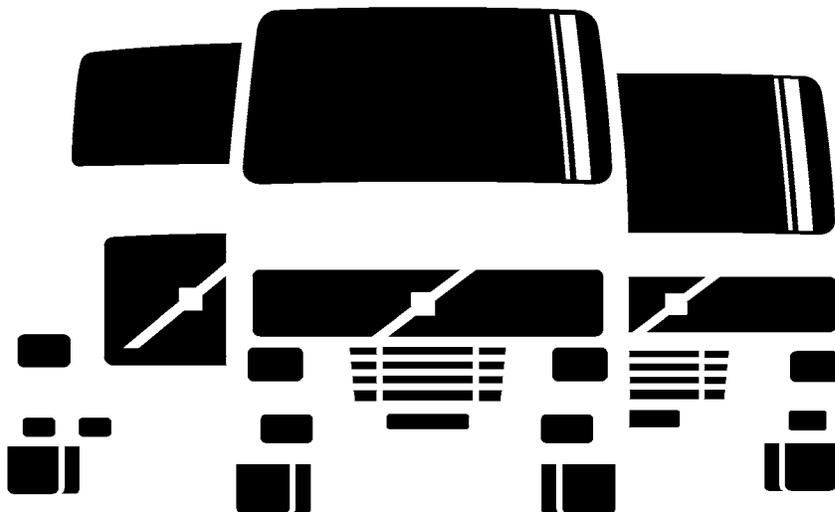


Service Manual Trucks

Group **593–502**

Anti-Lock Brake System (ABS)
MERITOR WABCO with E Version ECU
VN/VHD



Foreword

The descriptions and service procedures contained in this manual are based on designs and methods studies carried out up to June 2001.

The products are under continuous development. Vehicles and components produced after the above date may therefore have different specifications and repair methods. When this is believed to have a significant bearing on this manual, supplementary service bulletins will be issued to cover the changes.

The new edition of this manual will update the changes.

In service procedures where the title incorporates an operation number, this is a reference to an S.R.T. (Standard Repair Time).

Service procedures which do not include an operation number in the title are for general information and no reference is made to an S.R.T.

The following levels of observations, cautions and warnings are used in this Service Documentation:

Note: Indicates a procedure, practice, or condition that must be followed in order to have the vehicle or component function in the manner intended.

Caution: Indicates an unsafe practice where damage to the product could occur.

Warning: Indicates an unsafe practice where personal injury or severe damage to the product could occur.

Danger: Indicates an unsafe practice where serious personal injury or death could occur.

Volvo Trucks North America, Inc.
Greensboro, NC USA

Order number: PV776-TSP154520

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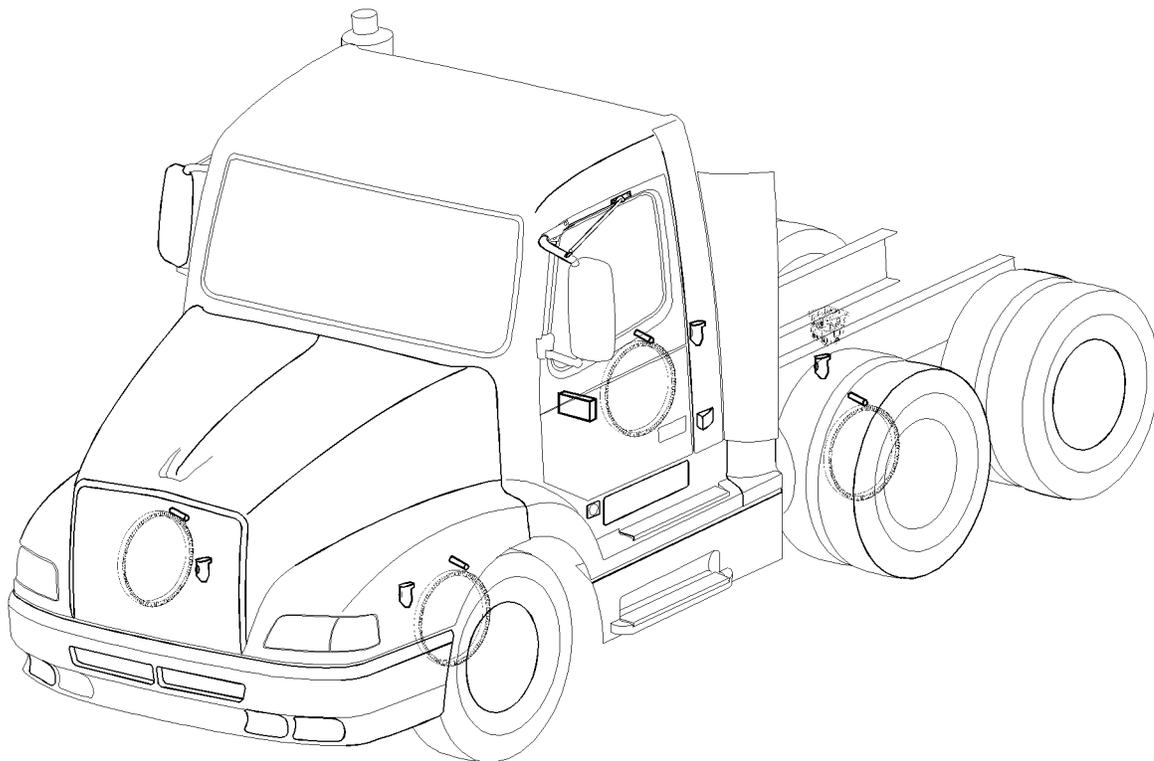
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General

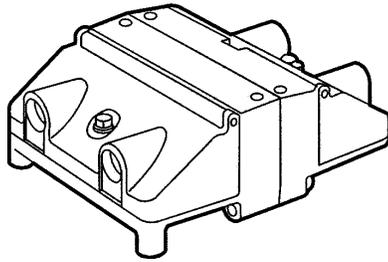
Anti-Lock Brake System with the E Version ECU

This manual contains service information for the E version Meritor WABCO Anti-Lock Braking System (ABS) and ABS with Automatic Traction Control (ATC) for trucks, tractors and buses. The E version ABS incorporates the Power Line Carrier Communication (PLC), an optional feature that allows tractor/trailer communication. For the driver, this means that a trailer ABS indicator lamp located on the vehicle dash will come on if a fault occurs in the trailer ABS.



Specifications

Electronic Control Unit



Make, Model Rockwell WABCO Series E
 Power requirement 12 VDC, two 10 amp fuses (in-line)
 ABS ECU power relay Relay R7 (VN), Power Relay PR3 (VHD)

Inputs

Wheel speed information 100 pulses per wheel revolution, variable voltage
 Traction control mode selection via dash switch

Outputs

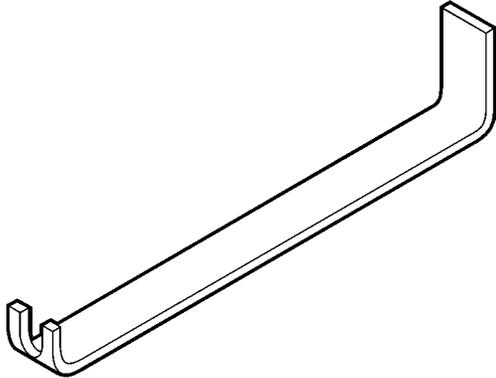
ABS Modulator valve signal pulsating on/off
 Traction control solenoid on/off
 Engine ECU reduces engine torque (Traction Control System)
 Engine ECU (via SAE J1939, see note¹) reduces engine torque (Traction Control System)
 Data Link SAE J1587/J1708 diagnostic information to instrument cluster
 Data Link SAE J1939 retarder interrupt and traction control functions
 Dash Lights Tractor ABS warning light (via relay R3), TCS warning light (VN)
 Tractor ABS warning light (via relay R9), TCS warning light (VHD)
 Trailer ABS Warning light

¹Available with Volvo engines from 1/1998.

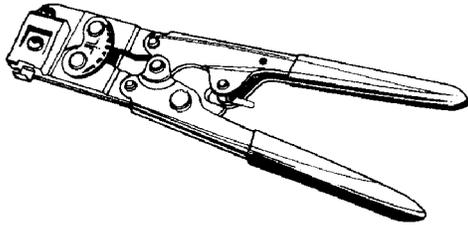
Tools

Special Tools

The following special tools may be required for work on the Anti-Lock Braking System. The tools can be ordered from the vendor specified in the tool description. Please use the corresponding tool number when ordering (Kent Moore 1-800-328-6657).



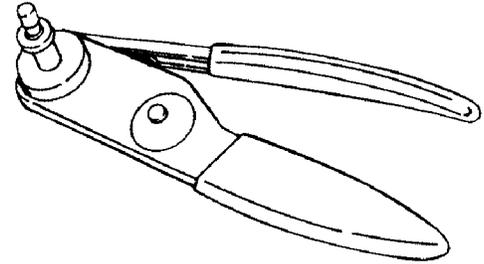
J-42942 ABS sensor adjustment tool (Kent-Moore)



J-35123 Metri-Pack hand crimp tool (Kent-Moore)



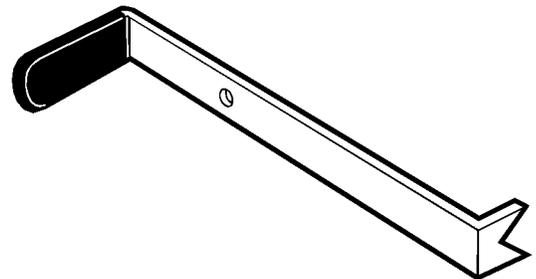
J-38125 Metri-Pack contact removal tool (Kent-Moore)



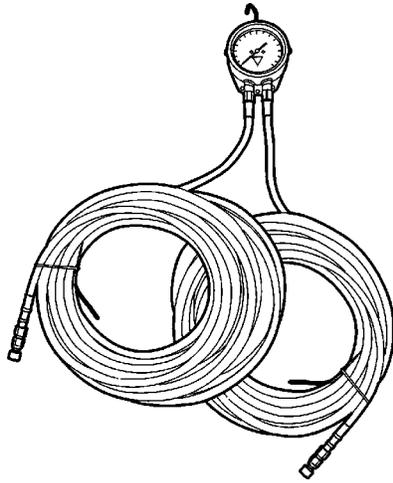
J-34182 Deutsche universal hand crimp tool (Kent-Moore)



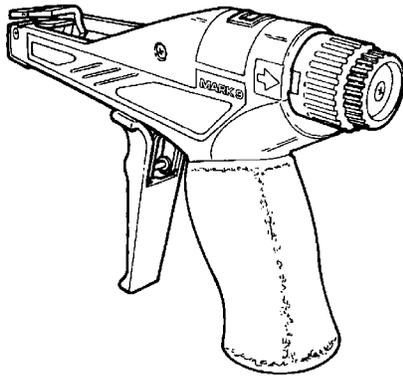
J-37451 Deutsche heavy-duty contact removal tool (Kent-Moore)



J-42189 Air line release tool (Kent-Moore)

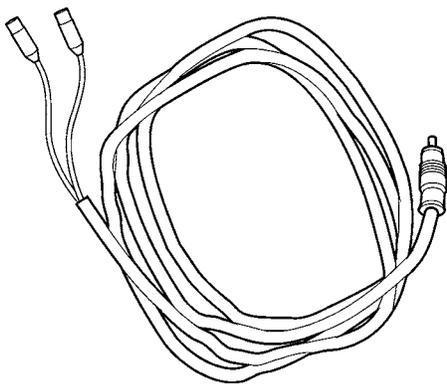


J-44399 Air System Tester

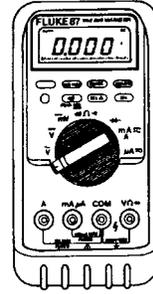


J-43143

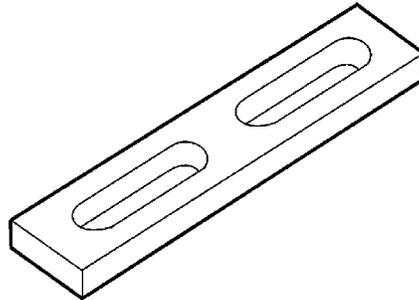
J-43143 Tie Strap Tensioner



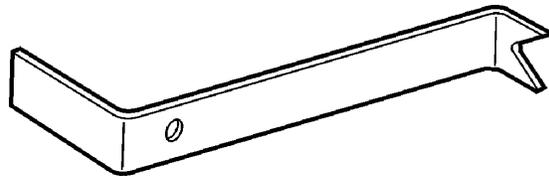
J-42883 Sensor pin-out cable (Kent-Moore)



Fluke 87 Digital Multimeter (John Fluke Mfg. Corp.)



