ANTI-LOCK BRAKING SYSTEMS (ABS) FOR TRUCKS, TRACTORS AND BUSES

FOR C VERSION ECUs

MAINTENANCE MANUAL

WABCO

About This Manual

This manual describes the correct service, replacement, installation and operation procedures for WABCO anti-lock braking systems for trucks, tractors and buses.

Before You Begin

1. Read and understand all instructions and procedures before you begin to service components.
2. Read and observe all Warning and Caution hazard alert messages in this publication. They provide information that can help prevent serious personal injury, damage to components, or both.
3. Follow your company's maintenance and service, installation, and diagnostics guidelines.
4. Use special tools when required to help avoid serious personal injury and damage to components.

Hazard Alert Messages and Torque Symbols

⚠ WARNING

A Warning alerts you to an instruction or procedure that you must follow exactly to avoid serious personal injury and damage to components.

⚠ CAUTION

A Caution alerts you to an instruction or procedure that you must follow exactly to avoid damage to components.

This symbol alerts you to tighten fasteners to a specified torque value.

How to Obtain Additional Maintenance and Service Information

Visit our Literature Center at wabco-na.com/literature to access and order additional information.

Contact WABCO Customer Care Center at 855-228-3203 (United States and Canada); 800-953-0248 (Mexico); or email wnacustomercare@wabco-auto.com

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⚠ ASBESTOS FIBERS WARNING

The following procedures for servicing brakes are recommended to reduce exposure to asbestos fiber dust, a cancer and lung disease hazard. Material Safety Data Sheets are available from WABCO.

Hazard Summary

Because some brake linings contain asbestos, workers who service brakes must understand the potential hazards of asbestos and precautions for reducing risks. Exposure to airborne asbestos dust can cause serious and possibly fatal diseases, including asbestosis (a chronic lung disease) and cancer, principally lung cancer and mesothelioma (a cancer of the lining of the chest or abdominal cavities). Some studies show that the risk of lung cancer among persons who smoke and who are exposed to asbestos is much greater than the risk for non-smokers. Symptoms of these diseases may not become apparent for 15, 20 or more years after the first exposure to asbestos.

Accordingly, workers must use caution to avoid creating and breathing dust when servicing brakes. Specific recommended work practices for reducing exposure to asbestos dust follow. Consult your employer for more details.

Recommended Work Practices

1. Separate Work Areas. Whenever feasible, service brakes in a separate area away from other operations to reduce risks to unprotected persons. OSHA has set a maximum allowable level of exposure for asbestos of 0.1 f/cc as an 8-hour time-weighted average and 1.0 f/cc averaged over a 30-minute period. Scientists disagree, however, to what extent adherence to the maximum allowable exposure levels will eliminate the risk of disease that can result from inhaling asbestos dust. OSHA requires that the following sign be posted at the entrance to areas where exposures exceed either of the maximum allowable levels:

DANGER: ASBESTOS
CANCER AND LUNG DISEASE HAZARD
AUTHORIZED PERSONNEL ONLY
RESPIRATORS AND PROTECTIVE CLOTHING
ARE REQUIRED IN THIS AREA.

2. Respiratory Protection. Wear a respirator equipped with a high-efficiency (HEPA) filter approved by NIOSH or MSHA for use with asbestos at all times when servicing brakes, beginning with the removal of the wheels.

3. Procedures for Servicing Brakes.

a. Enclose the brake assembly within a negative pressure enclosure. The enclosure should be equipped with a HEPA vacuum and worker arm sleeves. With the enclosure in place, use the HEPA vacuum to loosen and vacuum residue from the brake parts.

b. As an alternative procedure, use a catch basin with water and a biodegradable, non-phosphate, water-based detergent to wash the brake drum or rotor and other brake parts. The solution should be applied with low pressure to prevent dust from becoming airborne. Allow the solution to flow between the brake drum and the brake support or the brake rotor and caliper. The wheel hub and brake assembly components should be thoroughly wetted to suppress dust before the brake shoes or brake pads are removed. Wipe the brake parts clean with a cloth.

c. If an enclosed vacuum system or brake washing equipment is not available, employers may adopt their own written procedures for servicing brakes, provided that the exposure levels associated with the employer's procedures do not exceed the levels associated with the enclosed vacuum system or brake washing equipment. Consult OSHA regulations for more details.

d. Wear a respirator equipped with a HEPA filter approved by NIOSH or MSHA for use with asbestos when grinding or machining brake linings. In addition, do such work in an area with a local exhaust ventilation system equipped with a HEPA filter.

e. **NEVER** use compressed air by itself, dry brushing, or a vacuum not equipped with a HEPA filter when cleaning brake parts or assemblies. **NEVER** use carcinogenic solvents, flammable solvents, or solvents that can damage brake components as wetting agents.

4. Cleaning Work Areas. Clean work areas with a vacuum equipped with a HEPA filter or by wet wiping. **NEVER** use compressed air or dry sweeping to clean work areas. When you empty vacuum cleaners and handle used rags, wear a respirator equipped with a HEPA filter approved by NIOSH or MSHA for use with asbestos. When you replace a HEPA filter, wet the filter with a fine mist of water and dispose of the used filter with care.

5. Worker Clean-Up. After servicing brakes, wash your hands before you eat, drink or smoke. Shower after work. Do not wear work clothes home. Use a vacuum equipped with a HEPA filter to vacuum work clothes after they are worn. Launder them separately. Do not shake or use compressed air to remove dust from work clothes.

6. Waste Disposal. Dispose of discarded linings, used rags, cloths and HEPA filters with care, such as in sealed plastic bags. Consult applicable EPA, state and local regulations on waste disposal.

Regulatory Guidance

References to OSHA, NIOSH, MSHA, and EPA, which are regulatory agencies in the United States, are made to provide further guidance to employers and workers employed within the United States. Employers and workers employed outside of the United States should consult the regulations that apply to them for further guidance.

⚠ NON-ASBESTOS FIBERS WARNING

The following procedures for servicing brakes are recommended to reduce exposure to non-asbestos fiber dust, a cancer and lung disease hazard. Material Safety Data Sheets are available from WABCO.

Hazard Summary

Most recently manufactured brake linings do not contain asbestos fibers. These brake linings may contain one or more of a variety of ingredients, including glass fibers, mineral wool, aramid fibers, ceramic fibers and silica that can present health risks if inhaled. Scientists disagree on the extent of the risks from exposure to these substances. Nonetheless, exposure to silica dust can cause silicosis, a non-cancerous lung disease. Silicosis gradually reduces lung capacity and efficiency and can result in serious breathing difficulty. Some scientists believe other types of non-asbestos fibers, when inhaled, can cause similar diseases of the lung. In addition, silica dust and ceramic fiber dust are known to the State of California to cause lung cancer. U.S. and international agencies have also determined that dust from mineral wool, ceramic fibers and silica are potential causes of cancer.

Accordingly, workers must use caution to avoid creating and breathing dust when servicing brakes. Specific recommended work practices for reducing exposure to non-asbestos dust follow. Consult your employer for more details.

Recommended Work Practices

1. Separate Work Areas. Whenever feasible, service brakes in a separate area away from other operations to reduce risks to unprotected persons.

2. Respiratory Protection. OSHA has set a maximum allowable level of exposure for silica of 0.1 mg/m3 as an 8-hour time-weighted average. Some manufacturers of non-asbestos brake linings recommend that exposures to other ingredients found in non-asbestos brake linings be kept below 1.0 f/cc as an 8-hour time-weighted average. Scientists disagree, however, to what extent adherence to these maximum allowable exposure levels will eliminate the risk of disease that can result from inhaling non-asbestos dust.

Therefore, wear respiratory protection at all times during brake servicing, beginning with the removal of the wheels. Wear a respirator equipped with a high-efficiency (HEPA) filter approved by NIOSH or MSHA, if the exposure levels may exceed OSHA or manufacturers' recommended maximum levels. Even when exposures are expected to be within the maximum allowable levels, wearing such a respirator at all times during brake servicing will help minimize exposure.

3. Procedures for Servicing Brakes.

a. Enclose the brake assembly within a negative pressure enclosure. The enclosure should be equipped with a HEPA vacuum and worker arm sleeves. With the enclosure in place, use the HEPA vacuum to loosen and vacuum residue from the brake parts.

b. As an alternative procedure, use a catch basin with water and a biodegradable, non-phosphate, water-based detergent to wash the brake drum or rotor and other brake parts. The solution should be applied with low pressure to prevent dust from becoming airborne. Allow the solution to flow between the brake drum and the brake support or the brake rotor and caliper. The wheel hub and brake assembly components should be thoroughly wetted to suppress dust before the brake shoes or brake pads are removed. Wipe the brake parts clean with a cloth.

c. If an enclosed vacuum system or brake washing equipment is not available, carefully clean the brake parts in the open air. Wet the parts with a solution applied with a pump-spray bottle that creates a fine mist. Use a solution containing water, and, if available, a biodegradable, non-phosphate, water-based detergent. The wheel hub and brake assembly components should be thoroughly wetted to suppress dust before the brake shoes or brake pads are removed. Wipe the brake parts clean with a cloth.

d. Wear a respirator equipped with a HEPA filter approved by NIOSH or MSHA when grinding or machining brake linings. In addition, do such work in an area with a local exhaust ventilation system equipped with a HEPA filter.

e. **NEVER** use compressed air by itself, dry brushing, or a vacuum not equipped with a HEPA filter when cleaning brake parts or assemblies. **NEVER** use carcinogenic solvents, flammable solvents, or solvents that can damage brake components as wetting agents.

4. Cleaning Work Areas. Clean work areas with a vacuum equipped with a HEPA filter or by wet wiping. **NEVER** use compressed air or dry sweeping to clean work areas. When you empty vacuum cleaners and handle used rags, wear a respirator equipped with a HEPA filter approved by NIOSH or MSHA, to minimize exposure. When you replace a HEPA filter, wet the filter with a fine mist of water and dispose of the used filter with care.

5. Worker Clean-Up. After servicing brakes, wash your hands before you eat, drink or smoke. Shower after work. Do not wear work clothes home. Use a vacuum equipped with a HEPA filter to vacuum work clothes after they are worn. Launder them separately. Do not shake or use compressed air to remove dust from work clothes.

6. Waste Disposal. Dispose of discarded linings, used rags, cloths and HEPA filters with care, such as in sealed plastic bags. Consult applicable EPA, state and local regulations on waste disposal.

Regulatory Guidance

References to OSHA, NIOSH, MSHA, and EPA, which are regulatory agencies in the United States, are made to provide further guidance to employers and workers employed within the United States. Employers and workers employed outside of the United States should consult the regulations that apply to them for further guidance.

