.

83

PROPER ABS SENSOR RESISTANCE

For most common types of ABS sensor , the sensor circuit resistance is between 700 – 3000 ohms.

Resistance can be measured at the sensor's connector for ease of access, or at the ECU to verify integrity of the sensor circuit all the way to the ECU.

84

SENSOR VOLTAGE CHECK

To perform a sensor voltage check, the wheel for the sensor being checked has to spin, (typically 30 rpm or more).
The voltage should be at least 0.200-volt AC. A voltage reading below this would usually indicate too large of a gap between the sensor and tooth wheel.

"How can you tell how fast you are spinning the wheel?"

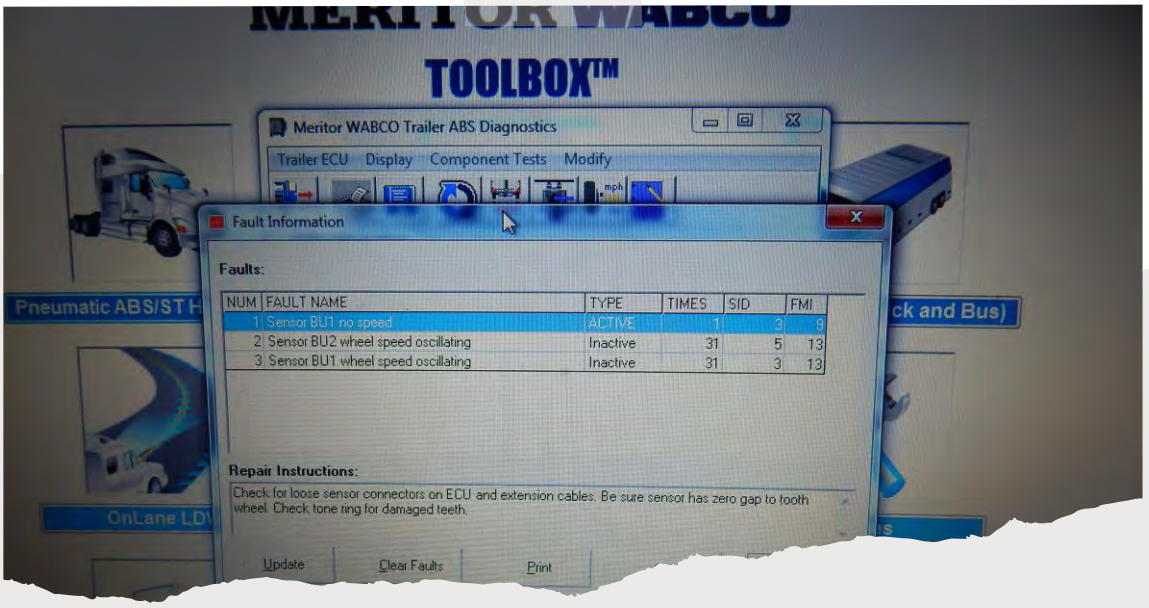
"Should you know that kind of information to compare one wheel to the other?"

85

ABS DIAGNOSTICS

All air-brake ABS manufacturers offer systems with self-diagnostic capability. On tractors and trucks, ABS provides this information to us through the warning lamp and/or an electronic diagnostic tool, which plugs into an diagnostic connector. Usually, it is the same connector that is used to troubleshoot electronic engines.