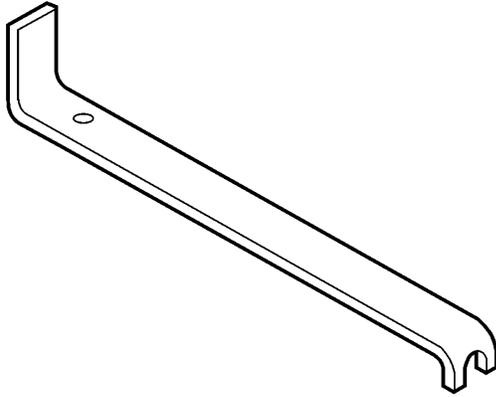
J-44775 Valve Assembly Fixture



J-44773 Airline Release Tool



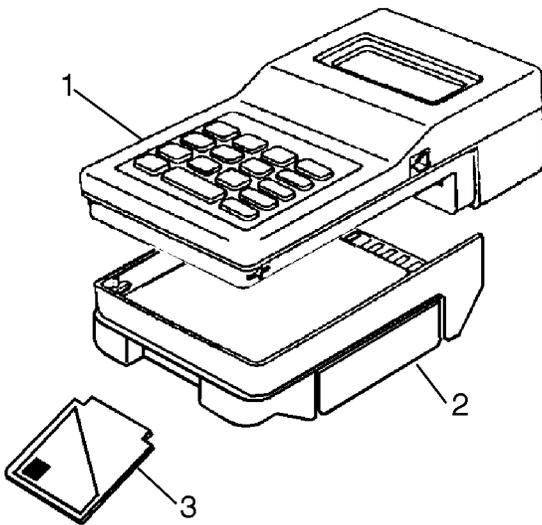
J-44769 Wheel Speed Sensor Extractor



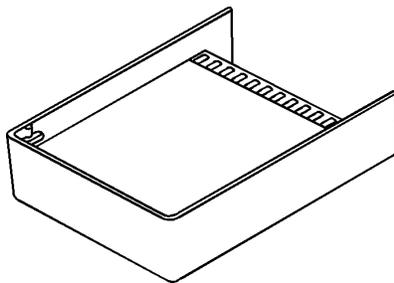
J-44966 Wheel Speed Sensor Remover for Heavy Duty Steer Axle and Aluminum Hub

Special Equipment

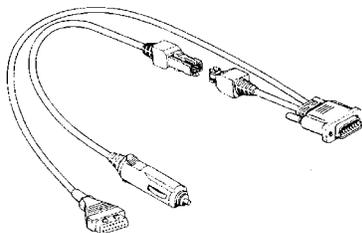
The following special equipment may be required for troubleshooting the Anti-Lock Brake System and can be ordered from the vendor specified in the equipment description.



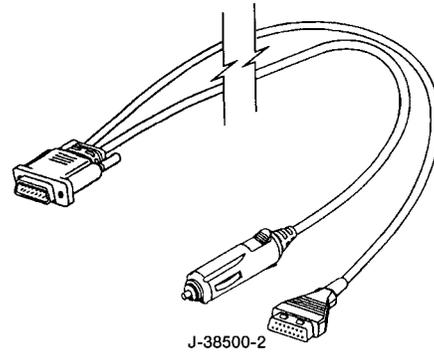
- 1. **108004** Pro Link 9000 with cartridge
- 2. **208040** MPC Cartridge
- 3. **808014** Wabco Application Card



J-38500-1100 MPSI Wabco ABS cartridge (Kent-Moore)



501002 Power/Data Cable, current version (MPSI)



J-38500-2 Power/Data Cable, earlier version (Kent-Moore)



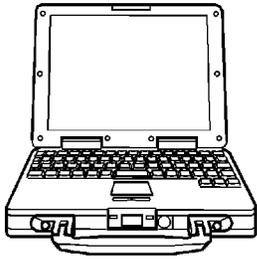
J-38500-60A Diagnostic cable adapter (Kent-Moore)



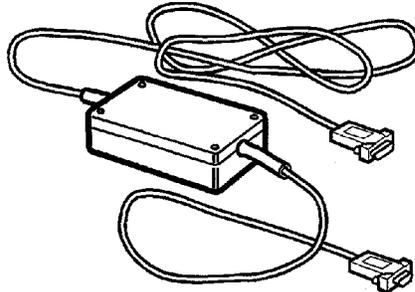
J-44012 Interface Adapter-ProLink

VCADS Pro Tools

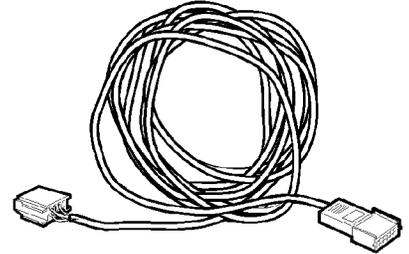
The following hardware is used to operate VCADS Pro. The tools can be ordered from Volvo Trucks North America quoting the specified part number.



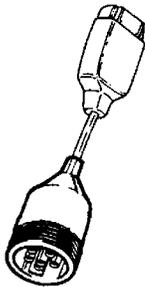
1



2



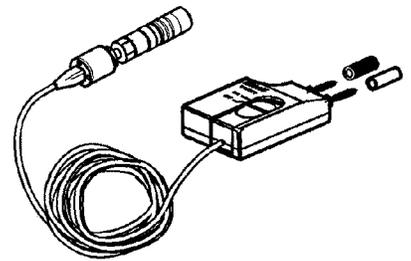
3



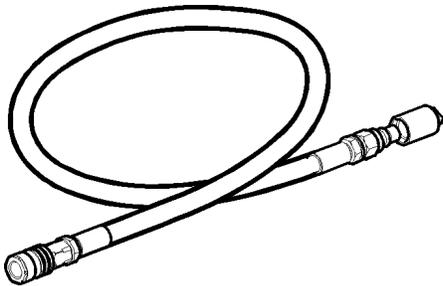
4



5



6

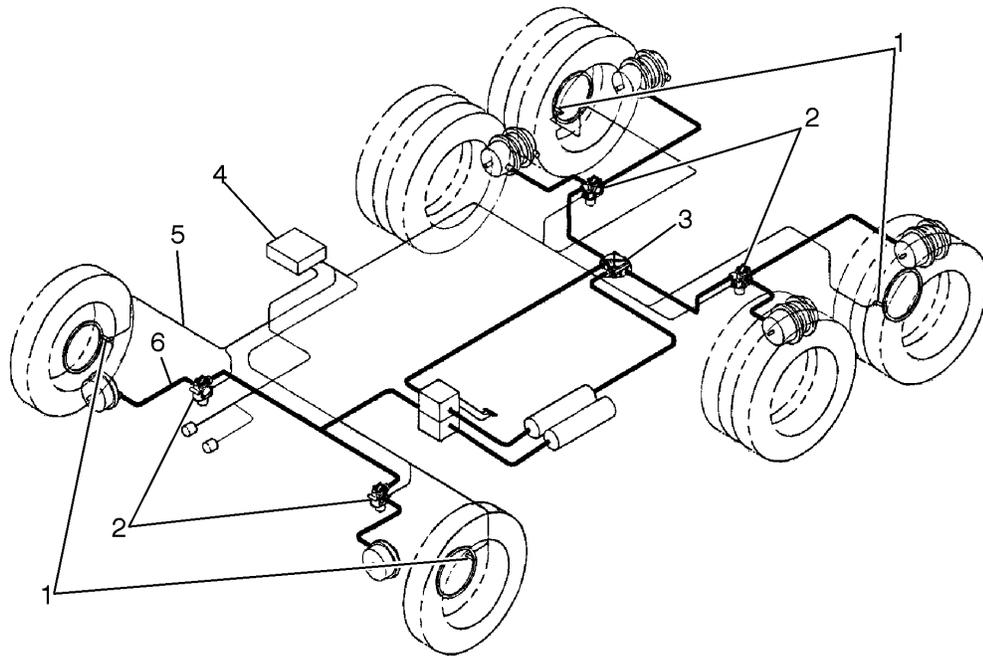


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- | | | | |
|---|----------------------------------------------------------------|---|--------------------------------------------------------------------------|
| 1 | PC tool-package | 5 | J-43939, 9 pin Diagnostic adapter (for vehicles built from January 1999) |
| 2 | 9998555, Communication interface unit | 6 | 9998496, Pressure gauge |
| 3 | 9812331, Extension cable | 7 | 9998495, Air Pressure Hose |
| 4 | J-43999, 6 pin Diagnostic adapter (for vehicles prior to 1999) | | |

Design and Function

Anti-Lock Brake System



4S/4M ABS with Traction Control

A	Air Lines
B	Electrical Lines
1	Wheel Speed Sensors
2	ABS Modulator Valves
3	Relay Valve
4	E Version ECU

System Description

The ROCKWELL WABCO Anti-Lock Braking System (ABS) is an electronically controlled system that continually monitors wheel speed and controls wheel braking during extreme braking situations. The ABS works in conjunction with the standard vehicle braking system.

A typical ABS configuration uses 4 wheel speed sensors and 4 air modulator valves. This is known as a 4S/4M configuration. A 6S/4M (6 sensors, 4 modulator valves) configuration is also available. The ABS monitors the wheel speed at all times and helps control braking during hard braking or slippery road conditions. The ABS improves the vehicle's stability and control by reducing wheel lock during braking.

If the ABS detects a problem in the system, the ABS in the affected wheel(s) is disabled, but that wheel still has normal brakes.

Signals from the wheel speed sensors are received and processed by the ABS Electronic Control Unit (ECU). When the ECU determines that a wheel is going to a locked condition, the appropriate modulator valve is activated and pressure to the brake chamber is reduced. When the wheel speed enters the stable region again, the air pressure is increased.

Traction Control System

Some vehicles are equipped with a Traction Control System (ATC or ATC). ATC prevents the drive wheels from spinning when starting from a standing position on a slippery surface, or when accelerating. The ATC utilizes the ABS ECU for control, but requires an additional control valve to automatically apply compressed air to the spinning wheels to increase traction.

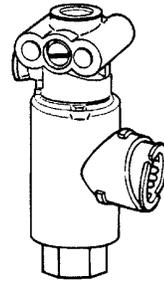


Fig. 1: ATC Valve

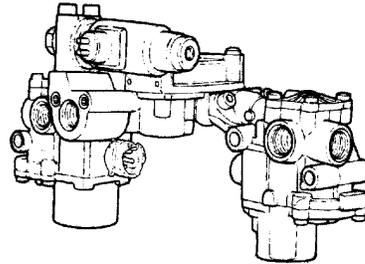


Fig. 2: ABS/ATC Valve Package

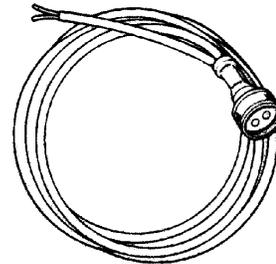


Fig. 3: ABS Modulator Valve Cable

The Anti-Lock Brake System (ABS) is an important component of the foundation brake system. Its purpose is to prevent wheels from locking up when the brakes are applied with great intensity under normal road conditions, or when applied normally on slippery road surfaces.

The ABS electronically monitors the rotational speed of both front wheels and the wheels on the rear axle. The wheel rotation signals are sent to an Electronic Control Unit (ECU) which sends signals to the ABS modulator valves if it detects that a wheel has locked up or is about to lock up. The modulator valves control the pressure to the service brake chambers.

Wheel rotation is determined by an electronic sensor mounted on the brake spider by a bracket. A signal is generated by the sensor as teeth on a tooth wheel (which is mounted on the wheel hub) pass by the sensor.

When the ECU senses that a wheel or set of wheels is about to lock during braking, a signal is sent to the appropriate modulator valve solenoid to intermittently open and close it. This opening and closing occurs very rapidly (several times per second) to reduce brake pressure and ensure that the wheel returns to rotating while still maintaining most of the brake capacity.

Some vehicles have a Traction Control System (ATC) included with the ABS. The ATC functions to stop a set of drive wheels from spinning when the driver attempts to accelerate the vehicle from a stand still or when a wheel is spinning due to road conditions, such as ice or loose gravel under the wheel. The ATC requires an additional valve that allows brakes to be automatically applied to

Tooth Wheel

The tooth wheel is an alloy ring that resembles a gear. It usually has 100 teeth cut into its surface. The purpose of the teeth are to cause a pulsating current flow in the sensor circuit. As the high side of each tooth passes near the sensor, it causes a small current to flow in the sensor. When the area between two teeth is in front of the sensor, the current flow stops.

As the tooth wheel rotates, the starting and stopping of the current flow is seen by the ECU as pulses. The greater the speed of the tooth wheel past the sensor, the more pulses are registered per second, which is a direct indication of wheel speed.

The tooth wheel is manufactured either as a ring that is pressed onto the wheel hub, or is machined as an integral part of the hub itself.

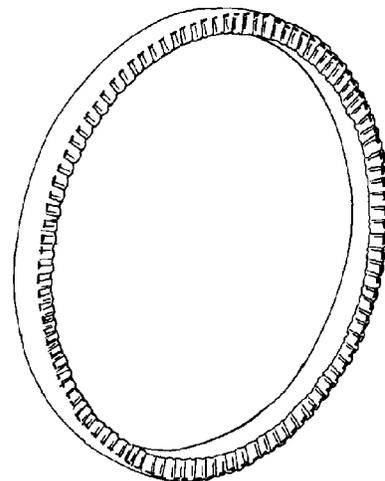
the spinning wheels.

The ROCKWELL WABCO ABS System consists of the following components:

- Tooth Wheel (4 or 6)
- Magnetic Sensor (4 or 6)
- Sensor Brackets and Locks (4 or 6)
- Modulator Valve (4)
- One of the following Electronic Control Units (ECUs)
 - ECU: 4S/4M ABS Only
 - ECU: 4S/4M ABS with ATC
 - ECU: 6S/4M ABS with ATC
- Fuses and Relays
- Tractor ABS Warning Lamp
- Trailer ABS Warning Lamp
- ATC Indicator Lamp
- Connectors
- ATC Switch (if ATC is installed)
- ATC Valve (if ATC is installed)

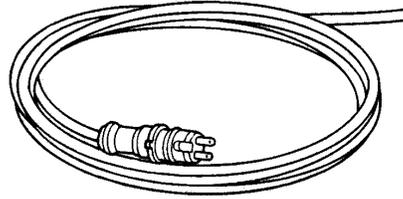
For design and function information about specific ABS components, see the following:

- "Tooth Wheel" page 15
- "Sensor" page 16
- "Modulator Valve" page 17
- "Electronic Control Unit (ECU)" page 20
- "Electrical" page 21
- "Instrumentation" page 22
- "Traction Control System" page 23
- "Tractor ABS Fault Detection" page 24
- "ABS Self-Tests" page 26



Sensor

The sensor is a magnetic inductor that allows current to flow through it from the ECU when the tooth wheel is passing in front of it. It continuously provides wheel speed information in the form of an AC signal to the ECU whenever the ignition is ON, regardless of whether or not the vehicle is in motion.