About This Manual

This manual contains service, troubleshooting, and repair information for the WABCO Anti-Lock Braking System (ABS) and ABS with Automatic Traction Control (ATC) for trucks, tractors, and buses manufactured after December 1990. If your ABS-equipped vehicle was manufactured before this date, call WABCO North America Customer Care at 855-228-3203 for assistance.

Vehicle Specifications

To use this manual you need the following information about your vehicle.

- Where is the ECU mounted?
- How is the ABS configured?
- What are the tire sizes used on the vehicle? Refer to Section 3.
- Is it equipped with ATC? Refer to Section 2.
- Use the chart shown in Table A to record vehicle identification data.

Table A: Vehicle Identification Chart

Vehicle		ECU Mounting		ABS Configuration			Tire Sizes		Optional ATC	
Model Year Manufacturer	VIN	Cab	Frame	4S/4M	6S/4M	6S/6M	Front	Rear	Y	N

Vehicle Identification

ECU Mounting Locations

The Electronic Control Unit (ECU) may be mounted in the cab or on the frame of the vehicle.

ABS Configuration

The ABS configuration is determined by the number of wheel end sensors and modulator valves. There are three possibilities.

- Four wheel end sensors, four modulator valves (4S/4M)
- Six wheel end sensors, four modulator valves (6S/4M)
- Six wheel end sensors, six modulator valves (6S/6M)

Typical ABS configurations are illustrated in Section 3

How ABS Works

The WABCO Anti-Lock Braking System (ABS) is an electronic system that monitors and controls wheel speed during braking. The system works with standard air brake systems.

The ABS monitors wheel speed at all times and controls braking during emergency situations. The WABCO ABS improves vehicle stability and control by reducing wheel lock during braking.

In the unlikely event of a malfunction in the system, the ECU will disable all or only a portion of the ABS, returning the affected wheels to normal braking.

An electronic control unit (ECU) receives and processes signals from the wheel speed sensors. When the ECU determines a wheel lockup condition, the unit activates an appropriate modulator valve, and air pressure is reduced. When the wheel speed enters the stable region again, the pressure is automatically increased.

There is an ABS warning lamp to let the driver — and the service technician — know the system is working. ABS warning lamps for systems installed on buses, trucks, or tractors are located on the dash or instrument panel, depending on the make and model of the vehicle.

Components

The **Electronic Control Unit (ECU)** is the brain of the system. It receives information from the sensors and sends signals to the ABS valves. The ECU may be mounted in the cab or on the frame of the vehicle. As illustrated, cab- and frame-mounted ECUs use a different style connector. Figure 1.1.

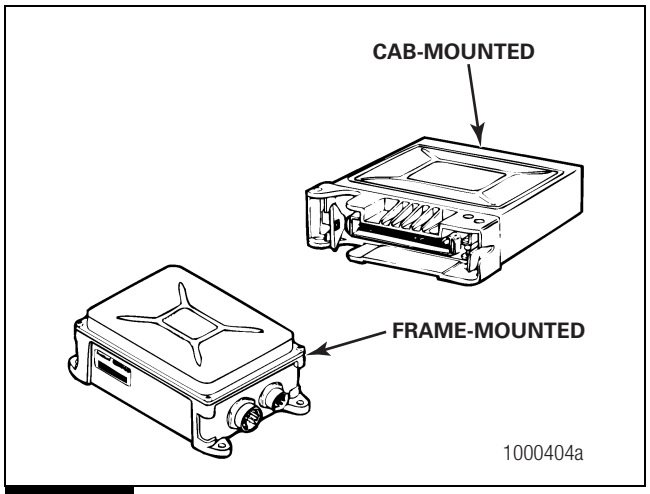


Figure 1.1

NOTE: Do not open the ECU. Opening the ECU to gain access to the internal components will void the warranty.

The **tooth wheel** is mounted on the hub of each monitored wheel. Figure 1.2.

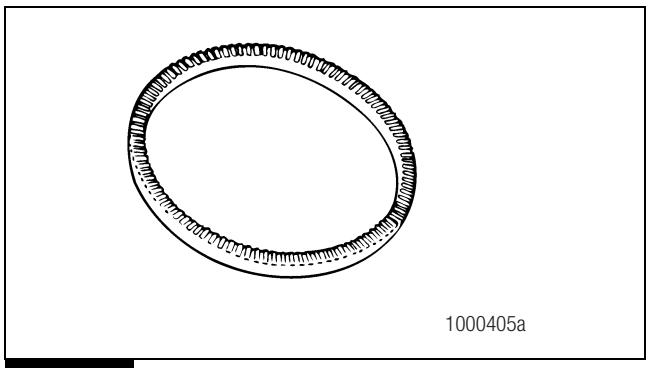


Figure 1.2

A **sensor** is installed so that its end is against the tooth wheel. The sensor continuously sends wheel speed information to the ECU. On a four-channel ABS, two sensors are installed on the steering axle and two additional sensors are mounted on one drive axle. The sensors on the steering axle are installed in the steering knuckle. The sensors on the drive axle are mounted in a block attached to the axle housing. Figure 1.3.

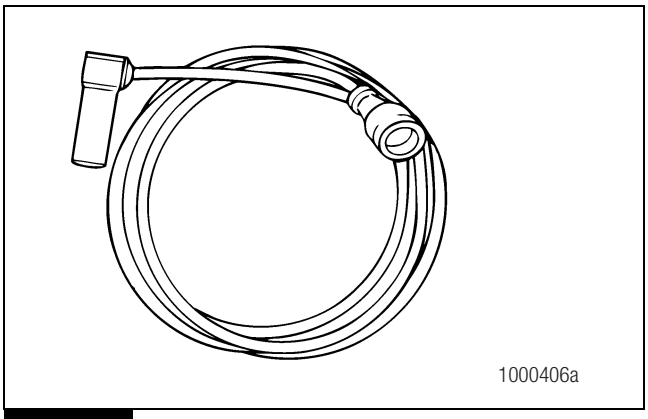


Figure 1.3

The **sensor clip** holds the sensor in place at the tooth wheel. Figure 1.4.

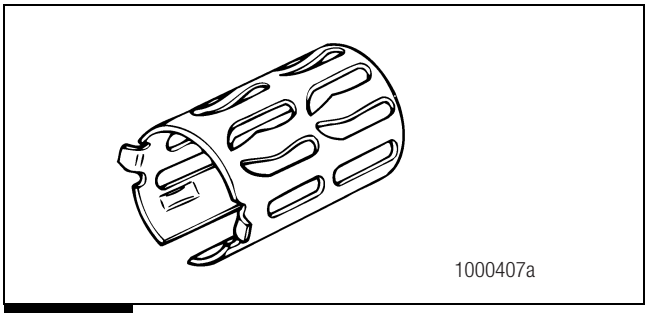


Figure 1.4

An **ABS modulator valve** controls air pressure to each affected brake during ABS function. Figure 1.5.

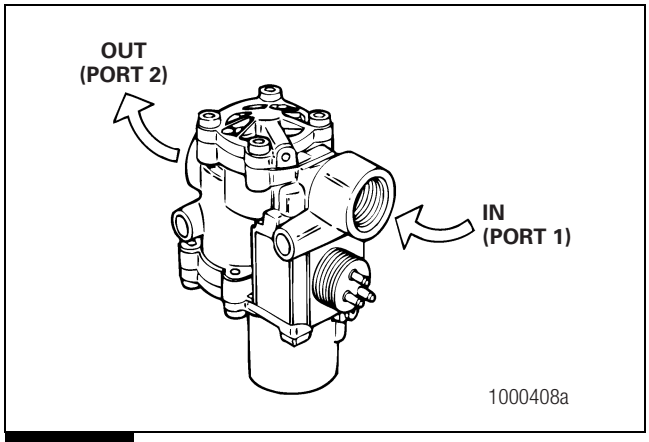


Figure 1.5

During normal braking, compressed air flows through the ABS valve to the brake chambers. During ABS operation, the ABS valve adjusts air pressure to the brake chambers to control braking and prevent wheel lock.

The ABS valve is usually located on a frame rail or cross member, between the relay valve or quick release valve and the brake chamber.

An alternative to individual valves is the **ABS valve package.** It combines two ABS modulator valves and one relay valve. Figure 1.6.

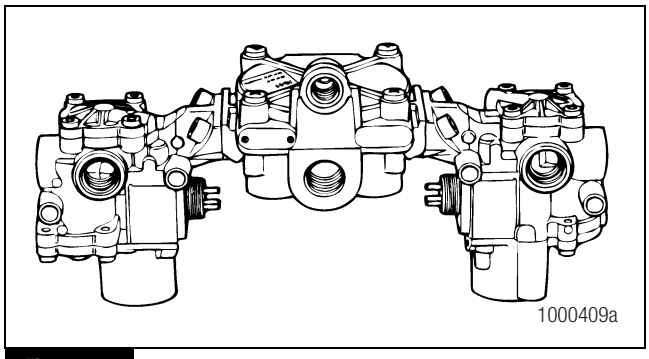


Figure 1.6

The **in-cab ECU harness** provides electrical connections for the power, ground, warning lamp, and communication connections to the ECU. Depending on your vehicle set-up, it may also include the blink code switch and lamp. Figure 1.7.

The **chassis harness** provides the electrical connections for the sensors and valves.

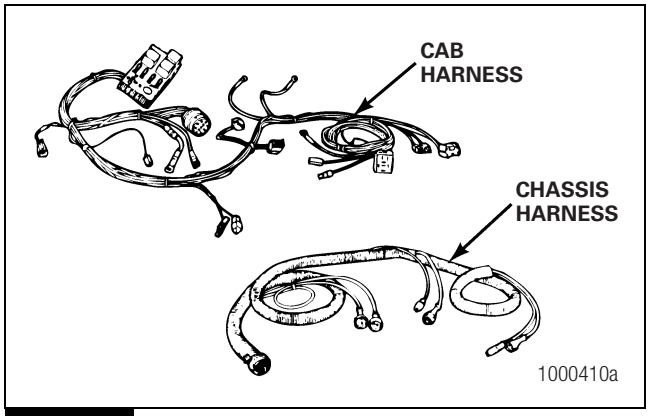


Figure 1.7

Sensor extension cables connect the sensor to the ECU. Figure 1.8.

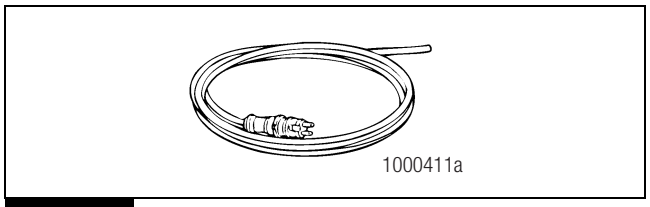


Figure 1.8

The **ABS Modulator Valve Cable** connects the ABS valve to the ECU. Figure 1.9.