86



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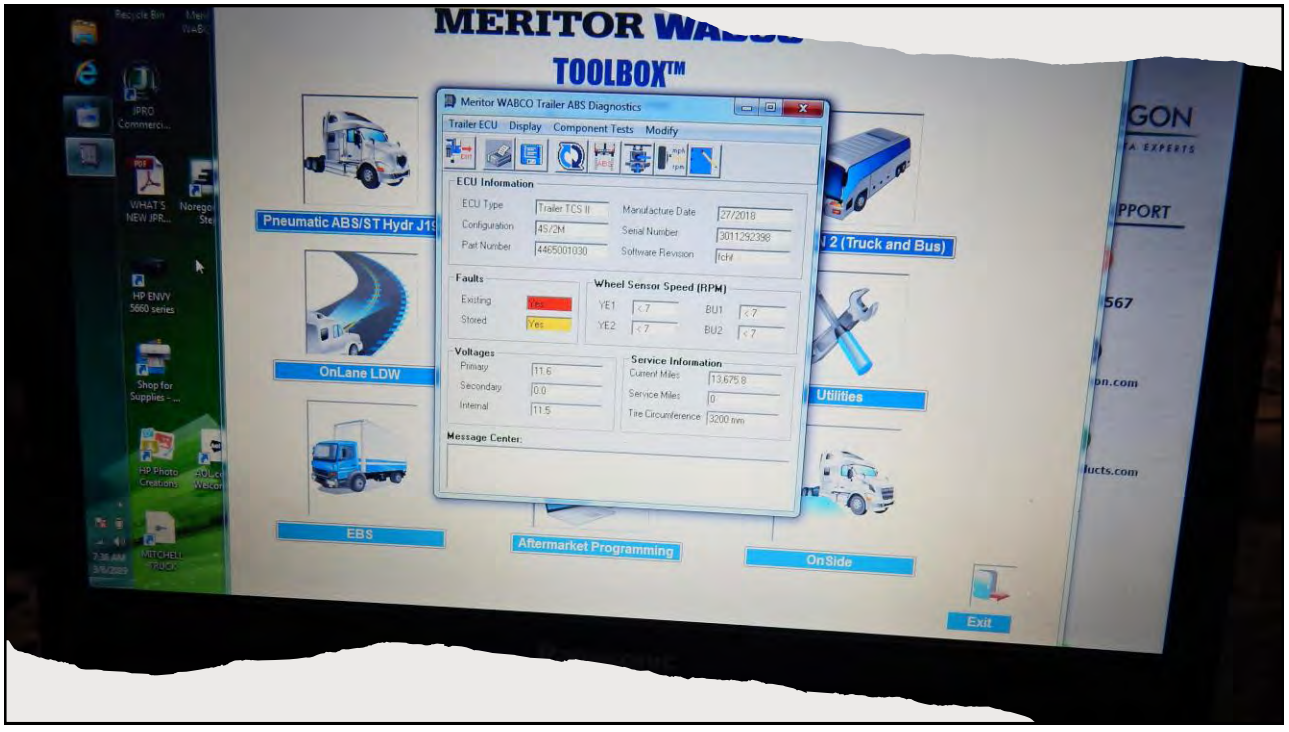

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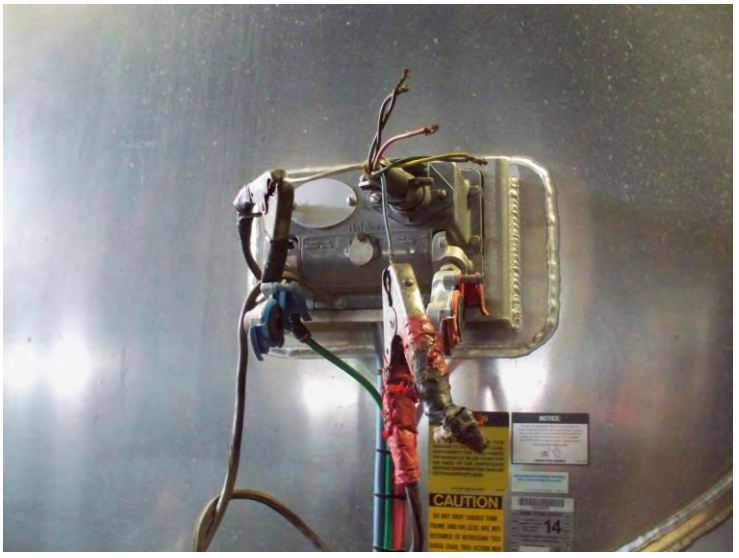
ABS DIAGNOSTICS

The ABS used on tractors and trucks may also use the ABS malfunction lamp to signal stored fault information through a blink code. Those vehicles that have this type of ABS have a blink code switch, located somewhere on the vehicle to activate the blink code system. Other ABS's may have light emitting diodes (LED's) on the ECU to indicate problems.