The sensors are installed in brackets that are bolted to the brake spider. Each sensor is held in place by a spring clip. The sensor is installed by pushing it all the way into the spring clip until it touches the tooth wheel.

The ABS is available in a 4- or 6-sensor configuration.

The standard 4 sensor/4 modulator ABS has a sensor on each front wheel. On a 4x2 vehicle, each rear wheel also has a sensor. On a 6x4 vehicle with 4-spring leaf suspension (with center equalizer or dogbone), the forward drive axle has sensors. On a 6x4 vehicle with all other suspensions, the rear drive axle has sensors (e.g. VOAS, B-ride, T-ride, RT, HN, HAS460) . On a 6x4 vehicle with traction control, both axles have sensors.

The 6-sensor configuration also utilizes 4 modulator valves, and has a sensor on each front wheel, and on each drive axle wheel.

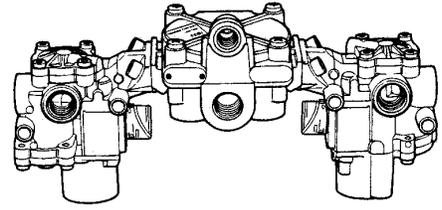
Note: On Heavy Duty Steer Axles and steer axles with Aluminum Hubs, some sensors are installed without the use of a bracket bolted to the Brake Spider.

Modulator Valve

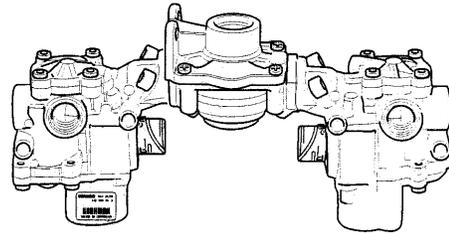
The ABS modulator valve is an air solenoid valve. It has two solenoid coils. One of the coils is energized to isolate the brake chamber from the brake system supply and vent the brake pressure from the brake chamber. The other coil is energized to isolate the brake chamber from the brake system supply and hold the pressure that is in the brake chamber.

During normal braking, compressed air for braking flows freely through the modulator valves to the brake chambers. When ABS function is required, the modulator valve for the affected wheel is energized on and off in order to quickly, but incrementally, reduce the braking air pressure to the point where the wheel begins to spin freely.

The modulator valves are located in the air supply path between the relay valve or quick release valve and the brake chambers. They are physically attached to the frame rail near the front wheels which they supply, and on the crossmember nearest the rear wheels.



Rear ABS Valve Package



Front ABS Valve Package

R-14 Relay Valve

The relay valve in an air brake system functions as a relay station to speed up the application and release of the brakes. The valve is normally mounted at the rear of the vehicle near the chambers it serves. The valve operates as a remote controlled brake valve that delivers or releases air to the chambers in response to the control air delivered to it from the foot brake valve.

The R-14 relay valve is designed for either reservoir or frame mounting. The R-14 incorporates a quick release and anti-compounding feature located above the horizontal service port. The R-14 anti-compound feature allows it to be conveniently used as either a service or spring brake relay valve. An exhaust cover is installed that protects the 3 mm (1/8 in.) balance port when the R-14 anti-compound feature is not in use.

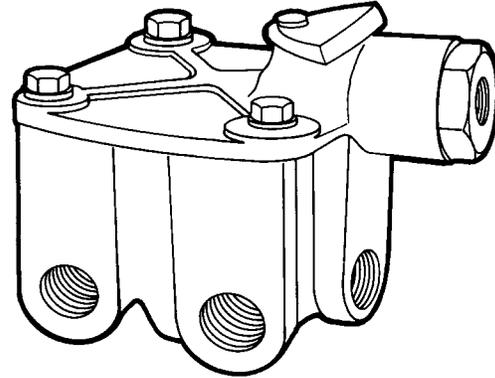


Fig. 4: R-14 Relay valve

Operation

Application

Air pressure delivered to the service port enters the small cavity above the piston and moves the piston down. The exhaust seat moves down with the piston and seats on the inner or exhaust portion of the inlet/exhaust valve, sealing off the exhaust passage. At the same time, the outer or inlet portion of the inlet/exhaust valve moves off its seat, permitting air supply flow from the reservoir, past the open inlet valve and into the brake chambers.

Balance

The air pressure being delivered by the open inlet valve also is effective on the bottom area of the relay piston. When air pressure beneath the piston equals the service air pressure above, the piston lifts slightly and the inlet spring returns the inlet valve to its seat. The exhaust remains closed as the service line pressure balances the delivery pressure. As delivered air pressure is changed, the valve reacts instantly to the change holding the application at that level.

Exhaust or release

When air pressure is released from the service port and air pressure in the cavity above the relay piston is exhausted, air pressure beneath the piston lifts the relay piston, and the exhaust seat moves away from the exhaust valve, opening the exhaust passage. With the exhaust passage open, the air pressure in the brake chambers is then permitted to exhaust through the exhaust port, releasing the brakes.

Anti-compounding

Simultaneous service and park application

When the R-14 Relay valve is used to control the spring brake chambers, use the anti-compound feature. With the anti-compound feature of the R-14 connected, a service application made while the vehicle is parked is countered by a release of the parking brakes. To use this feature, the exhaust cover of the quick release portion of the R-14 is removed and a line is connected to the delivery of the service brake valve or brake application is made, air from the service brake valve enters the exhaust port of the quick release of the R-14 and moves the diaphragm, blocking the service port. Air then proceeds into the cavity above the relay piston. The piston closes the exhaust and opens the inlet to deliver air to the spring brake cavity as described in "R-14 Relay Valve" page 18.

Maintenance

Every 160,000 km (100,000 miles), 12 months or 3600 operating hours, check the valve function using the procedure found in "R-14 Relay Valve" page 18. If the R-14 does not function properly, replace it with a new or re-manufactured valve.

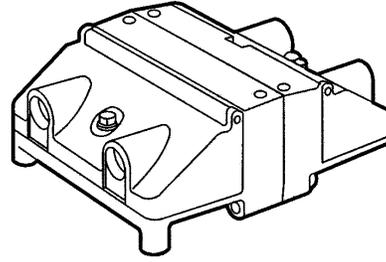
Electronic Control Unit (ECU)

The ABS ECU controls the ABS/ATC system. It receives wheel speed information from the sensors and sends signals to the ABS modulator valves. It is powered from the ignition bus via the ABS ECU power relay (R7 for VN, Power Relay PR3 for the VHD), and two in-line fuses mounted on the crossmember close to the ABS ECU.

The microprocessors in the ECU compare the speed of each wheel to the speed of the other wheels to determine if any one wheel is spinning. This comparison is performed many times every second. If any wheel is determined to be locked (not spinning or spinning very slowly in relation to the other wheels) while the other wheels are spinning, the ABS sends signals to the modulator valve for the locked wheel to reduce its braking force until it starts to spin again. This series of events occurs many times each second, giving the modulator valve the appearance of having a pulsating action.

In addition to the outputs provided to the modulator valves, the ABS ECU supplies inputs to the engine ECU for Traction Control and to the J1587/1708 Data Link for the instrument cluster lights and diagnostics.

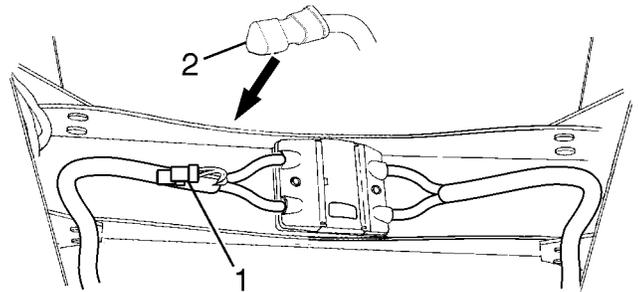
The ECU is housed in a sealed enclosure that protects the electronic circuits from the environment. The stresses on the cables resulting from vehicle operation are taken up by the ECU housing, which supports each cable as it exits the housing. The ECU housing is mounted to the rear of the intermediate crossmember.



Electrical

Fuses

The two power inputs to the ABS ECU are fused through individual 10 amp in-line fuses. These fuses are located on the crossmember near the ECU. The power to the in-line fuses (1) comes from the ignition circuit via the Ignition power relay (PR3 for the VHD). Also attached is a Terminating Resistor (2). (For more information refer to page 27.)

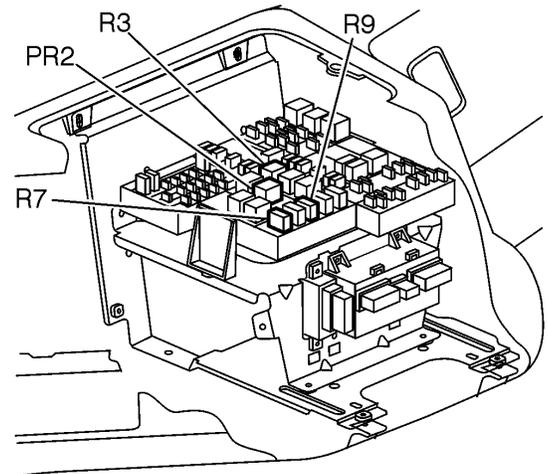


In-line fuses and Terminating Resistor

Relays

Relays are mounted in the Truck Electrical Center (TEC) in the center dash. The ABS ECU Power Relay (R7 and PR3) are battery powered through a 30A maxi fuse. Relay R7/PR3 is energized by the ignition circuit (196B) through a 40A maxi fuse and a 5A fuse. R7/PR3 is grounded to the bus bar.

The ABS Warning Lamp Relay (R3 for the VN and R9 for the VHD) is powered through the same ignition circuit (196B) as R7/PR3, with the 40A maxi fuse and 5A fuse. The relay coil is controlled by the 778 circuit from the ABS ECU, which is a ground signal. R3 provides a ground from the bus bar to the 779 circuit in the instrument cluster to turn the warning lamp off. Relay R3/R9 can also be used to request blink codes and clear fault codes. See "Diagnosing Faults using Blink Codes" page 33 and "Clearing Fault Codes by Removing R3/R9" page 38.

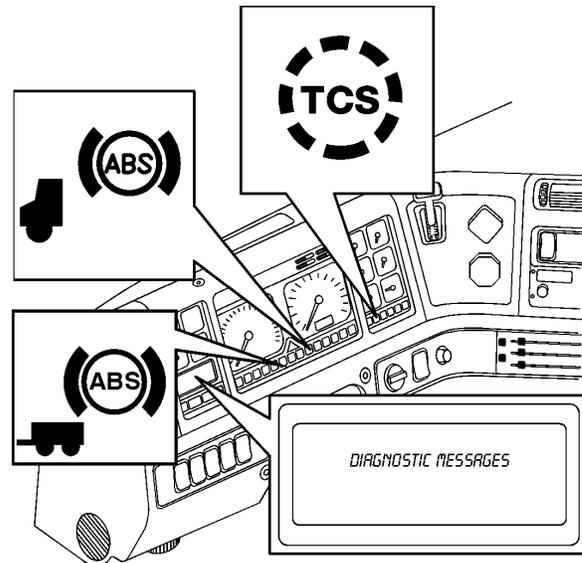


Relay location in TEC in center dash

Wiring

The wiring for the ABS is incorporated in the main cab and chassis wiring harnesses. Refer to *VN/VHD Series Electrical Schematics* for more information on routing and location of ABS wiring.

Instrumentation



ABS Warning Lamp (Tractor)

An amber ABS warning lamp is provided in the instrument cluster. Its function is to notify the operator that the ABS system has detected an unusual condition or fault in the system. The lamp will illuminate under the following conditions:

- When the ignition switch is turned ON the lamp comes ON momentarily for a bulb check, then goes out. After servicing the ABS, the lamp will stay ON until the vehicle speed reaches approximately 11 km/h (7 mph), then the lamp goes out.
- If the ABS self-monitoring circuits detect a fault in the system.
- To display ROCKWELL WABCO blink codes for troubleshooting.

ABS Warning Lamp (Trailer)

An amber ABS warning lamp is provided in the instrument cluster. Its function is to notify the operator that the ABS system has detected an unusual condition or fault in the system. The lamp will illuminate under the following conditions:

- To notify operator of a fault in one or more towed

trailers.

- When the ignition switch is turned ON the lamp comes ON momentarily for a bulb check, then goes out. After servicing the ABS, the lamp will stay ON until the vehicle speed reaches approximately 11 km/h (7 mph), then the lamp goes out.

ATC Lamp

There is an amber ATC warning lamp on the instrument cluster. The lamp has the following function:

- If the ATC switch is off (in Mud/Snow mode), the ATC lamp will blink continuously to remind the driver that ATC is in Mud/Snow mode. The Mud/Snow function increases available traction on soft surfaces like snow, slush, or mud by slightly increasing the allowable wheel spin.

Diagnostic Display

The graphic display is on the left side of the instrument cluster. It can be used to display diagnostic messages from the ABS. The system uses the SAE J1587/J1708 data link. Refer to "Anti-Lock Brake System Troubleshooting" page 29 for information on how to troubleshoot ABS problems.

Traction Control System

The ABS on a vehicle may also include traction control. The Traction Control System (ATC) uses the same wheel sensors as the ABS to determine if one drive wheel is spinning much more rapidly than the others. If the ATC determines that a wheel is spinning and the vehicle speed is below 40 km/h (25 mph), it opens the relay valve to apply some braking force to stop the wheels from spinning.

If all drive wheels are spinning, the system sends a signal to the engine ECU to reduce the engine torque to provide improved traction. This action helps reduce the amount of wheel spin and gives the driver greater vehicle control.