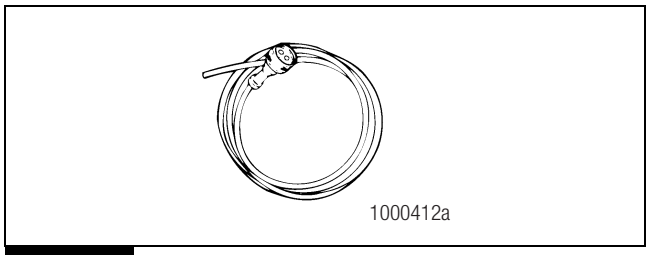


Figure 1.9

The **ABS warning lamp** comes on when the ignition switch is activated. The lamp goes out when the speed of the vehicle reaches approximately 4 mph (6 km/h). If the warning lamp remains lit or comes on at any other time during vehicle operation, it signals a malfunction in the ABS. Figure 1.10.

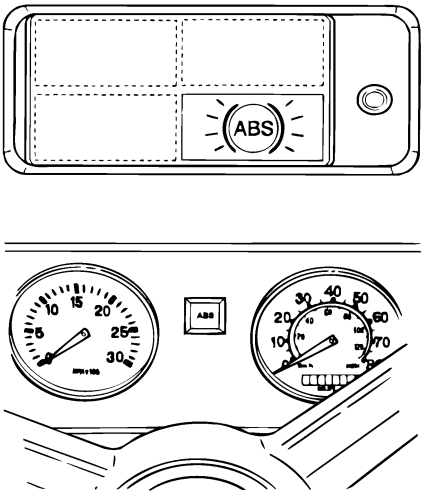


Figure 1.10

Optional Test Equipment

Refer to Section 3 for operating instructions.

The **WABCO test adaptor** helps service and troubleshoot the ABS system. Use with cab-mounted ECUs only. Figure 1.11.

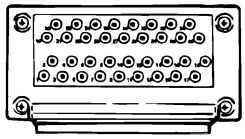


Figure 1.11

The MPSI Pro-Link® 9000 with the WABCO cartridge, available from Kent-Moore, lets you test ABS components. Figure 1.12.

Figure 1.12

Optional ATC

Automatic traction control (ATC) is an option available on ABS-equipped vehicles. It helps move vehicles on slippery surfaces and reduces drive wheel overspin. ATC works automatically in two different ways.

1. If a drive wheel starts to spin, ATC brakes that wheel and transfers engine torque to the wheels with better traction.
2. If all drive wheels spin, ATC reduces engine torque to provide improved traction.

If the drive wheels spin during acceleration, the ATC indicator lamp comes on and stays lit. To determine if a vehicle has ATC, look for an indicator lamp on your dash or instrument panel marked “ATC,” "ASR," or “wheel spin.” Some vehicles without ATC have a “wheel spin” lamp. Figure 2.1.

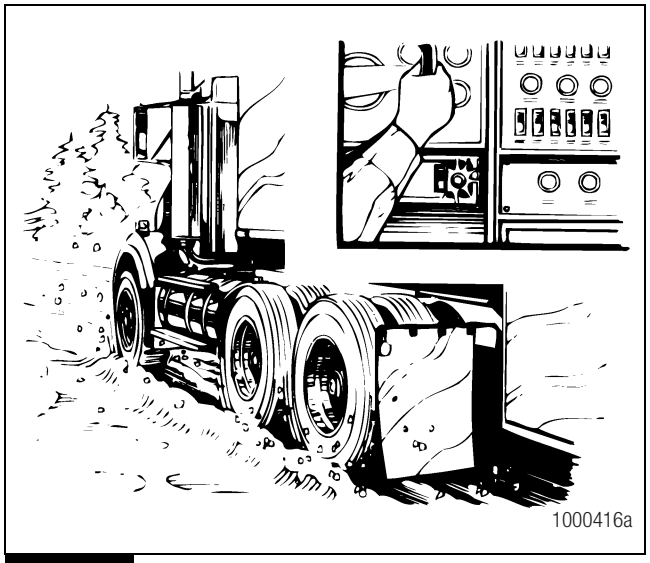


Figure 2.1

Deep Snow and Mud Switch

A **deep snow and mud** switch may be included with ATC. This feature increases available traction for vehicles on extra soft surfaces like slush or mud. The selection switch and indicator lamp are located on the dash. When this feature is selected, the indicator lamp blinks continuously. Figure 2.2.

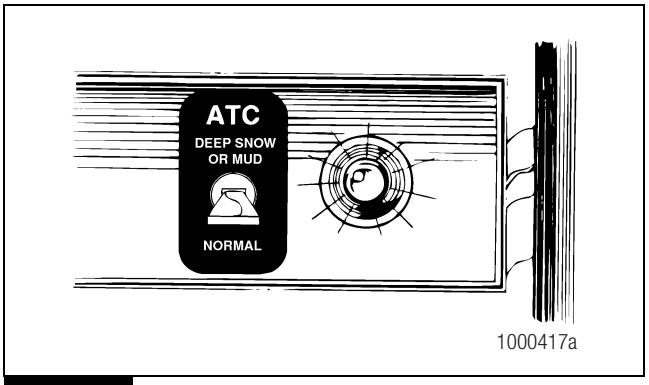


Figure 2.2

Components

ATC uses two solenoid valves, two double-check valves and a wiring harness with ATC connectors. Figure 2.3.

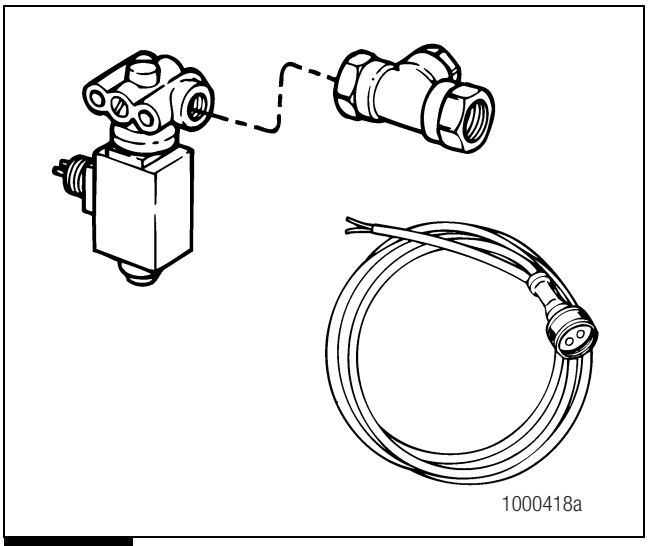


Figure 2.3

ATC solenoid valves are usually mounted on the frame toward the rear of the vehicle.

The air line between the ATC valve and the double check valve must gradually slope toward the ATC valve. This allows condensation to drain out of the ATC valve exhaust.

Refer to Section 3, Section 4 and Section 5 for additional ATC information.

Maintenance

There is no regularly scheduled maintenance required for the WABCO ABS or ABS/ATC. However, ABS does not change current vehicle maintenance requirements.

Troubleshooting

Suggested Diagnostic Tools

Standard: Blink Code Reference Information

Optional: WABCO Test Adaptor

Optional: Pro-Link® 9000

Blink Code Reference Information

To troubleshoot a possible ABS fault, use the blink code diagnostics built into the system. Before you begin, you should be familiar with the following definitions.

Blink Code Definitions

Blink Code: A series of blinks or flashes that describe a particular ABS system configuration and fault.

Blink Code Cycle: A set of three series of flashes, each set separated by a 2.5 second pause. The **first set** of flashes represents the system set-up:

One flash = 6S/6M

Two flashes = 4S/4M

Four flashes = 6S/4M

The last **two sets** identify the system fault.

Blink Code Switch: A switch that activates blink code diagnostic capabilities. Switch locations vary, depending on the make and model of the vehicle. Figure 3.1.

⚠ CAUTION

You must turn the blink code switch to the OFF position before engaging in normal operation. If the switch is left in the ON position, reduced engine power can result, for vehicles equipped with ATC only.

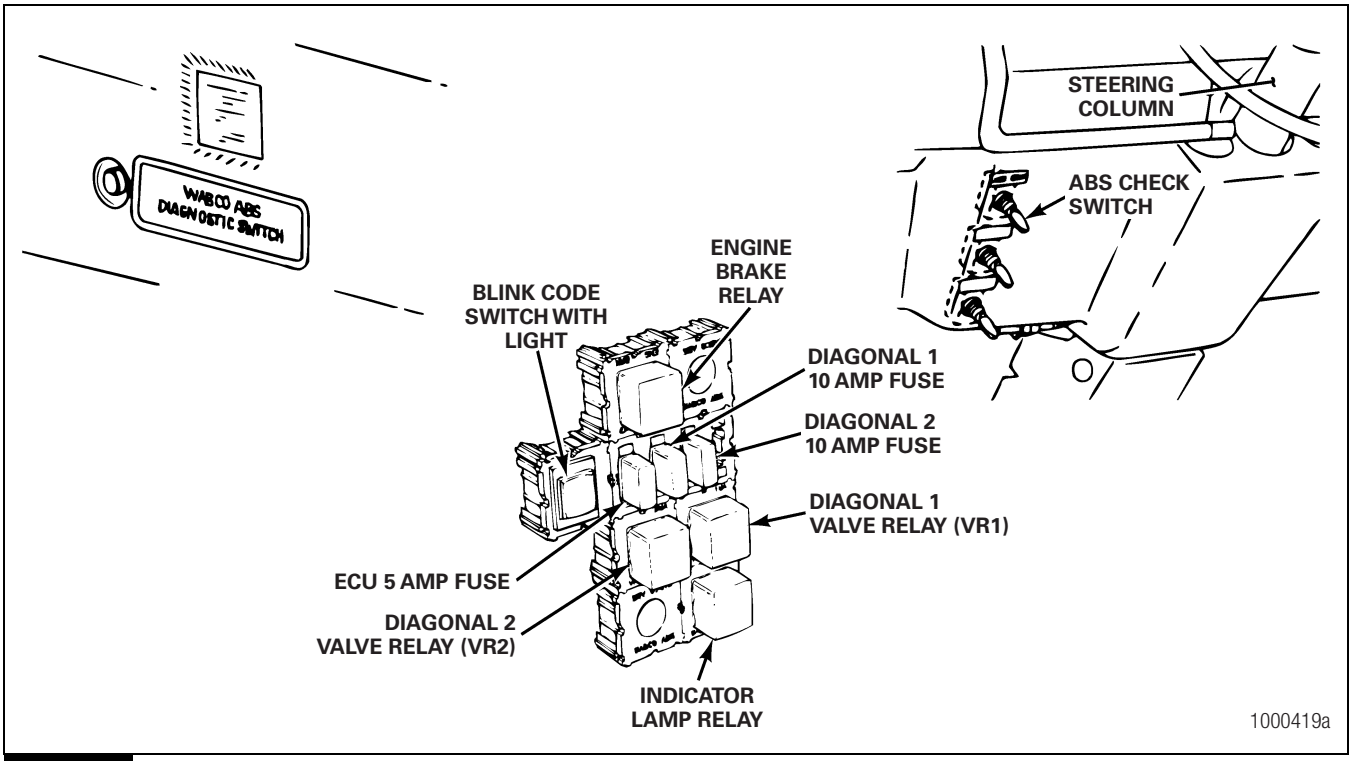


Figure 3.1

Erasing a fault: The process of clearing a fault from the ECU:

1. After an **Existing fault** has been corrected
2. After an **Intermittent fault** has been displayed

After the fault has been cleared, the blink code displays a new code. If there are no other faults, the blink code displays system O.K. (i.e., 2-0-0).