ABS's on trailers sometimes have a place to connect an electronic diagnostic tool. The connector is either on a pigtail to the ECU, or inside the ECU box.

89



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DIAOGNOSTIC LEDs

91

TRACTION CONTROL SYSTEMS

Traction control systems are designed to prevent the spinning of powered wheels which cause traction loss in the power mode.

It does this by braking the spinning wheels and sometimes throttling back the engine power. Traction control electronics are integrated into the ABS "ECU".

The air pressure to apply the brakes is supplied by a solenoid valve inserted into the brake control line going to the relay valve controlling the brakes on the powered axle(s).

92

TRACTION CONTROL SYSTEMS

The system works by applying the brakes on the spinning wheel(s) when the wheel speed sensors tell the ECU that a wheel is accelerating to a much faster speed than the wheel on the other end of the axle.

It does this by energizing the solenoid valve, which directs air pressure to the relay valve and at the same time closing the modulator valves to keep air pressure from the brake chambers.

The ECU then starts pulsing air into the brake chamber on the spinning wheel until the ECU is satisfied with the wheel speed balance.

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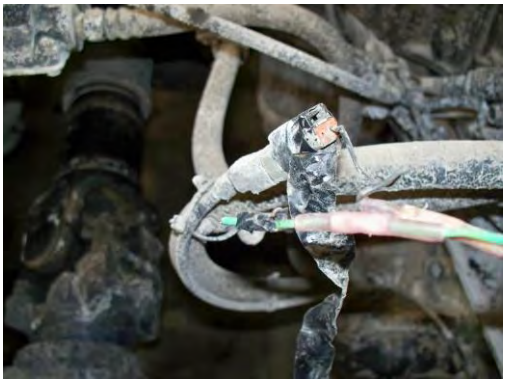
NOTE:
One benefit of monitoring wheel speed with a tooth wheel/sensor system is that dirt or dust does not affect operation. If the space between the teeth are full of dirt and particles from the brake linings, the monitoring operation is not affected. The magnetic properties of dirt in the gaps are similar to that of air. As long as the change in the magnetic field is determined by the teeth and the space of the tooth wheel, the output voltage will remain unaffected.
Removing the dirt with compressed air will not remedy an ABS fault. "Dirt in the gaps doesn't affect voltage output".

94



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100

ANTILOCK BRAKE SYSTEMS (ABS) INSPECTIONS

ABS Malfunction Indicator Lamps

Vehicles required to have an "ABS": Must have an ABS malfunction indicator lamp.

ABS In-cab Malfunction Indicator Lamp

101

ANTILOCK BRAKE SYSTEMS (ABS) INSPECTIONS

They must be Yellow and light up when the ABS has a "malfunction"

that affects the generation or transmission of response or control signals"

in the ABS.

They are also required to light up for short periods of time for a "bulb check", whenever the ABS starts to receive electrical power.

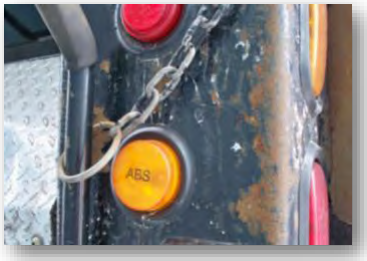
Typically, when the key is turned on.

NOTE: Warning lamps for trailers and dollies are not required to light up for a bulb check unless the vehicle is stopped.

102

ANTILOCK BRAKE SYSTEMS (ABS) INSPECTIONS

All trailers/dollies built on or after March 1,1998 must feature an external ABS MIL as part of the ABS.



All new trailers must be capable of activating an in-cab (towing Vehicle) trailer lamp beginning in March 2001.