To prevent the wheel brake from overheating, the differential brake threshold is increased linearly, at vehicle speeds exceeding 35 km/h (22 mph). Slip is controlled by engine reduction. Also, when the vehicle speed exceeds 50 km/h (31 mph) the differential brake control doesn't start but relies on the already existing brake control.

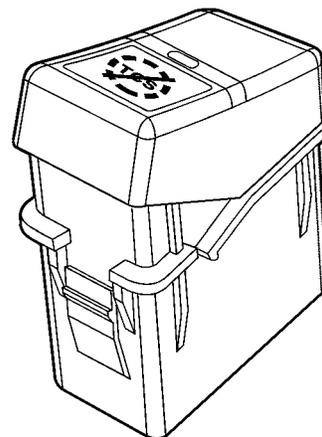
The traction control system includes an extra relay valve, mounted on the left hand frame rail close to the rear crossmember.

ATC Mud/Snow Function

The ATC includes a ATC mud/snow option switch, labeled as shown. It is a momentary switch. In the normal position, the ATC operates normally to increase traction to the spinning wheels. When the switch is pressed once, the ATC lamp on the dash will blink continuously to indicate that the ATC is in mud/snow mode.

The mud/snow function increases available traction on soft surfaces like snow, slush or mud by slightly increasing the allowable wheel spin.

The ATC will resume normal operation when the ATC switch is again pressed and the ATC lamp goes out, or when the ignition is turned OFF.



ATC Switch

Tractor ABS Fault Detection

During operation, the ABS ECU continuously monitors the system for faulty conditions. If the ABS detects that a fault has occurred, as determined by the absence of correct signal from one of the ABS components, the system illuminates the Tractor ABS warning lamp. This lamp will stay on until the system has been repaired and the fault has been cleared from the ECU's memory.

When a fault is detected by the system, it deactivates the anti-lock braking function in the wheel that has the fault. Normal braking ability is maintained in the wheel that has the fault, however.

The ROCKWELL WABCO ABS ECU has the ability to store the details of faults that it detects within its own memory so that the technician can easily locate the problem. The faults are placed into two categories: existing and stored (Note: the instrument cluster graphic display shows these two categories as active and inactive). Existing or active faults are those present in the system, such as a short-circuited data link. Stored or inactive faults are faults which have been repaired, or intermittent faults. Intermittent faults are those that occurred in the system and have not been repaired, but are no longer present, such as a temporary open sensor circuit that might be caused by a loose connector.

If the fault is existing, the details of the fault will be stored in the ABS ECU memory and will remain there until the fault has been repaired and the technician clears the fault memory. If the fault was intermittent, the system stores the details of the fault, but the fault may be cleared from memory without repair.

Following detection of any fault, the ABS warning lamp will come ON and stay on until the ignition is switched OFF. The warning lamp will remain ON when the ignition is on until the fault is repaired and cleared.

The ABS ECU can store the details of several faults, although they are not necessarily stored in the order they are received. If using the blink codes for display of faults, the faults must be repaired and cleared from memory one at a time in order to display additional faults. The ABS warning lamp will not go out when driving until all faults have been corrected and cleared.

Note: Proper ABS/ATC operation requires that front and rear tire size be within 14% of one another. Exceeding this range without electronically resetting the ECU may cause the ABS warning lamp to illuminate and the system to deactivate.

Trailer ABS Fault Detection

Starting in March 2001, Federal Regulations required that each new vehicle have an in-cab warning lamp that notify the operator of any faults with the Trailer's ABS System.

Note: If the vehicle is not equipped with a J560 connector or cable (7 way trailer connector), either on the back of the cab or at the end of the frame, then the vehicle is not considered "Towing equipped". According to Federal Regulations if the vehicle is not "Towing equipped" then it is not subject to the Trailer ABS Warning Lamp requirements.

Control of the Trailer ABS Warning Lamp is performed by the Tractor ABS ECU. The ECU works off of signals it receives from the ABS ECU(s) on the trailer(s). These signals exist in a Power Line Carrier (PLC) communication system. The Trailer ABS ECU sends a message to the Tractor ABS ECU every 1/2 second relaying information concerning any warnings and turning on or shutting off the warning lamp.

An example of a fault code for the Trailer ABS is if the Trailer ABS Warning Lamp stays on and no trailer is connected. If this occurs then there is a problem in the lamp circuit or Trailer ABS ECU. Another fault code occurs if the Trailer ABS Warning Lamp remains on when a PLC compatible trailer is connected. To remedy this fault disconnect the trailer cable and wait a minimum of 15 seconds before reconnecting. If the lamp goes out upon reconnection then the fault is in the Trailer ABS System. If the lamp stays on then the error is in the Tractor ECU.

Note: The Tractor ABS ECU does not store fault codes from the Trailer ABS System.

ABS Self-Tests

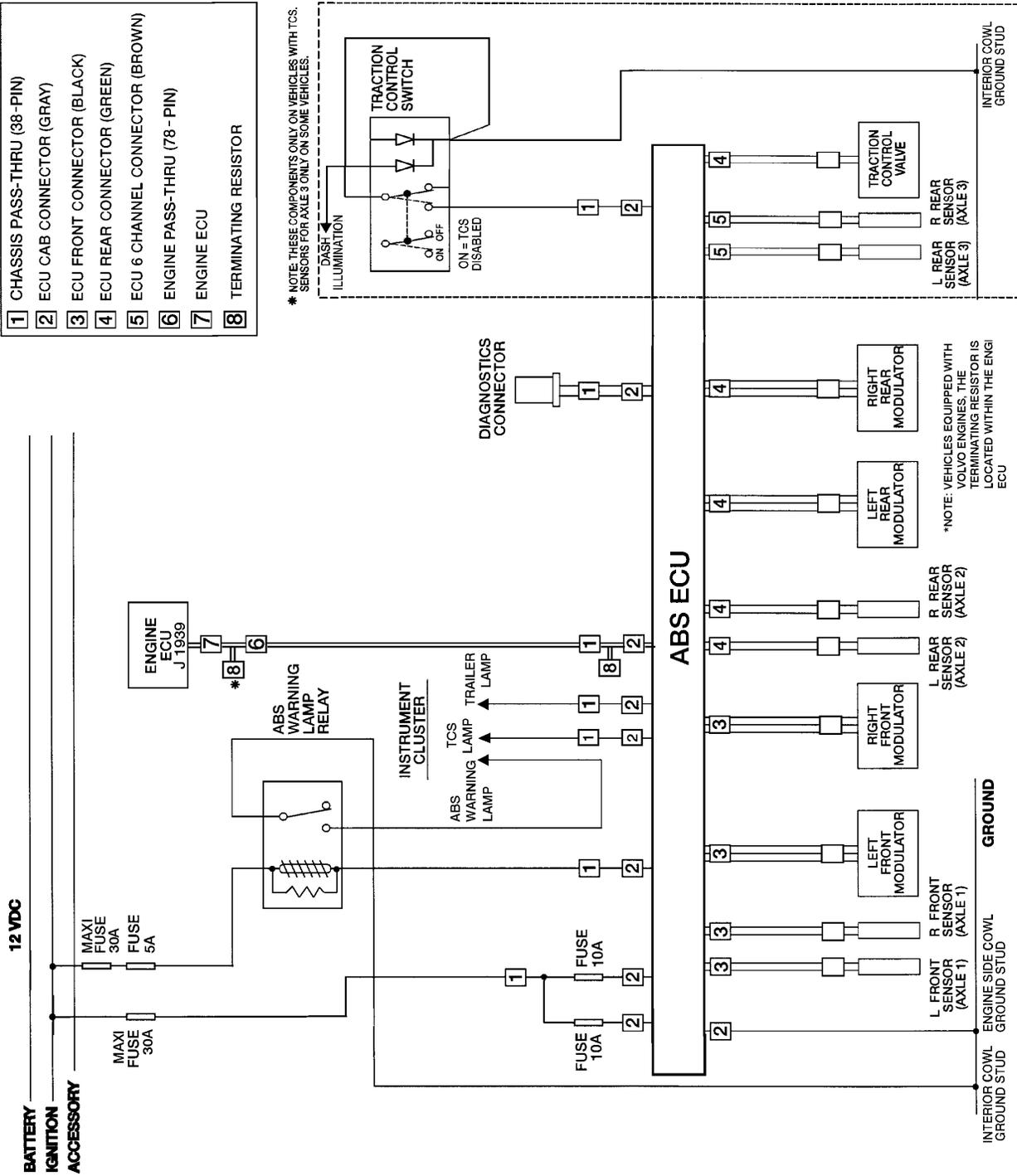
The ROCKWELL WABCO ABS has a variety of self-monitoring features. When the ignition is turned ON, the ABS warning lamp in the instrument cluster illuminates to tell the operator that the system is powered and that it is conducting self-tests. There are two tests performed by the system at this point.

The first test cycles the modulator valves, to ensure the circuits and valves are functional. This is an audible test. The valves cycle in the following order:

- 1 Right front
- 2 Left rear
- 3 Left front
- 4 Right rear

One additional self-test is performed by the ABS. This test occurs once the vehicle begins moving. As the vehicle starts to speed up from a standstill, the ABS monitors the output from each of the wheel speed sensors and verifies that they are reading correctly, and within the correct range compared with the other wheels.

If the test is satisfactory, the ABS warning goes out when the vehicle speed reaches approximately 6 km/h (4 mph). If the test is not satisfactory, the warning lamp will remain illuminated.



Troubleshooting

Anti-Lock Brake System Troubleshooting

- 1 VCADS Pro. See “VCADS Pro” page 30.
- 2 Instrument cluster diagnostic display (see “Diagnosing Faults using the Instrument Cluster” page 31).
- 3 ROCKWELL WABCO blink codes (see “Diagnosing Faults using Blink Codes” page 33).
- 4 By removing a relay (see “Clearing Fault Codes by Removing R3/R9” page 38).

For additional troubleshooting information see:

- “Component Troubleshooting” page 39
- “Other Component Troubleshooting” page 43

All codes must be in a stored or inactive state before clearing.

Note: You must use Multiple Protocol Cartridge (MPC) and Meritor WABCO application card, version 2.0 or higher, with E version ECUs. The PLC functions of E version ABS cannot be tested with the Pro-Link.

Note: Tire size range — For proper ABS/ATC operation with the standard ECU, front and rear tire size must be within 14% of each other. Exceeding this size allowance without electronically resetting the ECU may cause the warning lamp to illuminate and the system to deactivate. If the difference between front and rear tire sizes will be greater than 14%, contact ROCKWELL WABCO for instructions on how to reset the ECU.

Calculate the tire size with the following equation:

$$\% \text{ Difference} = \left\{ \frac{RPM \text{ Steer}}{RPM \text{ Drive}} - 1 \right\} \times 100$$

RPM = tire revolutions per mile

VCADS Pro

VCADS Pro is a Windows based software tool used to perform tests and calibrations on ECUs on the vehicle.

A PC tool with VCADS Pro software is connected to the vehicle's diagnostic connector using adapters and a communication interface unit.

VCADS Pro Test and Calibration applications makes it possible to test and to calibrate the ECUs. The applications consist of standard graphical interfaces displaying graph presentations and continuous reading of parameters. The Test and Calibration applications are organized according to function group.

Wabco ABS units installed on Volvo VN and VHD trucks are tested using the VCADS Pro tool. This tool conducts troubleshooting and diagnostics for the ABS unit.

Note: For further information on VCADS Pro, refer to the VCADS Pro User's Manual, in group 03.

MPSI Pro-Link 9000 (with MPC Cartridge and Application Card)

The MPSI Pro-Link 9000 is a hand-held electronic diagnostic instrument. When used with the MPC cartridge and Wabco ABS application card or with the Wabco ABS cartridge, the Pro-Link tool provides easy diagnosis of faults within the ABS, including:

- a faulty input;
- a faulty command; or
- a faulty reaction to a command.

In addition, the Pro-Link 9000 provides the ability to run a series of component tests on the ABS/ATC system.

Diagnosing Faults using the Instrument Cluster



DANGER

Before working on a vehicle, set the parking brakes, place the transmission in neutral, and block the wheels. Failure to do so can result in unexpected vehicle movement and can cause serious personal injury or death.

The graphic display of the instrument cluster can be used to display diagnostic messages from the ABS. The system uses the SAE J1587/1708 data link and is installed in vehicles with electronically controlled engines.

Fault codes cannot be cleared using the instrument cluster graphic display.

To see diagnostic messages,

- 1 Stop the engine.
- 2 Turn the ignition ON.
- 3 Press the MODE button on the vehicle dash until the Diagnostics Menu is displayed. Use the Up and Down buttons to display DIAGNOSTIC MESSAGES.
- 4 Press the SET button to have the datalink retrieve data.
- 5 Press the DOWN button until the brake screen is displayed. The Set button can be pressed to toggle the display between the text description and the received data. If the display shows "UNKNOWN" in any line, press the Set button to display the MID, PID or SID and FMI.
 - a. If the condition that caused the currently displayed fault still exists, the cluster will display "ACTIVE."
 - b. If the condition that caused the currently displayed fault is no longer occurring, the cluster will display "INACTIVE."
 - c. The number of times a fault has occurred will be displayed when available. In some cases, a short message may also be displayed.
- 6 Record all codes displayed.
- 7 To display the next stored fault, press the Down button.

Diagnostic Messages

Diagnostic messages are provided as text descriptions or SAE J1587/J1708 fault codes (MID, SID and FMI). A list of these fault codes for ABS follows.

All ABS fault codes in the Instrument Cluster graphic display have the following for line 1:

Fault Description	MID (Message ID)
Brakes	136

The following is a list of the possible faulty component messages for the Instrument Cluster graphic display (Line 2), and the corresponding SAE J1587/J1708 code.