Fault: An ABS malfunction detected and stored in memory by the WABCO ECU. System faults may be **existing** or **intermittent.**

Existing Fault: An active ABS fault; for example, a sensor circuit malfunction on the left front steering axle that currently exists. An existing fault must be repaired before it can be cleared from memory.

Intermittent Fault: An inactive fault; for example, a loose wire that caused a system fault to register. An intermittent fault does not require repair before it can be cleared from memory.

IF . . . ABS warning lamp comes on and stays on after:

Ignition turned OFF, then ON

and

Vehicle driven in excess of four mph (6 km/h) . . . ⇒ **Fault is Existing**

IF. . . ABS warning lamp comes on and stays on after:

Vehicle driven in excess of four mph (6 km/h)

and

ABS warning lamp goes out after: Ignition turned OFF, then ON

and

Vehicle again driven in excess of four mph (6 km/h) . . . ⇒ **Fault is Intermittent**

Blink Code Facts

As long as the ignition key and blink code switch remain in the ON position, the blink code will repeat.

Intermittent fault codes can be erased from the ECU memory, but the condition that caused the fault could still exist. Record intermittent fault codes and make any necessary adjustments or repairs to the vehicle.

After using the blink code, turn the blink code switch OFF before resuming normal operation.

Using the Blink Code

Servicing Alert

An ABS warning lamp alerts drivers to a possible system malfunction. If the ABS lamp stays on during normal vehicle operation, the driver knows the vehicle needs to be serviced.

Blink Code Display

The blink code is displayed on one of the following lamps installed in the vehicle.

- An independent blink code lamp or a combination blink code switch and lamp
- An ATC lamp located on the vehicle instrument panel, for ABS/ATC-equipped vehicles

Lamp locations vary, depending on the make and model of the vehicle

Figure 3.2 and Figure 3.3 illustrate the blink code cycle.

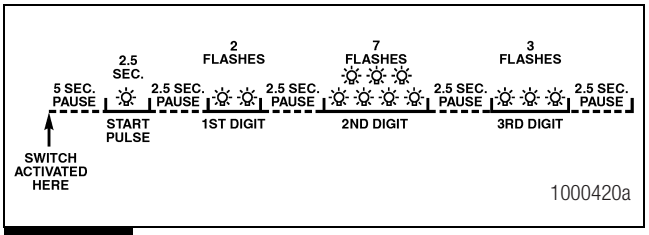


Figure 3.2

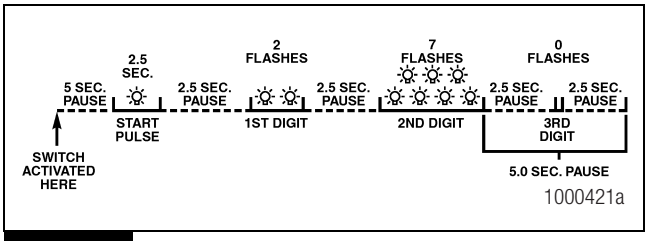


Figure 3.3

Blink Code Diagnostic Procedure

Follow the steps outlined in Table B to use the blink code.

Table B: Blink Code Diagnostic Procedure

Step — Action	System Response	Action
I Turn Ignition Key **ON.** **and** Turn Blink Code Switch **ON.**	ABS lamp comes on and stays on. Blink Code lamp comes on after approximately 5 seconds, then goes off. At the end of 5 seconds, blink code cycle begins.	Observe lamps.
II Identify the 3-digit blink code.	First set of flashes (indicates system configuration). Pause. . .. ⇒ Second set of flashes. Pause. Third set of flashes. . . . ⇒	Observe and record blink code. After blink code is identified, turn blink code switch **OFF**, cycle will continue until all three sets of flashes have been displayed. After COMPLETE blink code cycle, turn ignition **OFF**. Look up 3-digit code on *Diagnostics Chart* or Blink Code Card, TP-94157.
III Repeat Step I to determine status of fault: **Intermittent** or **Existing.**	If a new code or a system O.K. code (i.e., 2-0-0) appears, fault was Intermittent. ***NOTE: System O.K. code indicates fault erased from ECU memory.*** If code repeats, fault is existing (active) and must be repaired.	Keep a record of fault for future reference. ***NOTE: Make necessary adjustments or repairs to vehicle to prevent future occurrences.*** Perform repair listed on *Diagnostics Chart* or TP-94157. Repeat procedure until System O.K. code received.

Working with Blink Code Diagnostics

When using blink code diagnostics, the following conditions may occur. Table C.

Table C: Blink Code Conditions

Step	Condition	Cause	Action
I	Lamp does not light.	Loose or burned out bulb.	Check bulb. Check connections. Make necessary repairs.
		Voltage not within acceptable range (11-15 volts).	Check connections. Measure voltage. Make necessary repairs.

Step	Condition	Cause	Action
I, III	Code continues to repeat.	Ignition and blink code switch not turned off.	Turn Blink Code switch off. Wait for lamp to stop flashing. Turn Ignition off.
		Fault not repaired.	Review *Diagnostics Chart* or TP-94157 to ensure all possible conditions were corrected. Verify all repair work.
		Fault not erased from ECU after report.	Repeat procedure until System O.K. code received.
II	Code not listed on *Diagnostics Chart* or TP-94157.		

Blink Code Diagnostics

Use the following charts to identify blink codes.

Table D: Blink Codes

Additional 6S/6M and 6S/4M blink codes follow this table.

	Fault Code		
Blink Code[1]	Location	Cause	Solution
1-0-0	N/A	No Faults — System O.K.	No action needed.
2-0-0			
4-0-0			
1-6-6	Voltage Relay 1	Low voltage to the diagonal relay or defective relay.	Check vehicle voltage or replace relay if needed.
2-6-6			
4-6-6			
1-6-7	Voltage Relay 2		
2-6-7			
4-6-7			
1-6-8	Right Front Wheel	Erratic wheel speed signal from the steering axle.	Check for loose wheel bearings, faulty sensor wiring connections, excessive hub runout, a sensor gap that is too wide, or damage to tooth wheels on the steering axle.
2-6-8			
4-6-8			
1-6-9	Left Front Wheel		
2-6-9			
4-6-9			

Additional 6S/6M and 6S/4M blink codes follow this table.

Fault Code			
Blink Code[1]	**Location**	**Cause**	**Solution**
1-6-10 2-6-10 4-6-10	Right Front Wheel	Sensor circuit failure on steering axle.	Check sensor, sensor cable and cable connections.
1-6-11 2-6-11 4-6-11	Left Front Wheel		
1-6-12 2-6-12 4-6-12	Right Front Wheel	Steering axle sensor out of adjustment.	Adjust sensors on steering axle.
1-7-0 2-7-0 4-7-0	Left Front Wheel		
1-7-0 2-7-0 4-7-0	Left Rear Wheel	Erratic wheel speed from drive axle.	Check for loose wheel bearings, faulty sensor wiring connections, excessive hub runout, sensor gap that is too wide, or damage to tooth wheels on the drive axle.
1-7-1 2-7-1 4-7-1	Right Rear Wheel		
1-7-2 2-7-2 4-7-2	Left Rear Wheel	Sensor circuit failure on drive axle.	Check sensor, sensor cable and cable connections.
1-7-3 2-7-3 4-7-3	Right Rear Wheel		
1-7-4 2-7-4 4-7-4	Left Rear Wheel	Drive axle sensor out of adjustment.	Adjust sensors on drive axle. Check for differences between steer and drive tire sizes.
1-7-5 2-7-5 4-7-5	Right Rear Wheel		
1-8-3 2-8-3 4-8-3	N/A	Improperly wired J1922 Engine Data Link. Short circuit to power or ground, or open circuit.	Check J1922 Engine Data Link, cable and connections.

Additional 6S/6M and 6S/4M blink codes follow this table.

Fault Code			
Blink Code[1]	**Location**	**Cause**	**Solution**
1-8-5 2-8-5 4-8-5	N/A	Improperly wired J1922 Engine Data Link. Short circuit to power or ground, open circuit, wires switched.	Check J1922 Engine Data Link, cable and connections.
1-8-7 2-8-7 4-8-7	N/A	Message error detected in J1922 Engine Data Link.	Erase fault from ECU memory. No other action required.
1-8-9 2-8-9 4-8-9	N/A		
1-8-10 2-8-10 4-8-10	Right Front Wheel	Short circuit in steering axle ABS valve-to-ground connection.	Check ABS valve and cable. Replace as required.
1-8-11 2-8-11 4-8-11	Left Front Wheel		
1-8-12 2-8-12 4-8-12	Right Front Wheel	Open circuit in steering axle ABS valve or cable.	Check ABS valve and cable. Replace as required.
1-8-13 2-8-13 4-8-13	Left Front Wheel		
1-8-14 2-8-14 4-8-14	Right Front Wheel	Short circuit in steering axle ABS valve-to-ground connection.	Check ABS valve and cable. Replace as required.
1-8-15 2-8-15 4-8-15	Left Front Wheel		
1-9-0 2-9-0 4-9-0	Right Front Wheel	Open circuit in steering axle ABS valve or cable.	Check ABS valve and cable. Replace as required.
1-9-1 2-9-1 4-9-1	Left Front Wheel		

Additional 6S/6M and 6S/4M blink codes follow this table.