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ANTILOCK BRAKE SYSTEMS (ABS) INSPECTIONS

NOTE: The location of the ABS lamp will vary amongst vehicles. There seems to be no standard. Also, the style will differ between manufacturers. And if the bulb does not come on for bulb check, it could be a challenge to locate the ABS light. There is no criteria to how long the bulb should stay on. It could be a short period of time. This could require the cycling of the key a few times.

104

Annual Inspection Requirements

ABS has been added to:

Appendix A to subchapter B of Chapter III- Minimum Periodic Inspection Standards.

This basically updates the minimum periodic inspection standards to include requirements to inspect anti-lock brake systems and automatic brake adjusters.

The ABS portion deals with ABS Indicators and malfunctions and missing or inoperative ABS components.

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ANTILOCK BRAKE SYSTEMS (ABS) INSPECTIONS

In the U.S. the following vehicles are exempt from the requirements to have ABS:

- **Any trailer that has a width of more than 102.36 inches with extendable equipment in the fully retracted position and is equipped with two short track axles in a line across the width of the trailer.**
- **Any vehicle equipped with an axle that has a gross axle weight rating (GAVWR) of 29,000 pounds or more.**
- **Any truck that has a speed attainable in 2 miles of not more than 45 mph, an unloaded vehicle weight that is not less than 95% of its gross vehicle weight rating (GVWR), and no capacity to carry occupants other than the driver and operating crew.**

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ANTILOCK BRAKE SYSTEMS (ABS) INSPECTIONS

Any trailer that has a GVWR of more than 120,000 pounds and whose body conforms to that described in the definition of heavy hauler trailer set forth in S4; *Heavy hauler trailer* means a trailer which has one or more of the following characteristics, but which is not a container chassis trailer:

Its brake lines are designated to adapt to separation or extension of the vehicle frame, or

Its body consists only of a platform whose primary cargo-carrying surface is not more than 40 inches above the ground in an unloaded condition, except that it may include sides that are designed to be easily removable and a permanent "front end structure" as that term is used in (393.106) of this title.

Any trailer that has an unloaded weight which is not less than 95% of its GVWR.

Any load divider dolly.

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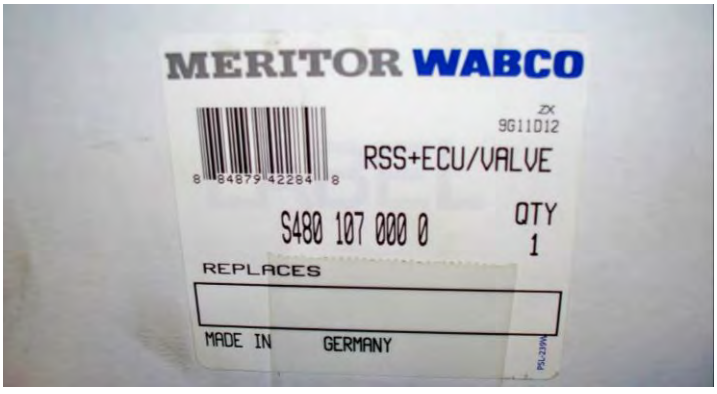
Trailer with " ROLL STABILITY SUPPORT"

108



ROLL STABILITY SUPPORT (RSS)

- **This systems ECU provides additional assistance to maintain trailer directional stability with "ROLL STABILITY SUPPORT".**
- **"Combining the data received from the wheel speed sensors and an internal lateral accelerometer, the RSS will proactively engage the Roll Stability Support to increase triler stability and reduce the possibility of a rollover condition."**