Fault Description	SID's (Subsystem ID's)
ABS Snsr axle 1 L	1
ABS Snsr axle 1 R	2
ABS Snsr axle 2 L	3
ABS Snsr axle 2 R	4
ABS Snsr axle 3 L	5
ABS Snsr axle 3 R	6
ABS valve axle 1 L	7
ABS valve axle 1 R	8
ABS valve axle 2 L	9
ABS valve axle 2 R	10
ABS valve axle 3 L	11
ABS valve axle 3 R	12
ABS rtrdr ctrl relay	13
ABS relay, diagonal 1	14
ABS relay, diagonal 2	15
ABS, dif 1 - ASR valve	18
ABS, dif 2 - ASR valve	19

The following is a list of the possible fault condition messages for the Instrument Cluster graphic display (Line 3), and the corresponding SAE J1587/J1708 code.

Fault Description	FMI's (Failure Modes)
Data valid, but high	0
Date valid, but low	1
Data erratic	2
Voltage shorted high	3
Voltage shorted low	4
Current low or open C	5
Current high or short C	6
Mech syst no respons	7
Abnormal freq or PW	8
Abnormal update rate	9
Abnormal change rate	10
Failure unknown	11
Bad device	12
Out of calibration	13
Special instructions	14

Diagnosing Faults using Blink Codes



Before working on a vehicle, set the parking brakes, place the transmission in neutral, and block the wheels. Failure to do so can result in unexpected vehicle movement and can cause serious personal injury or death.

If a Pro-Link tool is not available for troubleshooting, ROCKWELL WABCO blink codes may be used.

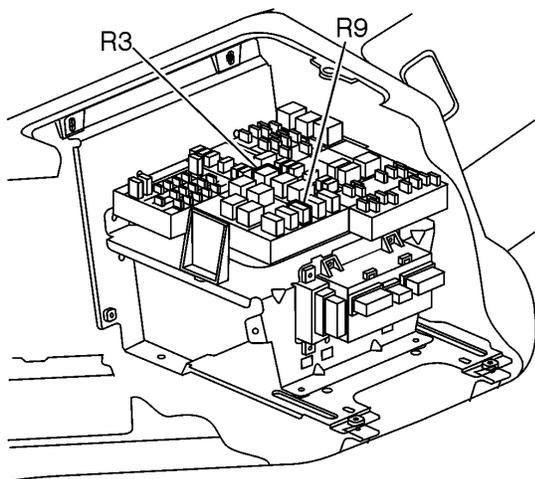
The ABS ECU has the ability to produce a series of light flashes called blink codes to display fault codes. The ABS warning lamp on the instrument cluster is used to display blink codes.

When the diagnostic function is activated by removing and reinstalling relay R3/R9, any existing faults will be displayed. If more than one fault is current, the first fault must be repaired before another existing fault can be displayed. After repairing an existing fault, cycle the key switch and remove and reinstall the relay to request the next existing fault.

After all existing faults have been repaired they will become stored faults and can be cleared from the ECU's memory.

To display blink codes:

- 1 Turn the vehicle ignition ON.
- 2 Remove relay R3 for 1 second and reinstall.

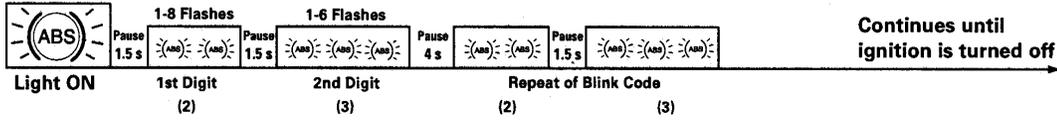


Relay Location (in Truck Electrical Center in center of dash)

- 3 This initiates the **blink code cycle**. The blink code cycle consists of light flashes and pauses. At the beginning of each cycle the light is on briefly, then there is a 1.5 second pause followed by a 1–8 flashes, which identifies the first digit of the fault. After another 1.5 second pause, the second set of 1–6 short flashes identifies the second digit of the fault. Note the blink code(s).
 - For an **existing fault**, the ABS warning lamp will repeatedly display one code, with a 4 second pause in between codes, until the ignition has been cycled. The system will not display another existing blink code until the fault for the one displayed has been corrected and erased from the ECU.
 - For a **stored fault**, the lamp will display a code for each stored fault, then stop blinking. Faults will be displayed one time only.
 - 4 Turn the vehicle ignition switch OFF.
 - 5 Refer to the Blink Code Diagnostics table to determine the fault information.
- Note:** Perform Steps 6 through 8 only if a blink code is received that is not listed in the Blink Code Diagnostics table.
- 6 Verify all ABS electrical connections are tight. Check for corrosion and damaged wiring.
 - 7 Attempt to clear the fault from the ECU (see "Clearing Fault Codes" page 37).
 - 8 If the fault will not clear, the problem may be in the ECU itself. Contact ROCKWELL WABCO for additional instructions.

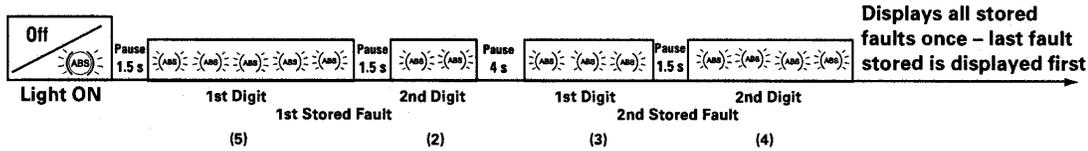
Example Blink Codes

Active Fault



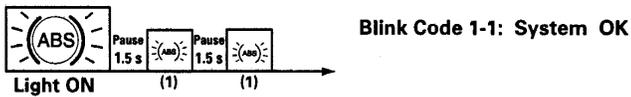
Example:
Blink Code 2-3: Fault in ABS modulator valve, right rear drive axle.

Stored Faults



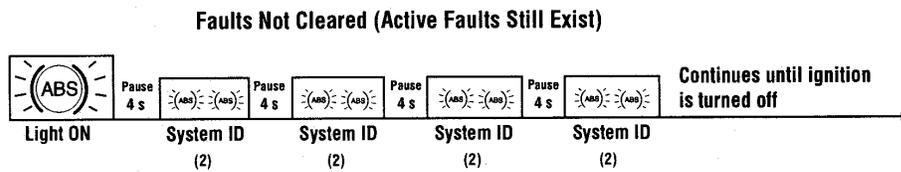
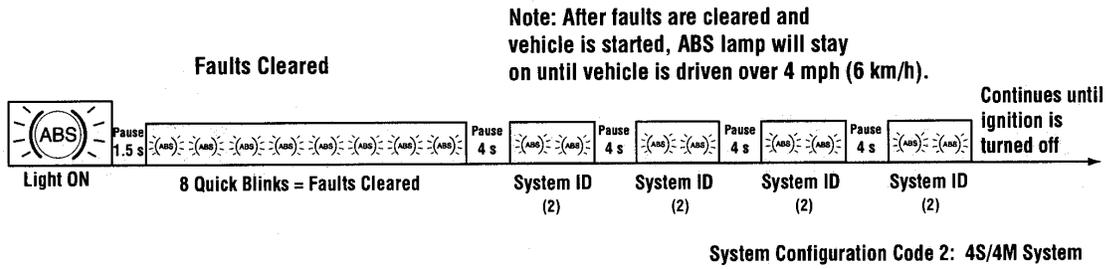
Example:
Blink Code 5-2: Sensor signal erratic, left front steer axle.
3-4: Too much sensor gap, left rear drive axle.

System O.K.



S = Seconds

Example Blink Codes (Continued)



S = Seconds

Blink Code Diagnostics Chart

Rockwell WABCO Blink Codes	
First digit	Second digit - Specific location of fault
1 No faults	1 No faults
2 ABS modulator valve	1 Right front steer axle
3 Too much sensor gap	2 Left front steer axle
4 Sensor short or open	3 Right forward/rear tandem drive axle
5 Sensor signal erratic	4 Left forward/rear tandem drive axle
6 Tooth wheel	5 Right rear/rear tandem drive axle
	6 Left rear/rear tandem drive axle
7 System function	1 J1939 data link
	2 ATC valve
	3 Retarder relay (third brake)
	4 ABS warning lamp
	5 ATC configuration
	6 ATC prop./dif lock/stop valve
8 ABS ECU	1 Low power supply
	2 High power supply
	3 Internal fault
	4 System configuration error
	5 Ground

Clearing Fault Codes

Fault codes may be cleared with the Pro-Link and ROCKWELL WABCO ABS cartridge, or by removing relay R3.

Note: For information on the proper use of VCADS Pro refer to the VCADS Pro User's Manual, in group 03.

Clearing Fault Codes with the Pro-Link

Note: Existing faults cannot be cleared until they have been repaired. Clear faults from the ECU after the faults have been recorded on the work order and repaired.

- 1 Connect the Pro-link to the diagnostic socket located under the left side of the dash.
- 2 Turn the vehicle ignition ON.
- 3 **Important:** Record all fault codes on the work order before they are cleared. They cannot be retrieved after clearing.
- 4 Follow the Pro-Link menus to select stored faults. (Existing faults cannot be cleared, only stored faults.)

```

      TRACTOR ABS MENU

      - - - - SELECTIONS - - - -

      ↑          STORED FAULTS          ↓
  
```

- 5 Press the FUNC key. To clear all stored faults, use the ← and → keys to place brackets [] around the Y in the last line of the display, then press ENTER.

```

      CLEAR ALL
      STORED FAULT(S)?

      CLEAR [Y] ← → N
  
```

- 6 When the faults have been cleared the Pro-Link screen displays the following.

```

      STORED FAULT(S)
      CLEARED

      [ENTER] TO CONTINUE
  
```

Clearing Fault Codes by Removing R3/R9

If a Pro-Link is not available, fault codes may be cleared as follows.

Note: R3 is the Power Relay and R9 acts as the Warning Lamp Relay.

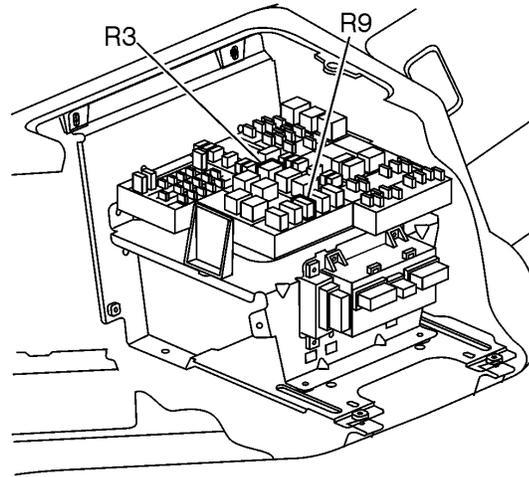
Note: An existing or active fault cannot be cleared until it has been repaired. Clear each fault from the ECU after it has been recorded on the work order and repaired.

Faults are cleared when the ECU is powered up and the fault no longer exists. Clear faults as follows:

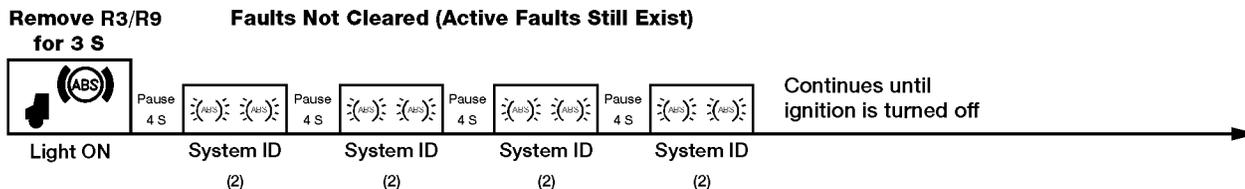
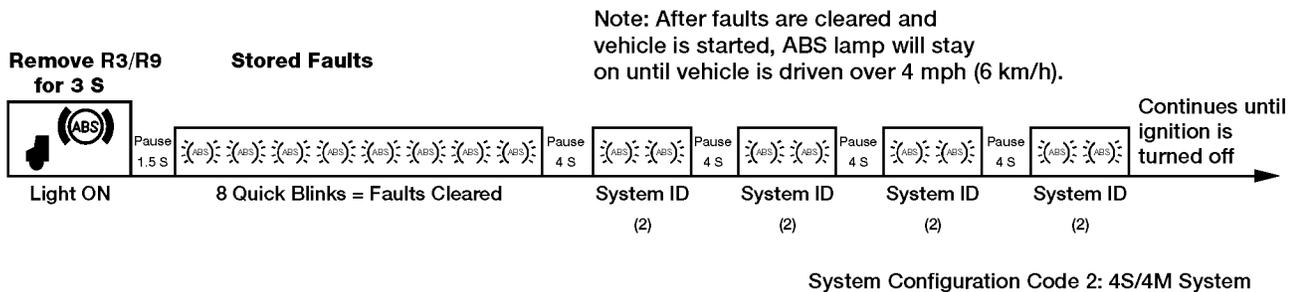
- 1 Ignition ON.
- 2 Remove relay R3/R9 for 3 seconds, and reinsert.
- 3 The ABS warning lamp should quickly blink on and off about 8 times, then after a 4 second delay will show the blink code for the system configuration (2 blinks for 4S/4M; 4 blinks for 6S/4M). The 4 second delay and system blink code will repeat until the ignition is cycled.

Note: If the 8 quick blinks are not displayed, the fault has not been cleared. Repeat the procedure and check for existing faults if the fault will not clear.

- 4 Ignition OFF.
- 5 Check faults to verify that there are no faults remaining.



Relay Location (in Truck Electrical Center in center of dash)



S = Seconds

Note: The System ID code is 2 blinks for 4S/4M; 4 blinks for 6S/4M.