Fault Code			
Blink Code[1]	**Location**	**Cause**	**Solution**
1-9-2	Left Rear Wheel	Short circuit to ground in drive axle ABS valve or cable.	Check ABS valve and cable. Replace as required.
2-9-2			
4-9-2			
1-9-3	Right Rear Wheel		
2-9-3			
4-9-3			
1-9-4	Left Rear Wheel	Open circuit in drive axle ABS valve or cable.	Check ABS valve and cable. Replace as required.
2-9-4			
4-9-4			
1-9-5	Right Rear Wheel		
2-9-5			
4-9-5			
1-9-6	Left Rear Wheel	Short circuit to ground in drive axle ABS valve or cable.	Check ABS valve and cable. Replace as required.
2-9-6			
4-9-6			
1-9-7	Right Rear Wheel		
2-9-7			
4-9-7			
1-9-8	Left Rear Wheel	Open circuit in drive axle ABS valve or cable.	Check ABS valve and cable. Replace as required.
2-9-8			
4-9-8			
1-9-9	Right Rear Wheel		
2-9-9			
4-9-9			
1-10-2	Left Rear Wheel	Short circuit in ATC valve to ground connection.	Check ATC valve and cable. Replace as required.
2-10-2			
4-10-2			
1-10-3	Right Rear Wheel		
2-10-3			
4-10-3			
1-10-7	N/A	Short circuit in wiring or relay that controls engine brake.	Check engine brake relay and wiring to relay coil.
2-10-7			
4-10-7			

Additional 6S/6M and 6S/4M blink codes follow this table.

Fault Code			
Blink Code[1]	**Location**	**Cause**	**Solution**
1-10-8	Left Rear Wheel	Excessive drive axle wheel spin caused by driver or dynamometer.	Check steer axle sensor gap. Erase fault from ECU memory.
2-10-8			
4-10-8			
1-10-9	Right Rear Wheel		
2-10-9			
4-10-9			
1-11-12	Right Front Wheel	Short circuit between steering axle ABS valve and power supply connection.	Check ABS valve and cable. Replace as required.
2-11-12			
4-11-12			
1-11-13	Left Front Wheel		
2-11-13			
4-11-13			
1-11-14	Left Rear Wheel	Short circuit between drive axle ABS valve and power supply connection.	Check ABS valve and cable. Replace as required.
2-11-14			
4-11-14			
1-11-15	Right Rear Wheel		
2-11-15			
4-11-15			
1-12-2	Left Rear Wheel	Short circuit between ATC valve and power supply connection.	Check ATC valve and cable. Replace as required.
2-12-2			
4-12-2			
1-12-3	Right Rear Wheel		
2-12-3			
4-12-3			
1-12-4	N/A	Short circuit between pin 12 of ABS ECU and power supply connection.	Check ECU harness.
2-12-4			
4-12-4			
1-12-7	N/A	Short circuit between engine brake and ground connection.	Check engine brake relay.
2-12-7			
4-12-7			

Additional 6S/6M and 6S/4M blink codes follow this table.

Fault Code			
Blink Code[1]	**Location**	**Cause**	**Solution**
1-12-8 2-12-8 4-12-8	Right Front Wheel	Short circuit between steering axle ABS valve and battery.	Check ABS valve and cable. Replace as required.
1-12-9 2-12-9 4-12-9	Left Front Wheel		
1-12-10 2-12-10 4-12-10	Left Rear Wheel	Short circuit between steering axle ABS valve and battery.	Check ABS valve and cable. Replace as required.
1-12-11 2-12-11 4-12-11	Right Rear Wheel		
1-12-14 2-12-14 4-12-14	Left Rear Wheel	Short circuit between steering axle ATC valve and battery.	Check ATC valve and cable. Replace as required.
1-12-15 2-12-15 4-12-15	Right Rear Wheel		
1-13-0 2-13-0 4-13-0	N/A	Short circuit between pin 12 of ABS ECU and battery.	Check ECU harness.
1-13-4 2-13-4 4-13-4	Voltage Relay 1	Diagonal valve relay not operating correctly.	Check diagonal valve relay.
1-13-5 2-13-5 4-13-5	Voltage Relay 2		
1-13-8 2-13-8 4-13-8	Voltage Relay 1	Power supply voltage too high.	Repair vehicle power supply.
1-13-9 2-13-9 4-13-9	Voltage Relay 2		

[1] *First digit of Blink Code identifies system configuration: 1 = 6S/6M, 2 = 4S/4M, 4 = 6S/4M.

Table E: — Additional 6S/6M or 6S/4M Blink Codes: 4 = 6S/4M, 1 = 6S/6M

Fault Code			
Blink Code Axle 3			
Left	Right	Cause	Solution
1-7-8 4-7-8	1-7-9 4-7-9	Erratic wheel speed from third axle.	Check for loose wheel bearings, faulty sensor wiring connections, excessive hub runout, sensor gap that is too wide or damage to tooth wheels on third axle.
1-7-10 4-7-10	1-7-11 4-7-11	Sensor circuit failure on third axle.	Check sensor, sensor cable and cable connections.
1-7-12 4-7-12	1-7-13 4-7-13	Third axle sensor out of adjustment.	Adjust sensors on third axle. Check for differences between steer and rear tire sizes.
1-9-10	1-9-11	Short circuit to ground in third axle ABS valve or cable.	Check ABS valve and cable. Replace as required.
1-9-12	1-9-13	Open circuit in third axle ABS valve or cable.	Check ABS valve and cable. Replace as required.
1-9-14	1-9-15	Short circuit to ground in third axle ABS valve or cable.	Check ABS valve and cable. Replace as required.
1-10-0	1-10-1	Open circuit in third axle ABS valve or cable.	Check ABS valve and cable. Replace as required.
1-12-0	1-12-1	Short circuit in connection between third axle ABS valve and battery.	Check ABS valve and cable. Replace as required.
1-12-12	1-12-13	Short circuit in connection between third axle ABS valve and battery.	Check ABS valve and cable. Replace as required.

Testing

The locations of sensors and valves are illustrated in Figure 3.4, Figure 3.5, Figure 3.6, Figure 3.7, Figure 3.8 and Figure 3.9. Most vehicles with spring suspension have sensors on forward-rear axle. Most vehicles with air suspension have sensors on rear-rear axle.

NOTE: Liftable axles are always the third axle with ABS.