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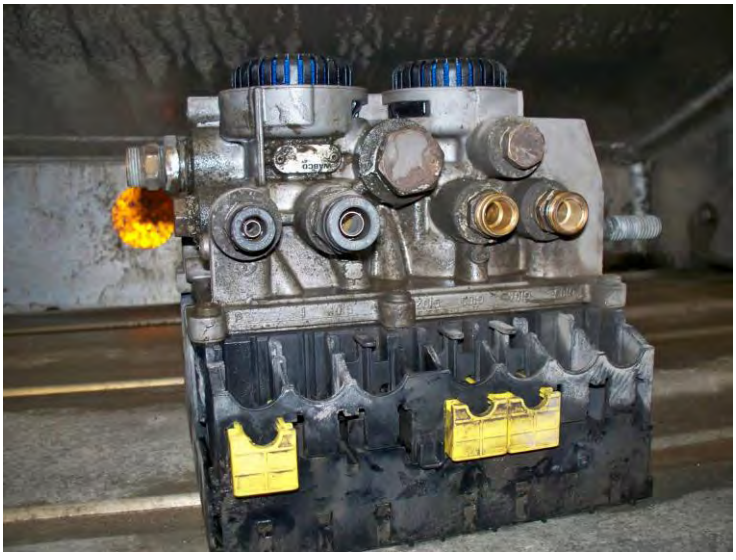

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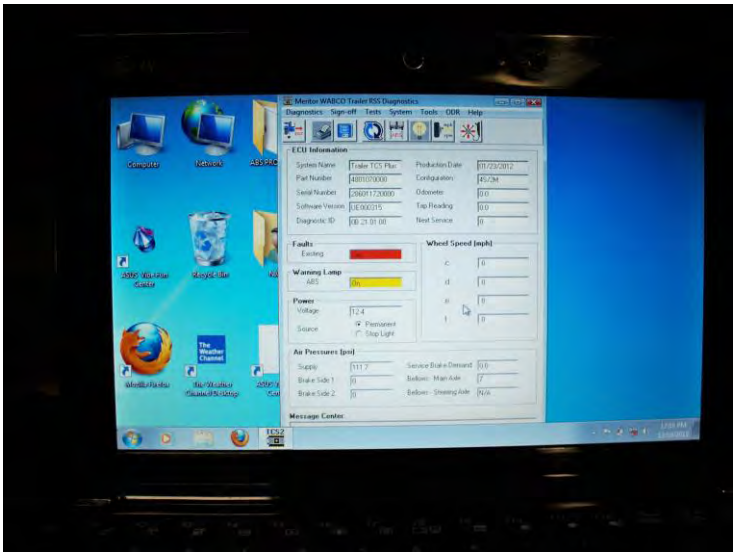
Muffler used on the WABCO RSS system.

113


Meritor WABCO Trailer RSS Diagnostics
Diagnostics Sign-off Tests System Tools ODR Help
ECU Information
Faults
Warning Lamp
Power
Wheel Speed (mph)
Air Pressures (psi)
Message Center

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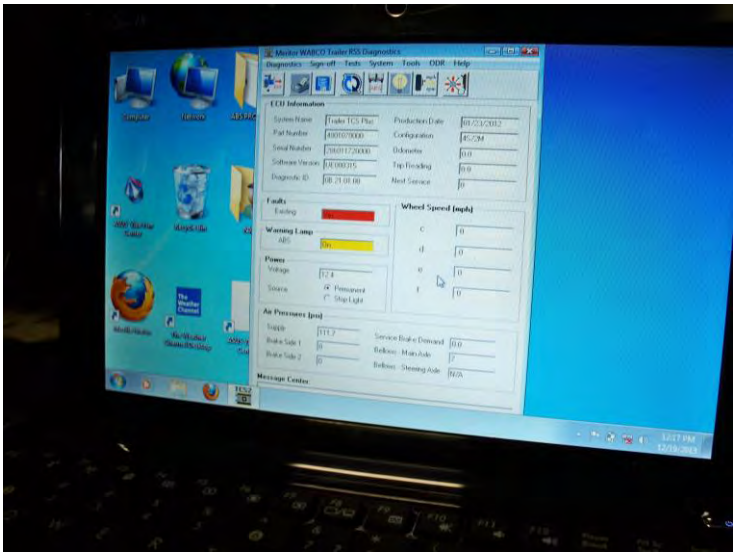
Meritor WABCO Trailer RSS Diagnostics
Diagnostics Sign-off Tests System Tools ODR Help
ECU Information
Faults
Warning Lamp
Power
Wheel Speed (mph)
Air Pressures (psi)
Message Center