Component Troubleshooting



DANGER

Before working on a vehicle, set the parking brakes, place the transmission in neutral, and block the wheels. Failure to do so can result in unexpected vehicle movement and can cause serious personal injury or death.

If diagnostics indicate that there is a problem with the ABS, the following component tests may be used to determine whether the problem is in the component or the wiring. Prior to performing any component tests, make a visual inspection of the cables, connectors and valves for loose connections, corrosion and breakage.

The ABS modulator valves and TCS valves can be checked by measuring the resistance of the coils. This measurement can be made at the valve or at the ECU connector.

ABS Modulator Valve

To check resistance, perform the following:

- 1 Verify that the vehicle ignition is OFF.
- 2 Disconnect the cable to the modulator valves at the ECU (connector for front or rear components as appropriate).
- 3 Measure the resistance across terminals listed on the table below. Acceptable reading is between 4.0 and 8.0 Ω .

Note: See " " page 59 for connector/terminal location.
- 4 If resistance in Step 3 was not within tolerance for any valve, perform Steps 5 through 6. Otherwise, go to Step 7.
- 5 Disconnect the connector on that valve.
- 6 Measure the resistance across terminals 1 and 2 and across terminals 1 and 3. If both resistance values are outside tolerance, the modulator valve must be replaced. If the resistance values are correct, the problem is in the cable.
- 7 Reconnect the connector.



To check that the ABS valves are operating properly perform the following:

- 1 Apply the brakes.

- 2 Turn on the ignition.
- 3 Wait for the ABS indicator lamp to come on.
- 4 Listen to the valves cycle consecutively as follows:
4 Channel Valve Cycle Order: 1-2-3-4.
6 Channel Valve Cycle Order: 1-2-3-4-5-6.

Traction Control Valve

To check resistance, perform the following:

- 1 Verify that the vehicle ignition is OFF.
- 2 Disconnect the cable to the Traction Control valves at the ECU (connector for rear components).
- 3 Measure the resistance across terminals listed on the table below. Acceptable reading is between 8.0 and 14.0 Ω .

Note: See " " page 59 for connector/terminal location.
- 4 If resistance in Step 3 was not within tolerance for either valve, perform Steps 5 through 7. Otherwise, go to Step 8.
- 5 Disconnect the connector on that valve.
- 6 Measure the resistance across terminals 1 and 2.
- 7 If resistance value is not within tolerance, the Traction Control valve must be replaced. If the resistance value is correct, the problem is in the cable.
- 8 Reconnect the connector.

ABS/Traction Valve Resistance					
Component	ABS ECU Connector	Terminals	Satisfactory Resistance	Possible Faults	
ABS inlet, left front axle	Front (black) harness connector	11 to 2	4.0 to 8.0 Ω	Wiring between ECU and valve damaged	
ABS exhaust, left front axle		11 to 10			
ABS inlet, right front axle		9 to 4			
ABS exhaust, right front axle		9 to 3			
ABS inlet, left rear axle	Rear (green) harness connector	11 to 12		8.0 to 14.0 Ω	Ground lead to valve disconnected
ABS exhaust, left rear axle		11 to 10			
ABS inlet, right rear axle		8 to 9			Solenoid valve shorted
ABS exhaust, right rear axle		8 to 7			
Traction Control valve		5 to 6			

Sensors

To check the resistance of a sensor, perform the following:

- 1 Verify that the vehicle ignition is OFF.
- 2 Disconnect the cable to the sensors at the ECU (connector for front or rear sensors as appropriate).
- 3 Use the Sensor Pin-out Cable (Tool J-42883) and the Digital Multimeter (Fluke 87) to check the Wheel Speed Sensor, Coil Resistance, Ground Resistance, and Output Voltage on Rockwell Wabco ABS Brakes.
- 4 Measure the resistance across terminals listed on the table below. Acceptable reading is between 700 and 3000 ohms.

Note: See “” page 59 for connector/terminal location.

- 5 If resistance in Step 3 was not within tolerance for the sensor, perform Steps 5 through 7. Otherwise, go to Step 8.
- 6 Disconnect the connector for the sensor.
- 7 Measure the resistance across terminals 1 and 2.
- 8 If resistance value is not within tolerance shown in the table, the sensor must be replaced. If the resistance value is correct, the problem is in the cable.
- 9 Reconnect the connector.

ABS Sensor Resistance				
Sensor Location	ABS ECU Connector	Terminals	Satisfactory Resistance	Possible Faults
Left Front (Axle 1)	Front (black) harness connector	7 to 8	700 to 3000 Ω	Wiring between ECU and sensor damaged Damaged sensor connector Defective sensor
Right Front (Axle 1)		5 to 6		
Left Rear (Axle 2)	Rear (green) harness connector	1 to 2		
Right Rear (Axle 2)		3 to 4		
Left Rear (Axle 3)*	6-channel (brown) harness connector	3 to 4		
Right Rear (Axle 3)*		5 to 6		

* Only used in 6S/4M setup.

Sensor Adjustment Check

To check the proper adjustment of a sensor, perform the following:

- 1 Verify that the vehicle ignition is OFF.
- 2 Disconnect the cable to the sensors at the ECU (connector for front or rear sensors as appropriate).

3



DANGER

If placing a vehicle with Traction Control System (ATC) on jacks when servicing, the ATC must be disabled. If the ATC is not disabled and one of the wheels starts to spin, the ATC will compensate and the vehicle may come off the jack and may cause serious personal injury or death.

Note: Before servicing the vehicle, disable the ATC by disconnecting the harness at the ATC control valve.

Spin the wheel for the sensor to be checked, by using the Sensor pin-out tool (J-42883), at approximately 30 RPM.

- 4 Measure the AC voltage across terminals listed on the table below. Acceptable reading is greater than 0.200 VAC and steady.

Note: See “” page 59 for connector/terminal location.

- 5 If voltage in Step 4 was not acceptable, perform Step 5 through 7. Otherwise, go to Step 8.
- 6 Refer to the table below for possible causes.
- 7 Adjust or replace the sensor as required.
- 8 Recheck sensor adjustment.

ABS Sensor Adjustment Check

Sensor Location	ABS ECU Connector	Terminals	Satisfactory Condition	Possible Faults
Left Front (Axle 1)	Front (black) harness connector	7 to 8	> 0.200 VAC	No voltage: <ul style="list-style-type: none"> ● sensor wire broken ● sensor wire shorted ● sensor gap too large Large variations: <ul style="list-style-type: none"> ● excessive tooth wheel runout ● tooth wheel damaged ● excessive wheel bearing end play
Right Front (Axle 1)		5 to 6		
Left Rear (Axle 2)	Rear (green) harness connector	1 to 2		
Right Rear (Axle 2)		3 to 4		
Left Rear (Axle 3)*	6-channel (brown) harness connector	3 to 4		
Right Rear (Axle 3)*		5 to 6		

* Only used in 6S/4M setup.

Other Component Troubleshooting



DANGER

Before working on a vehicle, set the parking brakes, place the transmission in neutral, and block the wheels. Failure to do so can result in unexpected vehicle movement and can cause serious personal injury or death.

Note: Refer to the system schematics for circuit information.

Relay Number	Relay Function
R3	Power Relay
R9	Warning Lamp Relay
PR2	Alternate Power Relay
R7	Alternate Warning Lamp Relay

The following table provides additional possible faults within the ABS not previously covered within the Troubleshooting section.

Component Troubleshooting		
Symptom	Type of Failure	Check
Important: The following must be performed with the ignition ON.		
ABS light stays illuminated	Diagnostic faults present	Use Pro-link or cluster diagnostic menu to check for stored fault codes. Refer to previous troubleshooting information
	No ECU power: Fuse blown	<ul style="list-style-type: none"> ● Check 5A/30A fuse (fuse 10) in electrical center. ● Check 40A maxi fuse in electrical center ● Check the two 10A in-line fuses on the ABS ECU crossmember
	No ECU power: Open or short circuit in cab or chassis harness power/ground circuits	<ul style="list-style-type: none"> ● Check voltage at the gray ABS ECU (Cab) connector, terminals 1 to 11 and 2 to 12. Should read battery voltage with the ignition switch ON. (Note: terminals 1 (777A) & 2 (777B) are power; terminals 11 (ABS-A) & 12 (ABS-B) are ground). ● Check ECU and Cab connections for corrosion or loose terminals. ● Check relay R7/PR2/R9/R3 ground wire, circuit OR-H, for continuity to the ground bus bar in the electrical center.
	No ECU power: ABS ECU power relay R7 bad	<ul style="list-style-type: none"> ● Check power and ground at relay R7/PR2/R9/R3 coil. Measure voltage from circuits 196B to OR-H (pins 86 to 85 of the relay holder). ● Try replacing relay R7/PR2/R9/R7 with a known good relay.
	Relay R3 bad or short circuit in harness	<ul style="list-style-type: none"> ● Unplug relay R3/PR2/R9/R7. ABS light should go out. If not, check circuit 779 for short to ground. ● Check power and ground at relay R3/PR2/R9/R7 coil. Measure voltage from circuits 196B to 778 (pins 86 to 85 of the relay holder). ● Check circuit 778 from the ABS ECU for a short to ground ● Try replacing relay R3/PR2/R9/R7 with a known good relay.

Component Troubleshooting		
Symptom	Type of Failure	Check
Important: The following must be performed with the ignition ON.		
ABS warning lamp does not illuminate at key ON	ABS warning bulb burned out	Perform an instrument cluster bulb test from the cluster diagnostic menu screen: CLUSTER SELF-TEST BULB TEST?
	Relay R3 is bad or short circuit in harness	<ul style="list-style-type: none"> • Try replacing relay R3/PR2/R9/R7 with a known good relay. • Remove relay R3 and check for battery voltage at circuit 779 (pin 87A of R3/PR2/R9/R7 relay holder). Should read 12V. • Check connections in the harness.
	Bad ground to relay R3	Check relay R3/PR2/R9/R7 ground wire, circuit OR-F, for continuity to the ground bus bar in the electrical center.
TCS light flashing	TCS switch pressed once.	<ul style="list-style-type: none"> • Normal operation. Traction control in Mud/snow mode. • Press switch a second time to disengage mud/snow mode, or cycle ignition off and on.
TCS light stays illuminated	Short circuit in TCS switch.	Disconnect TCS switch and cycle ignition off and on.
	Short circuit in harness.	<ul style="list-style-type: none"> • Disconnect the instrument cluster RH connector (green 22-way) for the TCS lamp. Check circuits 774, 774-A and 774-B for short to ground.

ABS Indicator Light

Troubleshooting the ABS indicator lamp works as follows:

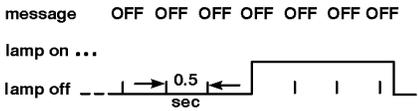
Ignition ON	Normal Operation	ABS lamp comes on at ignition momentarily for a bulb check, then goes out.	System is O.K.
	After servicing ABS	ABS lamp does not go out at ignition.	When vehicle is driven at speeds above 4 mph (6 km/h), lamp goes out. System is O.K.
	Off-road ABS operation. Refer to "Off-Road ABS" in this section.	ABS lamp flashes during vehicle operation.	The vehicle's normal ABS function is being modified due to road conditions.
	Existing Fault	ABS lamp does not go out at ignition.	Lamp does not go out at speeds above 4 mph (6 km/h) - a fault exists in the ABS system.

Trailer ABS Indicator Lamp

The trailer ABS indicator lamp on the vehicle dash applies to Trailer ABS only. The lamp is controlled by a signal to the tractor ECU, sent over the power line (PLC function). When a trailer ABS fault is detected, an ON message is sent, when no fault is detected, the ECU receives an OFF message. Table A illustrates trailer ABS lamp operation at power-up, or ignition on. Table B depicts lamp responses that occur during operation. Lamp

turn ON and OFF messages do not turn the lamp ON or OFF instantly. The delay between the receipt of the message and the lamp response time is intentional. It prevents erratic lamp activity. NOTE: For doubles or triples, the lamp does not distinguish between trailers. A system fault in any of the trailers will activate the trailer ABS indicator lamp.

Table A: Dash-mounted Trailer ABS Indicator Lamp Operation-Bulb Check (Information for Drivers)

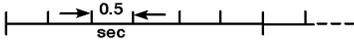
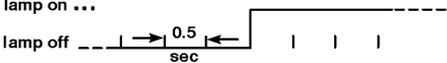
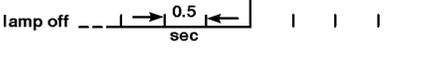
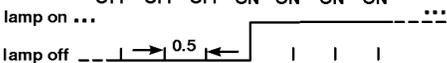
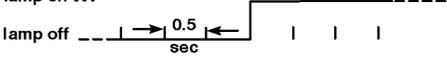
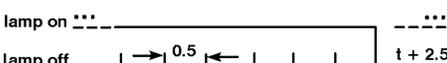
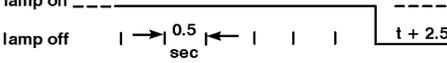
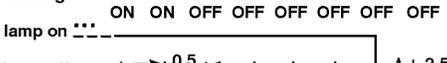
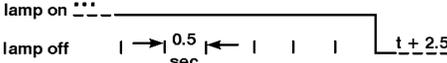
Signal from trailer to tractor ECU	Status of Trailer ABS Lamp on vehicle dash	Explanation
<p>Single or Multiple Trailers</p> <p>message OFF OFF OFF OFF OFF OFF OFF OFF</p> <p>lamp on ...</p> 	<p>Trailer ABS lamp comes on at ignition, OFF message is detected within three seconds of ignition, Trailer ABS lamp goes out.</p>	<p>Bulb Check performed and Trailer ABS system is OK. In this case, the lamp is ON for a Bulb Check only.</p>
<p>Single or Multiple Trailers</p> <p>message No ON or OFF messages</p> <p>lamp on OFF OFF . .</p> 	<p>Trailer ABS lamp does not come on within three seconds of ignition.</p>	<p>No Bulb Check, trailer added after initial power-up, system OK. There was no trailer PLC message for at least three seconds following ignition ON.</p>

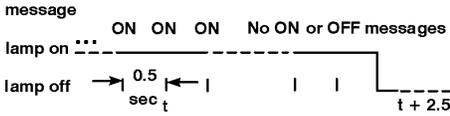
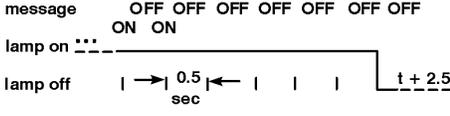
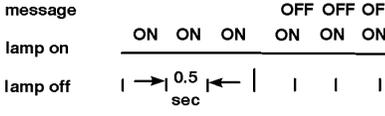
Note: ON = Turn ON message to Trailer ABS lamp.