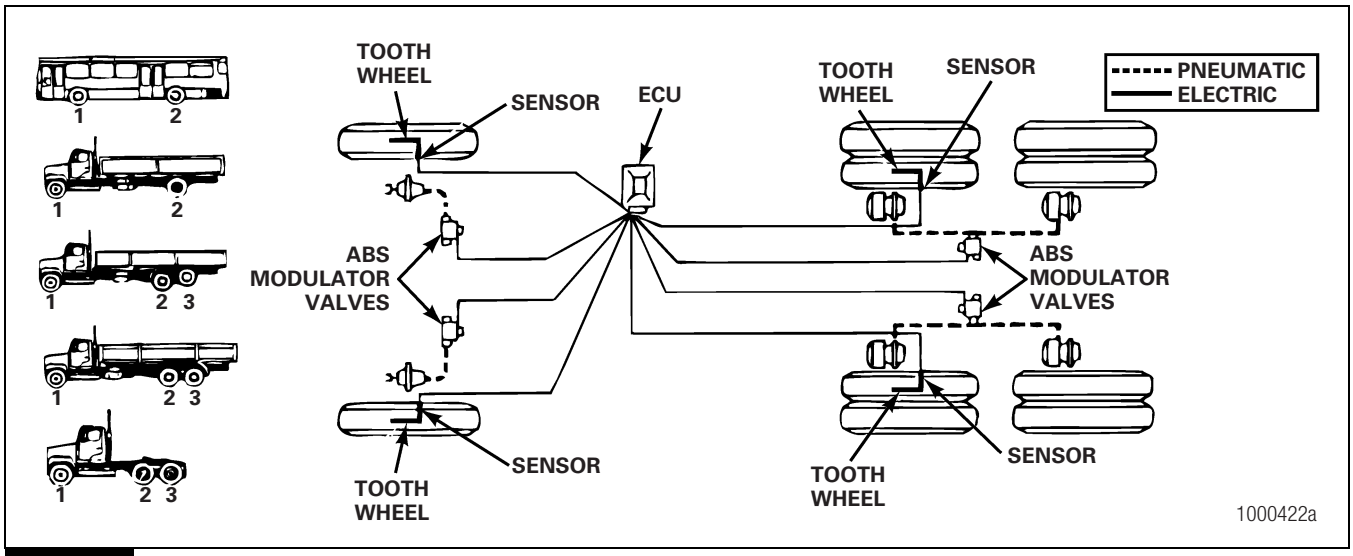


Figure 3.4

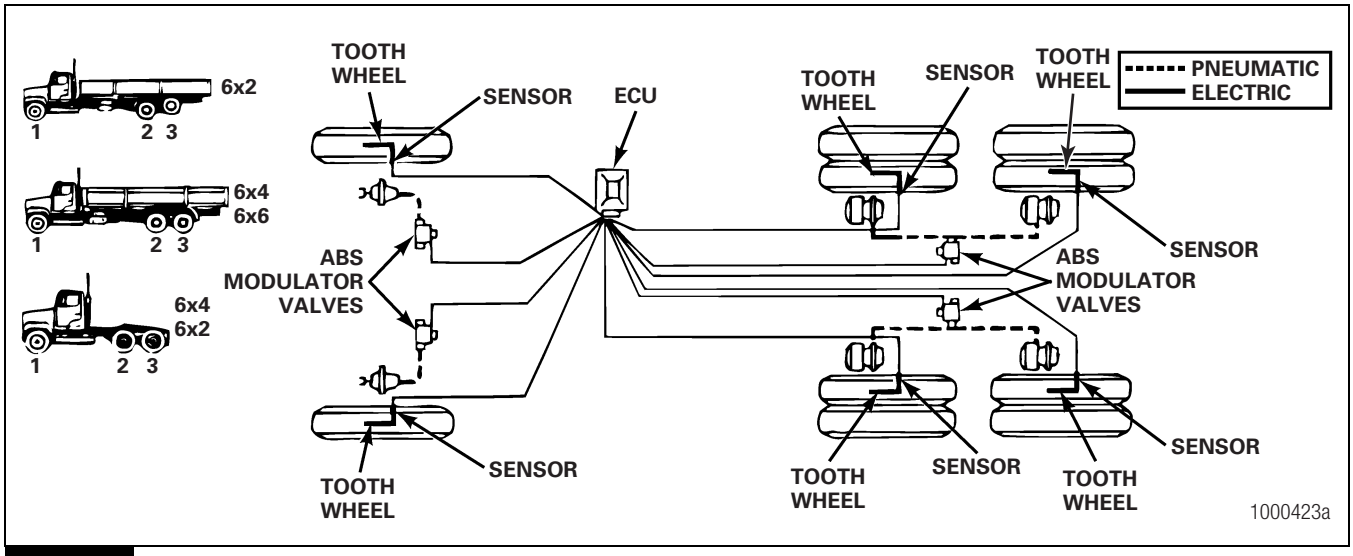


Figure 3.5

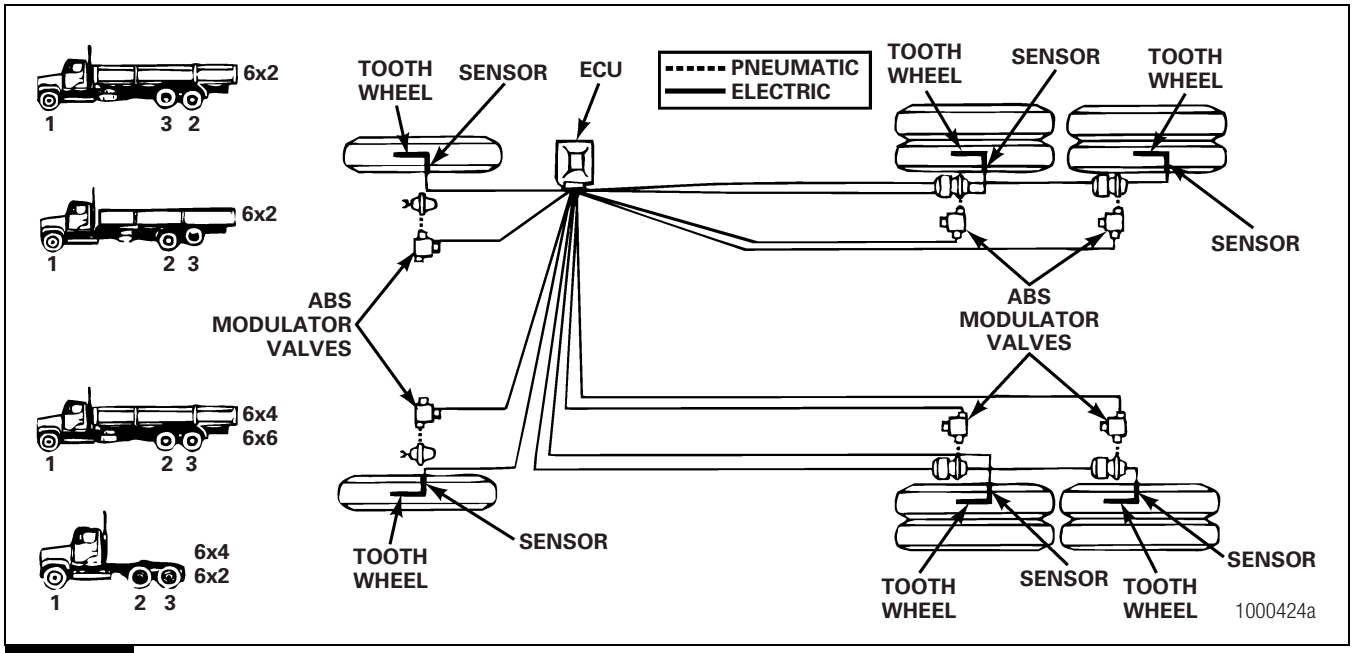


Figure 3.6

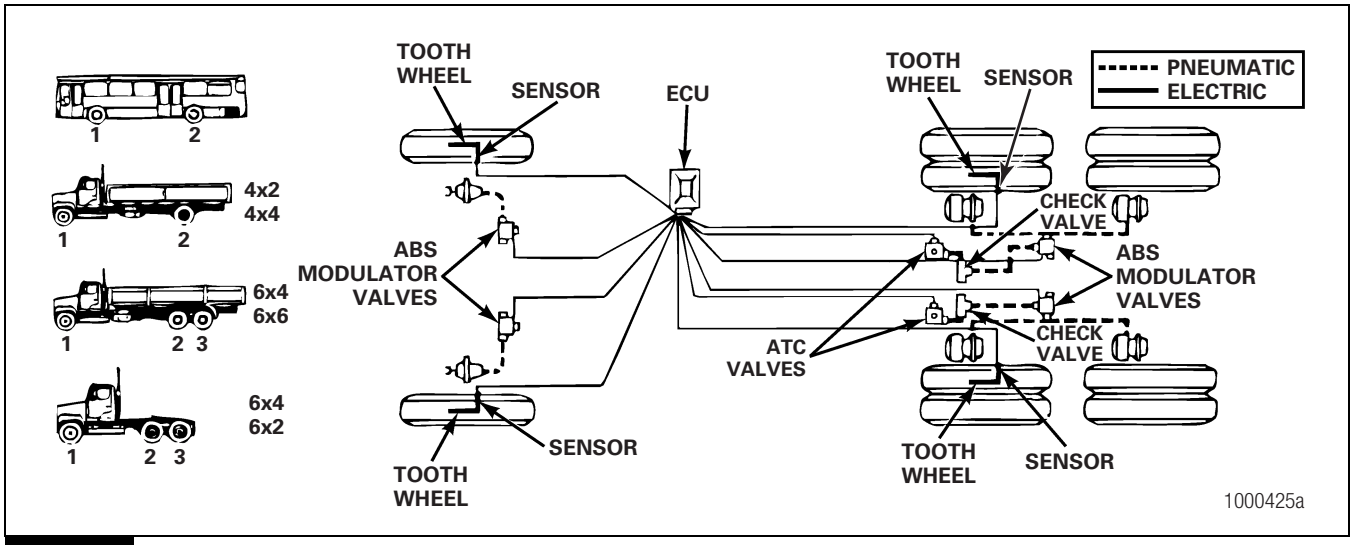


Figure 3.7

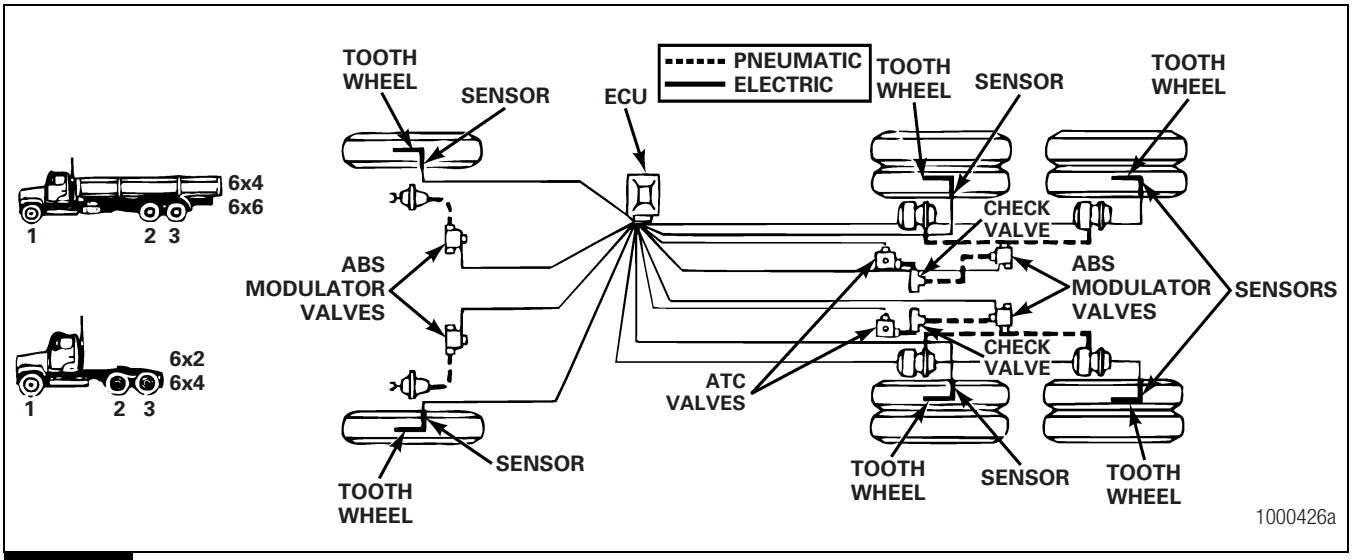


Figure 3.8

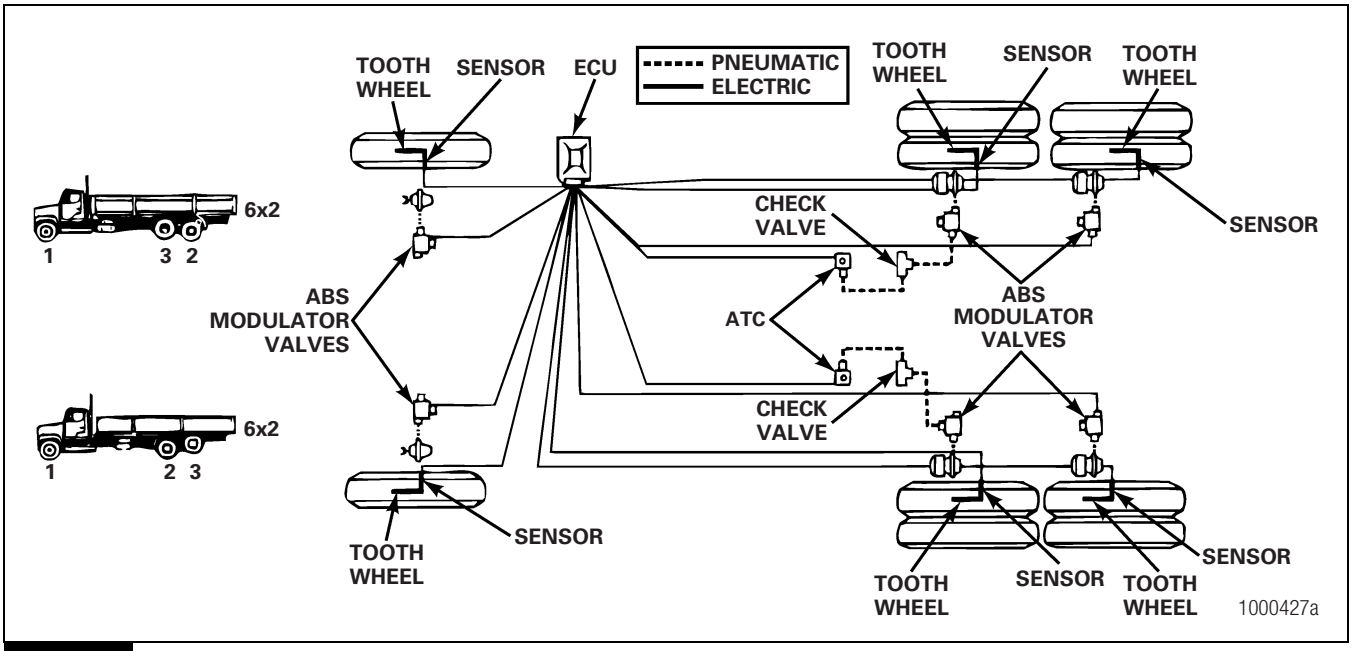


Figure 3.9

Optional Test Equipment

⚠ WARNING

Exhaust gas contains poison. When testing a vehicle with the engine running, test in a well-ventilated area or route the exhaust hose outside.