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Final Thoughts

Many manufacturers have used the "ABS" platform to provide various other safety systems. The following are some examples:

- **Automatic Traction Control (ATC)**
  - **ATC improves traction in various road conditions such as snow and ice. In simple terms- ABS reduces brake pressures to prevent wheel-lockup.**

    ATC applies brakes to help improve traction.
- **Electronic Stability Control (ESC)**
  - **ESC is utilized to prevent rollover and maintain directional stability to keep the vehicle traveling on its intended path rather than spinout and/or drift out of control.**

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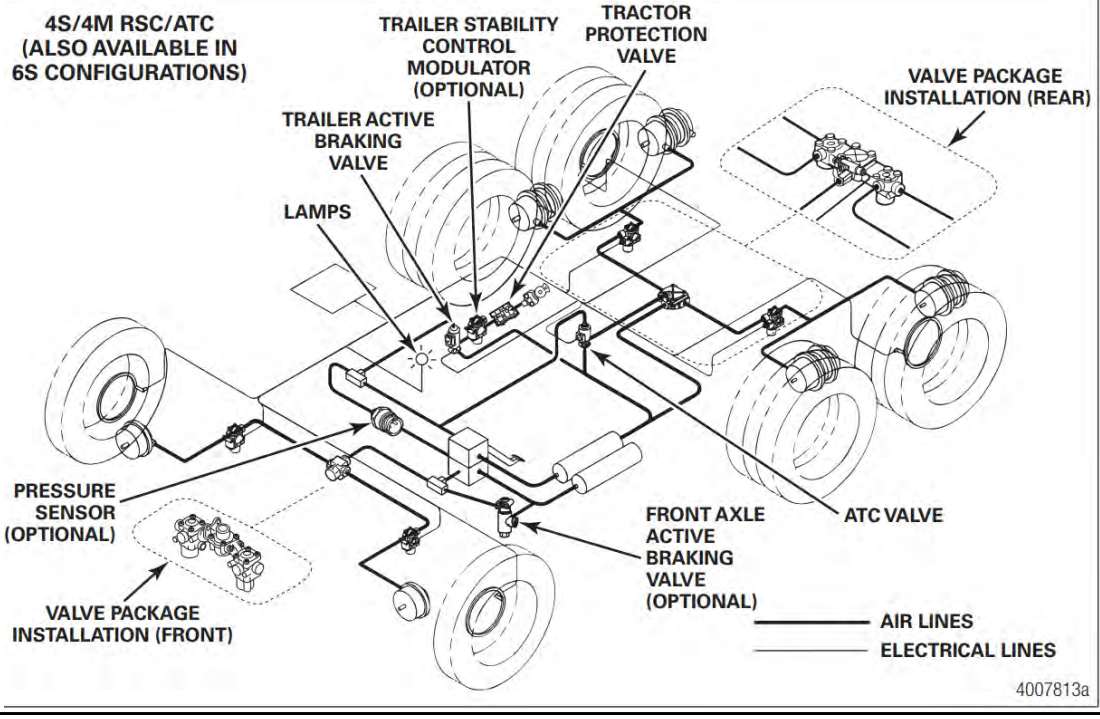

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Final Thoughts

- **Active Braking Systems**
  - **Utilize valves/solenoids to provide braking during ATC or ESC events.**

All the fore mentioned coupled with various sensors, cameras, radar etc. allowed manufactures to ease into Collision Mitigation. For example:

WABCO's "ONGUARD COLLISION SAFETY SYSTEM" and BENDIX's WINGMAN FUSION DRIVER ASSISTANCE SYSTEM"

Just like cars these systems have become very sophisticated.

One "commonality" with all these systems is electronics, sensors, radar, modules etc.

Are you informed enough to diagnose and repair these systems?

Possible future Lunch and Learn

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We offer greater freedom to fix cars and trucks by engineering exclusive, labor-saving and cost-effective repair solutions.

Thank You !

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