OFF = Turn OFF message to Trailer ABS lamp.

Removing a trailer with a fault causes the ABS lamp to turn off. Repair a trailer with a fault as soon as possible and before returning to use.

Table B: Dash-mounted Trailer ABS Indicator Lamp Operation-Bulb Check (Information for Service Technicians)

Signal from trailer to tractor ECU	Status of Trailer ABS Lamp on Vehicle Dash	Explanation	Action
<p>Single or Multiple Trailers</p> <p>message</p> <p>lamp on</p> <p>lamp off </p>	<p>Trailer ABS lamp does not come on within three seconds of ignition.</p>	<p>Not using the PLC system (no trailer connected) or trailer not equipped with PLC or fault in PLC system.</p>	<p>Use lamp on side of trailer to identify fault. Make necessary repairs.</p>
<p>Single Trailer</p> <p>message OFF OFF OFF ON ON ON ON</p> <p>lamp on ... </p> <p>lamp off </p>	<p>Trailer ABS lamp comes on.</p>	<p>Trailer ABS fault(s) occurred during operation and still exists.</p>	
<p>Multiple Trailers/Dollies</p> <p>message OFF OFF OFF OFF OFF OFF OFF OFF OFF OFF ON ON ON ON</p> <p>lamp on ... </p> <p>lamp off </p>			
<p>Single Trailer</p> <p>message ON ON OFF OFF OFF OFF OFF OFF</p> <p>lamp on ... </p> <p>lamp off </p>	<p>Trailer ABS lamp comes on but goes out 2.5 seconds after fault is detected.</p>	<p>Trailer ABS fault occurred during operation and the fault was corrected.</p>	<p>None</p>
<p>Multiple Trailers/Dollies</p> <p>message OFF OFF OFF OFF OFF OFF OFF OFF ON ON OFF OFF OFF OFF OFF OFF</p> <p>lamp on ... </p> <p>lamp off </p>			

Signal from trailer to tractor ECU	Status of Trailer ABS Lamp on Vehicle Dash	Explanation	Action
<p>Single Trailer</p> 	<p>ABS lamp is off, comes on, then goes off, 10 seconds after the loss of messages.</p>	<p>ABS fault existed, then signal was lost because trailer disconnected or PLC fault.</p>	<p>Use lamp on side of trailer to identify fault. Make necessary repairs.</p>
<p>Multiple Trailers/Dollies</p> 		<p>ABS fault existed, then trailer with fault lost signal because trailer was disconnected or PLC fault.</p>	
<p>Single Trailer to Multiples</p> 	<p>ABS lamp is on and stays on when a new trailer with no new fault is added.</p>	<p>There was a fault in existence before the new trailer was added and the ignition was not turned off before the trailer was added.</p>	
<p>Single Trailer to Multiples</p> 	<p>ABS lamp is on and stays on when a new trailer with new fault is added.</p>	<p>ABS fault was in existence before the new trailer was added. The ignition was not turned off before the trailer was added and the new trailer has an ABS fault.</p>	

Note: ON = Turn ON message to Trailer ABS lamp.
 OFF = Turn OFF message to Trailer ABS lamp.

Removing a trailer with a fault causes the ABS lamp to turn off. Repair a trailer with a fault as soon as possible and before returning to use.

Service Procedures

General Work Practices



CAUTION

Some older original equipment brake linings contain asbestos fibers, a cancer and lung disease hazard which could result in serious illness or death. Some brake linings contain non-asbestos fibers, the long term effects of which are unknown. Caution should be exercised in handling non-asbestos materials.

Most recently manufactured brake linings no longer contain asbestos fibers. In place of asbestos, these linings contain a variety of ingredients, including glass fibers, mineral wool, aramid fibers, ceramic fibers, and carbon fibers. At present, OSHA does not specifically regulate these non-asbestos fibers, except as maintenance dust. Medical experts do not agree about potential long term risks from working with and inhaling non-asbestos fibers. Some experts think that long term exposure to certain non-asbestos fibers could cause diseases of the lung, including pneumoconiosis, fibrosis, and cancer. Therefore it is recommended that workers use caution to avoid creating and breathing dust when working on brakes that contain non-asbestos fibers.



WARNING

Before beginning any service work on any part of the air system, be certain that the air pressure has been released. Failure to do so may cause a component to violently separate, which can result in serious personal injury.

Observe the following precautions when working with brakes and brake lining material:

- 1 Whenever possible, work on brakes in an area separate from other operations.
- 2 Always wear a respirator approved by NIOSH or MSHA during all brake service procedures. Wear the respirator from removal of the wheels through assembly.
- 3 Never use compressed air or dry brushing to clean brake parts or assemblies. OSHA recommends that brake enclosures be used. These enclosures have vacuums with **High Efficiency Particulate Air (HEPA)** filter and worker arm sleeves. If such equipment is not available, carefully clean brake parts and assemblies in the open air.
- 4 Clean brake parts and assemblies in the open air. During disassembly, carefully place all parts on the floor to avoid getting dust into the air. Use an industrial vacuum cleaner with a HEPA filter system to clean dust from the brake drums, torque plate (spider), and other brake parts. After using the vacuum,

remove any remaining dust with a rag soaked in water and wrung until nearly dry.

- 5 Avoid grinding or machining brake linings.
- 6 Properly clean the work area. Never use compressed air or dry sweeping to clean the work area. Use an industrial vacuum with a HEPA filter and rags soaked in water and wrung until nearly dry. Dispose of rags with care to avoid getting dust into the air. Use an approved respirator when emptying vacuum cleaners and handling rags.
- 7 After working on brakes, workers should wash their hands before eating, drinking, or smoking. Clothes worn during brake maintenance should not be worn home. Vacuum work clothes after use and launder them separately, without shaking, to prevent fiber dust from getting into the air.
- 8 Material Safety Data Sheets (MSDS) on this product, as required by OSHA, are available from the brake lining manufacturer.

Note: Before servicing the vehicle, disable the ATC by disconnecting the harness at the ATC control valve.



WARNING

Before beginning any service work on any part of the air system, be certain that the air pressure has been released. Failure to do so may cause a component to violently separate, which can result in serious personal injury.



CAUTION

It is preferable to avoid welding on a truck or tractor, or on components attached to it. Voltage and current spikes associated with welding could damage the vehicle electrical system. If welding must be performed on any structure on or in contact with the vehicle, follow the recommendations below:

- Disconnect both negative (-) and positive (+) battery cables. Ensure the cables remain separated and are not in contact with the vehicle chassis.
- Disconnect wiring harnesses from all Electronic Control Units (ECUs) on the vehicle.
- Disconnect the main wiring harnesses at the LH and RH pass-throughs to the cab.

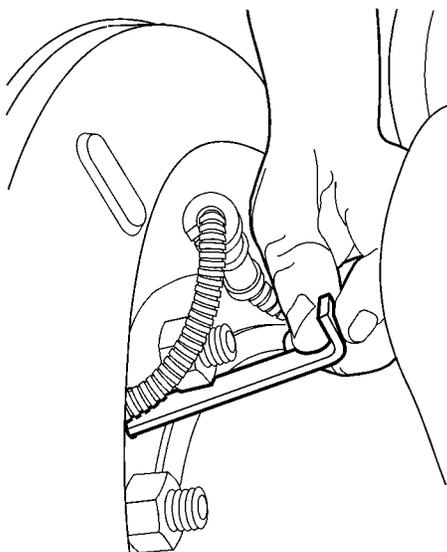
5932-05-03-01 ABS Sensor, Adjustment

Before beginning this procedure read the General Work Practices section ("General Work Practices" page 49) for further procedural information.

DANGER

Before working on a vehicle, set the parking brakes, place the transmission in neutral, and block the wheels. Failure to do so can result in unexpected vehicle movement and can cause serious personal injury or death.

1



CAUTION

Potential sensor damage. DO NOT use a screwdriver or sharp instrument to adjust sensor. Use of sharp instrument could cause sensor damage.

Slide the open end of a blunt instrument such as a dowel rod through the sensor opening in the brake spider until it rests against the sensor (the ABS Sensor Adjustment Tool, J-42942 will go in the hole at a slight angle).

Note: It is not necessary to remove the wheel or drum to adjust sensors using this method.

J-42942

2

CAUTION

Potential sensor damage. DO NOT use a hammer to drive the sensor into position. Hammering the sensor could cause the sensor to be inoperative.

Press the sensor toward the wheel hub until the sensor contacts the tooth wheel.

3

Remove the ABS Sensor Adjustment Tool, J-42942. Sensor will self-adjust after wheel rotation.

J-42942

4

Verify proper sensor adjustment as specified in "Sensor Adjustment Check" page 42.

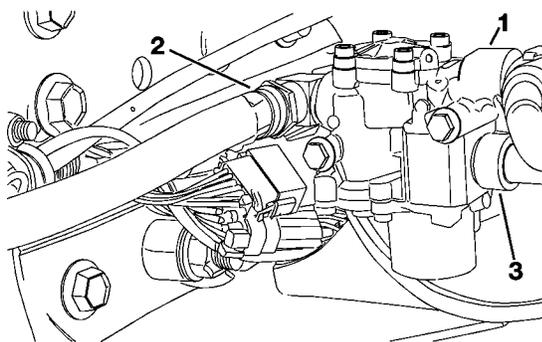
5635-03-02-01 ABS Modulator Valve, Replacement

Before beginning this procedure read the General Work Practices section ("General Work Practices" page 49) for further procedural information.



DANGER

Before working on a vehicle, set the parking brakes, place the transmission in neutral and block the wheels. Failure to do so can result in unexpected vehicle movement and can cause serious personal injury or death.



1
Park the vehicle on a level surface with the transmission in neutral and the front wheels chocked.

2
Remove all tie straps supporting the ABS modulator valve supply airline coming from the brake chamber.

3



WARNING

Before beginning any service work on any part of the air system, be certain that the air pressure has been released. Failure to do so may cause a component to violently separate, which can result in serious personal injury.

Using the Airline release tool (J-44773), disconnect the relay valve supply airline on the top of the modulator valve.

J-44773

4
Using the Airline release tool (J-44773), disconnect the modulator valve supply airline on the brake chamber.

J-44773

5
Disconnect the ABS modulator valve connector.

6
Disconnect the supply line from the ABS Modulator Valve coming from the brake chamber.

7
Remove the two mounting bolts from the ABS modulator valve.

8
Using a wrench, remove the two fittings from the ABS modulator valve.

J-44775

9
Using a wrench, install the two fittings into the replacement ABS modulator valve with the correct pipe sealant.

J-44775

10
Install the replacement ABS modulator valve onto the proper mounting bracket.

11
Connect the supply air line into the ABS Modulator Valve coming from brake chamber.

12

Connect the ABS modulator valve connector.

13

Connect the ABS modulator valve supply airline at the brake chamber and the relay valve supply airline, on top of the ABS modulator valve.

14

Replace the removed tie straps to support airlines and various harnesses.

5631-03-02-25

ABS ATC Valve, Replacement

Before beginning this procedure read the General Work Practices section ("General Work Practices" page 49) for further procedural information.

**DANGER**

Before working on a vehicle, set the parking brakes, place the transmission in neutral, and block the wheels. Failure to do so can result in unexpected vehicle movement and can cause serious personal injury or death.

Removal

1

Park the vehicle on a level surface, apply the parking brake, and block the wheels. Ensure vehicle ignition is OFF.

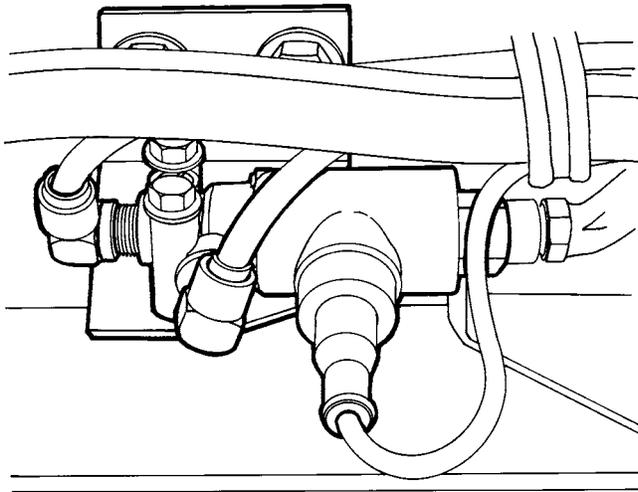
2

Bleed the air pressure from systems A and B.

3

Disconnect the electrical connector from the valve.

4



Traction valve mounted on LH frame rail at rear crossmember

Disconnect the air supply and discharge lines from the valve fittings by pushing in on the air line and fitting collar with release tool J-42189 and pulling on the air line. If air pressure is still in the system it is difficult to release the air line. Be sure to drain all air before starting procedure.

J-42189

5

Remove the 2 valve mounting bolts.

6

Release the exhaust air line from the valve using release tool J-42189 and remove the valve.