To avoid serious personal injury, keep away, and keep test equipment away, from all moving or hot engine parts.

NOTE:

- Refer to, and follow, the vehicle manufacturer's Warnings, Cautions, and service procedures.
- Unless otherwise directed, set the parking brake and place the gear selector in NEUTRAL for manual transmissions or PARK for automatic transmissions.

WABCO Test Adaptor

Use the WABCO test adaptor to measure the resistance across the harness pins.

⚠ CAUTION

When troubleshooting or testing the system at the main connector, be careful not to damage the electrical sockets.

When a test involves testing the cable harness, use the diagram in Figure 3.10 to identify pin locations on the 35-pin connector.

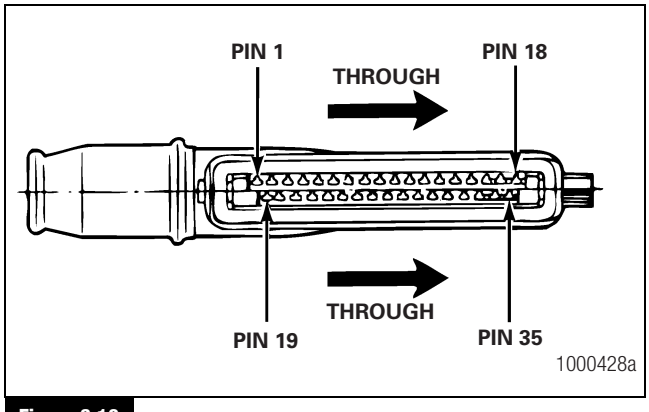


Figure 3.10

Volt-Ohm Meter (VOM)

The receptacles in the test adaptor accept the tips of standard VOM cables. These tips are approximately 0.080-inch diameter (2 mm). Use a good quality digital or analog VOM.

A VOM with automatic polarity sensing is recommended. This eliminates worry over polarity of the meter leads during voltage measurements.

Component Tests

The component tests for tractor, truck, and bus applications are:

- Vehicle voltages
- Sensors
- ABS modulator valves
- ATC valves
- ABS/ATC lamps
- ABS/ATC switches

Testing Procedure

To use the WABCO test adaptor:

⚠ CAUTION

The following tests could damage the measuring instruments or the ABS and/or ATC valves being tested. If you do not know how to use a VOM, do not conduct these tests.

If the VOM is not connected correctly, damage to the meter could result.

Valves should not be left connected to power (pin 9) for more than 10 seconds or the valve may be damaged.

- **Adhere to all safety warnings and cautions in this section when using the test adaptor. Always perform the tests in Table F before attempting the tests in Table G.**

1. Determine the failure code and meaning. Refer to Section 3.
2. Turn the vehicle ignition OFF.
3. Disconnect the 35-pin harness connector from the ECU.
4. Insert the test adaptor into the 35-pin harness connector.
5. Check the following table to determine which adaptor pins to test with the VOM.
6. Set the VOM to the appropriate scale.
7. Take the VOM measurement and write it down.
8. Compare measurements with the desired measurement value listed in Table F.

9. Repair or replace the wiring or component as necessary.
10. Disconnect the test adaptor from the harness and reconnect the harness to the ECU.
11. Verify that the ABS is functional. Road test the vehicle if necessary.

Table F: Test Adaptor Measurement Checks

Test or Measurement	VOM Setting (Test Adaptor Pins)	Other Action	Vehicle Ignition	(Record) Actual Measurement	Desired Measurement	Possible Causes of Malfunction
Voltage to ECU	**Volts DC** +9 & –27		OFF ON		0.0 volts 11.0-15.0 volts	• Constant power to ECU • Blown fuse • Power to ECU interrupted
Valve Relay Voltage	**Volts DC** VR1+1 & –27 VR2+19 & –27		OFF		0.0 volts 0.0 volts	• VR1 or VR2 relay contacts sticking
Warning Light Wiring	**Ohms** 26 & 9		OFF		2-50 ohms (typical)	• Bulb/LED • Wiring to warning light interrupted • ATC/diagnostic light wiring
ATC/Diagnostic Light Wiring	**Ohms** 3 & 9		OFF		2-50 ohms (typical)	• Bulb/LED • Wiring to ATC/ diagnostic light interrupted
Diagnostic Switch Wiring	**Ohms** 14 & 27	Press/toggle diag. switch	OFF		0-2 ohms	• Switch • Wiring to switch is interrupted

Test or Measurement	VOM Setting (Test Adaptor Pins)	Other Action	Vehicle Ignition	(Record) Actual Measurement	Desired Measurement	Possible Causes of Malfunction
Speed Sensor Resistance	**Ohms** LF 15 & 32 RF 17 & 34 LR 18 & 35 RR 16 & 33		OFF		700-3000 ohms	• Broken wire between ECU and sensor • Sensor connector • Defective sensor
Speed Sensor Resistance to Ground	**Ohms** LF 15 & 27 RF 17 & 27 LR 18 & 27 RR 16 & 27		OFF		> 30K ohms	• Shorted sensor wire • Chafed/cut sensor cable • Defective sensor
Speed Sensor Adjustment	**Volts AC** LF 15 & 32 RF 17 & 34 LR 18 & 35 RR 16 & 33	Turn wheel by hand at 30 RPM (2 sec./ rev.)	OFF		> 0.200 VAC	• No reading — Sensor wire broken — Sensor wire shorted • Sensor gap too large • Large variation — Excessive tone ring runout — Tone ring damaged — Excessive wheel bearing end play

Test or Measurement	VOM Setting (Test Adaptor Pins)	Other Action	Vehicle Ignition	(Record) Actual Measurement	Desired Measurement	Possible Causes of Malfunction
ABS Valve Coil Resistance	**Ohms** LF In 23 & 27 Exh 24 & 27 RF In 6 & 27 Exh 7 & 27 LR In 21 & 27 Exh 22 & 27 RR In 4 & 27 Exh 5 & 27		OFF		4-8 ohms 4-8 ohms	• Wiring between ECU and valve interrupted • Ground lead to valve interrupted • Shorted valve coil
ATC Valve Coil Resistance	**Ohms** LR 2 & 27 RR 20 & 27		OFF		8-14 ohms 8-14 ohms	• Wiring between ECU and valve interrupted • Ground lead to valve interrupted • Shorted valve coil

⚠ CAUTION

The word TOUCH means connect the appropriate lead to pin 9 only when you are ready to observe the results.

Conduct the ABS and ATC valve Function Tests only if the measurement checks in Table F yielded inconclusive results. This could occur because of improper plumbing to the ABS or ATC valves or because the wiring to the ABS valves has the inlet and exhaust portions of the solenoid interchanged. In either case, the ECU may not detect the error and it will be necessary to manually activate the valves to confirm correct function.

- **Adhere to the cautions listed for Table F when performing the following tests.**
- **Adhere to all safety warnings and cautions in this section when using the test adaptor.**
- **Always perform the tests in Table F before attempting the tests in Table G.**

Table G: ABS and ATC Valve Function Tests

Test	VOM setting Test Adaptor Pins	Vehicle Ignition	Additional Action	Desired Results	Possible Causes of Malfunction
ABS Valve Function	**10 Amps** LF: Exh (+) to 9	ON	Apply and maintain brake application • TOUCH (–) to 24 ⇒ • Release brake	Left front chamber exhausts continuously	• Wiring to valve is interchanged • Valve plumbing is incorrect • Valve defective
	In (+) to 9		• TOUCH (–) to 23 • Apply brake⇒	No pressure build-up in LF chamber	
	10 Amps RF: Exh (+) to 9	ON	Apply and maintain brake application • TOUCH (–) to 7 ⇒ • Release brake	Right front chamber exhausts continuously	
	In (+) to 9		• TOUCH (–) to 6 • Apply brake ⇒	No pressure build-up in RF chamber	
	10 Amps LR: Exh (+) to 9	ON	Apply and maintain brake application • TOUCH (–) to 22 ⇒ • Release brake	Left rear chamber(s) exahusts continuously	
	In (+) to 9		• TOUCH (–) to 21 • Apply brake ⇒	No pressure build-up in LR chamber(s)	
	10 Amps RR: Exh (+) to 9	ON	Apply and maintain brake application • TOUCH (–) to 5 ⇒ • Release brake	Right rear chamber(s) exhausts continuously	
	In (+) to 9		• TOUCH (–) to 4 • Apply brake ⇒	No pressure build-up in RR chamber(s)	

Test	VOM setting Test Adaptor Pins	Vehicle Ignition	Additional Action	Desired Results	Possible Causes of Malfunction
ATC Valve Function	**10 Amps** LR (+) to 9	ON	• TOUCH (–) to 2 • TOUCH (–) to 20	Pressure build-up in LR chamber(s)	• Plumbing to ATC valve blocked, incorrect • Valve defective
	RR (+) to 9			Pressure build-up in RR chamber(s)	

Final Test for a Tractor Equipped with ABS

NOTE: Turn the blink code switch to the OFF position. Complete the following test.

1. Check that the cab harness is attached to the ECU.
2. Start the engine.
3. Increase vehicle speed. At about four mph (6 km/h), the tractor warning light must go out.

   NOTE:

   - If the tractor warning light continues to stay on, check the blink codes, all components and connections.
   - When failures cannot be repaired, contact your District Service Manager at 800-535-5560 in the U.S. and Canada.

MPSI Pro-Link® 9000

NOTE: Turn the blink code switch to the OFF position. Complete the following test.

Use the Pro-Link® 9000 to:

- Diagnose System Faults on ABS and ABS/ATC systems with C2 and C3 ECUs. The Pro-Link® 9000 may be used in place of blink code diagnostic procedures.
- Perform component measurement and function tests.

NOTE: Pro-Link® screens identify faults as existing or stored. Refer to the definitions in this section.

Component Tests

Components that may be tested with the Pro-Link® 9000 are:

- Vehicle Voltages
- ABS Modulator Valves
- ATC Valves
- ABS/ATC Lamps
- Sensors
- Engine Datalink
- Retarder Relay
- Retarder Datalink
- ABS/ATC Switches

NOTE: Adhere to all safety Warnings and Cautions in this section.