7

Remove the air line fittings from the ATC (ATC) valve. Note the position of the fittings for correct installation and alignment of air lines.

Installation

1

Apply sealant to the fitting threads. Install the fittings in the original position for connecting the air lines.

2

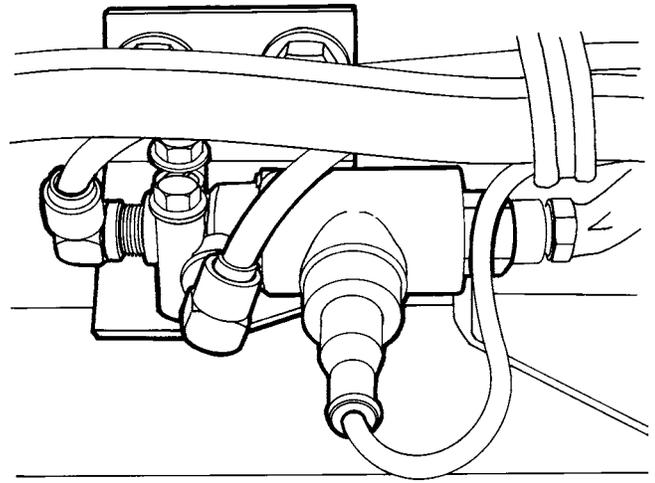
Connect the air line for the exhaust port on the ATC valve. Pull on the air line to be sure that it is locked into the fitting.

3

Install the valve to the mounting bracket using the two mounting bolts. Torque the bolts to 24 Nm (18 ft-lb).

24 Nm
(18 ft-lb)

4



Traction valve mounted on LH frame rail at rear crossmember

Connect the supply and delivery lines to the valve. Pull on the air lines to be sure that they are locked into the fittings.

5

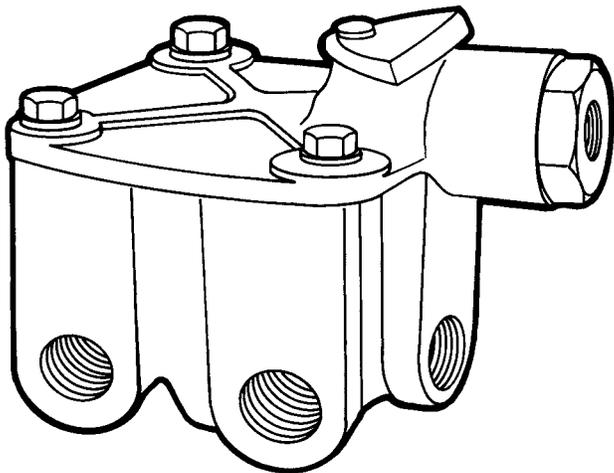
Connect the valve electrical connector and tighten the fastening ring.

6

Build air pressure in the systems to operating pressure (approx. 827 kPa [120 psi]). Check for leaks and operation of the traction valve. Operation of the valve can be checked with the Pro-link tool J-38500-1 and ROCKWELL WABCO cartridge (J-38500-404). Refer to *Component Tests* in the cartridge manual.

J-38500-1
J-38500-404

5635-03-02-04 ABS Relay Valve, Replacement



Before beginning this procedure read the General Work Practices section ("General Work Practices" page 49) for further procedural information.

DANGER

Before working on a vehicle, set the parking brakes, place the transmission in neutral and block the wheels. Failure to do so can result in unexpected vehicle movement and can cause serious personal injury or death.

1
Park the vehicle on a level surface with the transmission in neutral and the front wheels chocked.

2

WARNING

Before beginning any service work on any part of the air system, be certain that the air pressure has been released. Failure to do so may cause a component to violently separate, which can result in serious personal injury.

Drain the complete air system.

3
Remove any tie straps securing the airlines plumbed to this relay valve.

4
Disconnect the six airlines with the push-lock fittings, using special airline release tools J-44773 and J-42189. J-44773
J-42189

5
Remove the two torque bolts that mount the brake relay valve mount bracket.

6
Snug the brake relay valve in a vice and remove all six airline fittings. J-44775

7
Snug the replacement relay valve in a vice and install the six airline fittings using pipe sealant. J-44775

8
Install the replacement relay valve onto the vehicle.

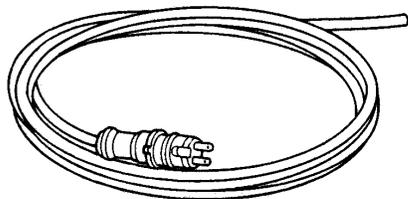
9
Connect the six airlines.

Note: Push airline in completely and remove to insure proper seal.

10
Replace all removed tie straps to secure the airlines plumbed to the relay valve.

11
Start the engine to build the air system, in order to check for leaks and proper operation.

5939-03-02-02 Wheel Speed Sensor, Replacement (Rear Axle)



Before beginning this procedure read the General Work Practices section ("General Work Practices" page 49) for further procedural information.

1



Before working on a vehicle, set the parking brakes, place the transmission in neutral and block the wheels. Failure to do so can result in unexpected vehicle movement and can cause serious personal injury or death.

Park the vehicle on a level surface with the transmission in neutral and the front wheels chocked.

2



Do not work under a vehicle supported only by jacks. Jacks can slip out from under the truck or fall over, causing personal injury or death. Always use jack stands under the truck.

Lift and stabilize the portion of the vehicle to be worked on with the proper jack and jackstand.

3

Remove the tires and wheels on the side of the axle to be worked on.

4

With the parking brake released, back off the brakes on this side and then remove the brake drum.

5

Disconnect the wheel speed sensor harness from the truck harness and remove any securing tie straps and then use special tool J-44769 to remove the sensor from the vehicle.

J-44769

6

Install the replacement wheel speed sensor, using special tool J-44769, and route the replacement harness, connect and secure with tie straps.

J-44769
J-42942

Note: Special tool J-42942 can be used to adjust the sensor without the removal of the wheels or brake drum.

7

Install the brake drum.

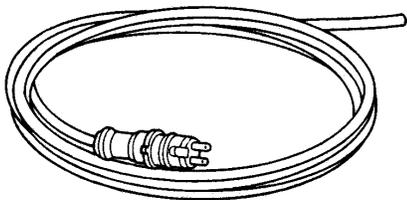
8

Reinstall the removed wheels and tires and using a small screwdriver adjust the brakes.

9

Assuring that the jack is in a safe location, lift the vehicle and remove the jackstand.

5939-03-02-01 Wheel Speed Sensor, Replacement (Steer Axle)



Before beginning this procedure read the General Work Practices section ("General Work Practices" page 49) for further procedural information.

1



Before working on a vehicle, set the parking brakes, place the transmission in neutral and block the wheels. Failure to do so can result in unexpected vehicle movement and can cause serious personal injury or death.

Park the vehicle on a level surface with the transmission in neutral and the front wheels chocked.

2



Do not work under a vehicle supported only by jacks. Jacks can slip out from under the truck or fall over, causing personal injury or death. Always use jack stands under the truck.

Lift and stabilize the portion of the vehicle to be worked on with the proper jack and jackstand.

3

Remove the tire and wheel from the side to be replaced.

4

Back the brakes off on this side by using a small screwdriver to pry out the spring loaded pawl, while releasing the brakes, and then remove the brake drum.

5

Remove the two wheel speed sensor harness tie-downs on the spindle itself. Then remove all of the securing tie straps and disconnect the sensor harness from inside the framerail.

6

Remove the wheel speed sensor housing from the Backing Plate Bracket.

7

Remove the wheel speed sensor from the vehicle.

8

Install the replacement wheel speed sensor in the bracket.

9

Route the replacement wheel speed sensor harness through the backing plate and the framerail.

10

Install the wheel speed sensor bracket.

11

Connect the wheel speed sensor, secure the two removed tie-downs, and replace all the removed tie straps.

12

Install the brake drum.

13

Reinstall the removed tire and wheel and adjust the brakes.

14

Insuring that the jack is in a safe location, lift the vehicle and remove the jackstand.

5939-03-02-03 Wheel Speed Sensor, Replacement (Heavy Duty Axle and/or Aluminum Hub)

Before beginning this procedure read the General Work Practices section ("General Work Practices" page 49) for further procedural information.

1



Before working on a vehicle, set the parking brakes, place the transmission in neutral and block the wheels. Failure to do so can result in unexpected vehicle movement and can cause serious personal injury or death.

Park the vehicle on a level surface with the transmission in neutral and the front wheels chocked.

2

Cut and remove the six tie straps securing the wheel speed sensor harness to the air brake chamber and inside the frame rail.

3

Disconnect the wheel speed sensor from the chassis harness in side the frame rail.

4

Remove the wheel speed sensor harness hold-down from the top kingpin cap.

5

Remove the wheel speed sensor from the housing in the spindle using tool J-44966.

6

Remove the wheel speed sensor harness from the vehicle.

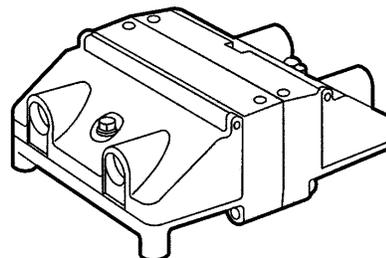
7

Install the removed wheel speed sensor hold-down to the replacement wheel speed sensor harness and secure.

8

Replace the removed tie straps to secure the replacement wheel speed sensor harness.

5931-03-02-01 ABS ECU, Replacement



Before beginning this procedure read the General Work Practices section ("General Work Practices" page 49) for further procedural information.

1



Before working on a vehicle, set the parking brakes, place the transmission in neutral and block the wheels. Failure to do so can result in unexpected vehicle movement and can cause serious personal injury or death.

Park the vehicle on a level surface with the transmission in neutral and the front wheels chocked.

2



Disconnect the engine ECU ground wire if the vehicle is equipped with one.

Remove the battery box cover and disconnect the negative battery cables.

3

Disconnect the three ABS ECU connectors from the ECU.

4

Cut the two tie straps securing the channeled wiring harnesses to the brackets supported by the ECU studs and nuts.

5

Remove the two ABS ECU stud nuts and remove the ABS ECU from the vehicle.

6

Remove the three mounting bracket bolts from the ABS ECU.

7

Install the mounting bracket on the replacement ABS ECU.

8

Install the replacement ABS ECU on the vehicle.

9

Secure the channeled wiring harnesses to the support bracket with tie straps.

10

Connect the three ABS ECU connectors.

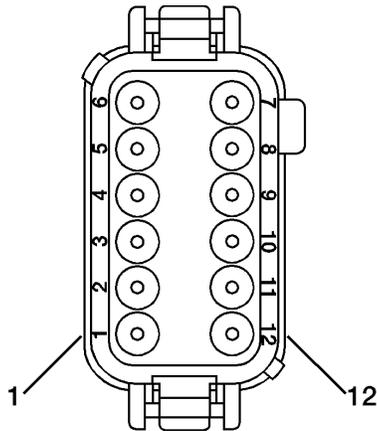
11**CAUTION**

Always connect the main battery ground first. If there are other ground cables connected to the battery (such as engine ECU, satellite system, etc.), connect those grounds last. Electronic modules may be damaged when additional grounds are connected/disconnected without the main battery ground connected.

Reconnect the engine ECU ground wire. Connect the negative battery cables and install the battery box cover.

Appendix

ABS ECU Connectors



Cab (Gray) ECU Connector		
Pin	Circuit No.	Description
1	777A	12V Supply
2	777B	12V Supply
3	774	Traction Control System (TCS) Lamp
4	400	J1587/1708 Data Link +
5	772	Engine Brake Disable (not used with J1939)
6	407	J1939 -L
7	406	J1939 -H
8	779A	Trailer ABS Warning Lamp
9	401	J1587/1708 Data Link -
10	778	ABS Warning Lamp Enable
11	ABS-A	Ground
12	ABS-B	Ground

Front (Black) ECU Connector		
Pin	Circuit No.	Description
2	733	LF Modulator Hold
3	752	RF Modulator Exhaust
4	753	RF Modulator Hold
5	750	RF Sensor Signal

Front (Black) ECU Connector		
Pin	Circuit No.	Description
6	751	RF Sensor Return
7	730	LF Sensor Signal
8	731	LF Sensor Return
9	754	RF Modulator Common
10	732	LF Modulator Exhaust
11	734	LF Modulator Common
1, 12		Not Used

Rear (Green) ECU Connector		
Pin	Circuit No.	Description
1	737	LR Sensor Signal
2	738	LR Sensor Return
3	757	RR Sensor Signal
4	758	RR Sensor Return
5	780	Traction Control Solenoid Source
6	781	Traction Control Solenoid Ground
7	759	RR Modulator Exhaust
8	761	RR Modulator Common
9	760	RR Modulator Hold
10	739	LR Modulator Exhaust
11	741	LR Modulator Common
12	740	LR Modulator Hold

6-Channel (Brown) ECU Connector*		
Pin	Circuit No.	Description
3	735	LR3 Sensor Signal
4	736	LR3 Sensor Return
5	755	RR3 Sensor Signal
6	756	RR3 Sensor Return
1-2, 7-12		Not Used

*Used for 6S/4M only.

Operation Numbers

5631-03-02-25	ABS ATC Valve, Replacement	52
5635-03-02-01	ABS Modulator Valve, Replacement	51
5635-03-02-04	ABS Relay Valve, Replacement	54
5931-03-02-01	ABS ECU, Replacement	57
5932-05-03-01	ABS Sensor, Adjustment	50
5939-03-02-01	Wheel Speed Sensor, Replacement (Steer Axle)	56
5939-03-02-02	Wheel Speed Sensor, Replacement (Rear Axle)	55
5939-03-02-03	Wheel Speed Sensor, Replacement (Heavy Duty Axle and/or Aluminum Hub)	57

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