Diagnostic and Testing Procedure

1. Locate the six-pin connector in the vehicle cab. Gather together everything you need during the test as follows.
   - Pro-Link® 9000
   - WABCO test cartridge
   - Six-pin connector

2. Slide the WABCO cartridge into the Pro-Link® keypad until the connection is tight. Figure 3.11.

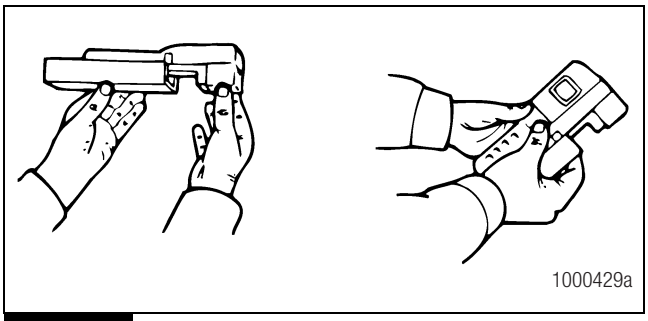


Figure 3.11

3. Chock the wheels, apply the parking brake, and verify that the ignition power is off.

⚠ WARNING

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 result.

4. Connect the Pro-Link® to the six-pin connector on the ECU.
5. Turn the ignition to the ON/RUN position.
6. Check the Pro-Link® screen to verify that it powers up.

   If the Pro-Link® does not power up or if the screen indicates "NO DATA RECEIVED:"

   - Check the connections.
   - Verify that the cartridge is correctly connected to the Pro-Link® keypad.
   - Verify 12 volts DC power and ground at the connector and ABS ECU.
   - Check the fuse panel for a blown fuse.
   - Check for the correct wiring in the diagnostic connector.

7. Refer to the Pro-Link® manual for complete diagnostic and testing instructions.

NOTE: The menu selections for the Pro-Link® are described below. Refer to the Pro-Link® manual for complete testing instructions.

Vehicle Voltages

Monitors the two voltage signals powering the ECU. Figure 3.12.

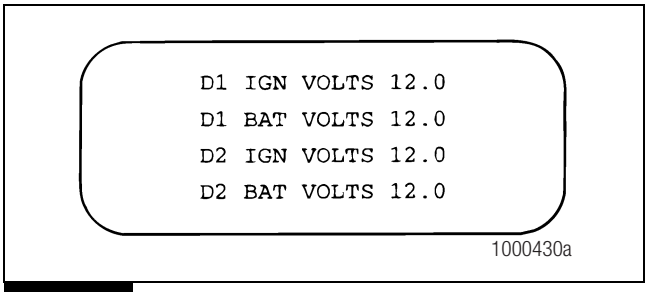


Figure 3.12

ABS Modulator Valves, Two Tests

Choose from four or six valves:

- For 4S/4M or 6S/4M systems choose the following.

  L Front Valve

  L 2nd Axle Valve

  R Front Valve

  R 2nd Axle Valve

- For 6S/6M there are two additional valves.

  R Third Axle Valve

  L Third Axle Valve

- Exercises ABS modulator valves one at a time. Figure 3.13.

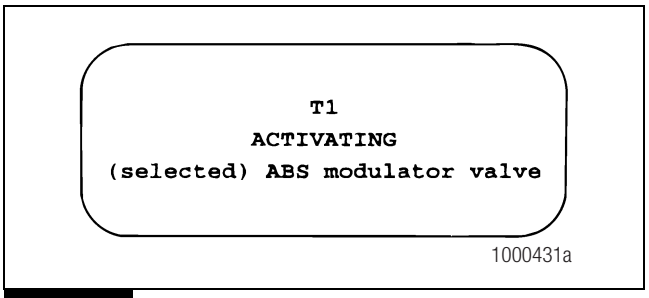


Figure 3.13

With brake applied:

- Selected ABS modulator valve will show decreased air chamber pressure. Figure 3.14.
- Test has four cycles, each with three decreases of pressure.
- Cycles are separated by a pause.

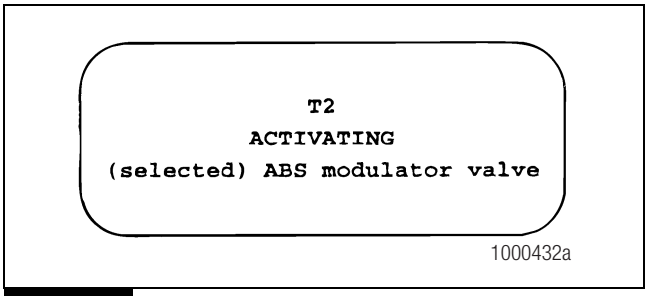


Figure 3.14

- Selected ABS modulator valve is cycled 15 times.
- A faint clicking of the internal solenoid is heard 15 times during this test.
- No change in air chamber pressure should occur.

ATC Valves

- Exercises the left and right rear ATC valves, one at a time. Figure 3.15.
- Valve is cycled 15 times for a period of six seconds.

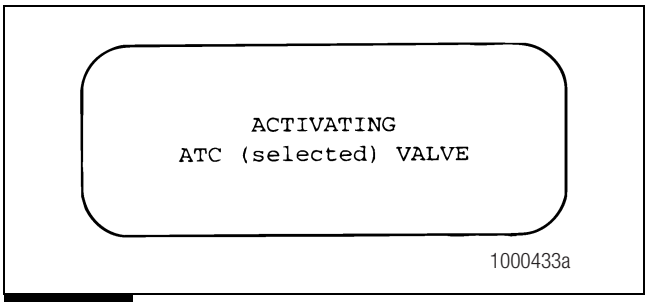


Figure 3.15

ABS/ATC Lamps

Monitors the ABS and ATC indicator lamps on the instrument panel. Figure 3.16.

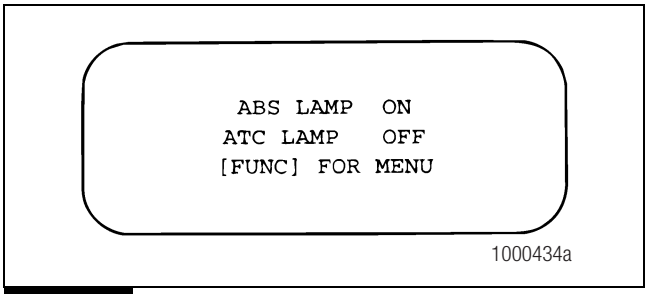


Figure 3.16

Sensors

During wheel rotation:

- Monitors the inputs to the ECU from the wheel sensors, one at a time. Figure 3.17.

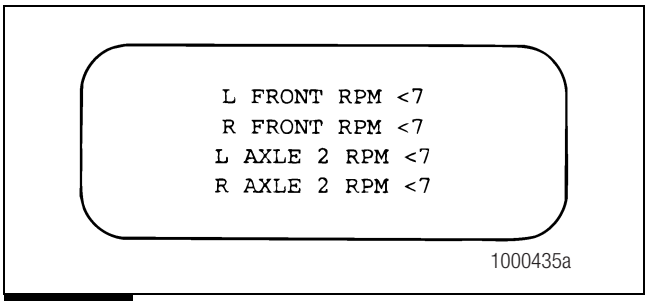


Figure 3.17

Engine Datalink, ATC Vehicles Only

Reduces engine torque to verify proper wiring. Figure 3.18.

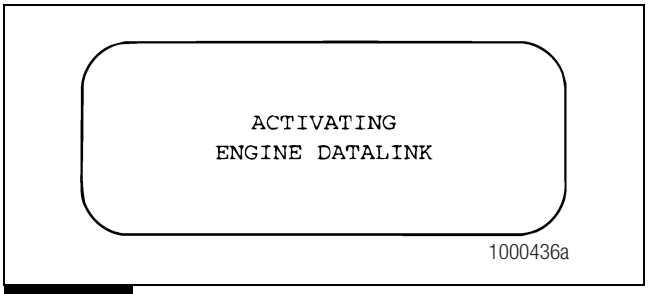


Figure 3.18

Retarder Relay

- Verifies the relay is functioning correctly. A click should be heard. Figure 3.19.
- Checks wiring connections.

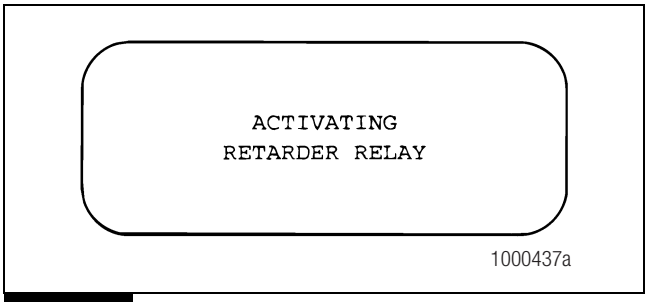


Figure 3.19

Retarder Datalink

Checks wiring connections. Figure 3.20.

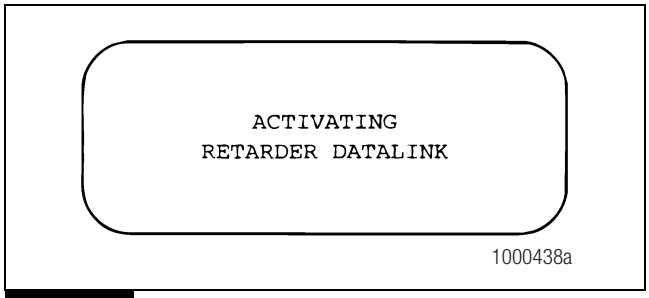


Figure 3.20

ABS/ATC Switches

Checks status of ABS and ATC/Deep Snow-Mud switches on the instrument panel. Figure 3.21.

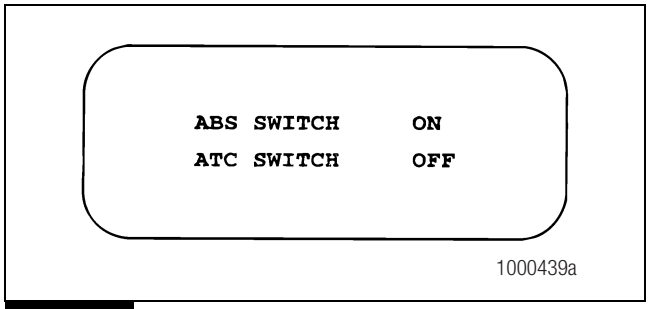


Figure 3.21

Testing Components

If the blink codes or MPSI Pro-Link® indicate a problem with an ABS or ABS/ATC component, always check the wiring or connections before replacing the component. In your preliminary check look for the following.

- Loose connections
- Corrosion
- Breakage

Refer to the WABCO Test Adaptor information in this section. The adaptor makes checking resistance across the harness pins easier.

⚠ CAUTION

When troubleshooting and testing the ABS system at the main ECU connector, be careful not to damage the electrical sockets on the ECU connector.

Ignition Voltage

Voltage must be between 11 and 15 v. Measure voltage between pin 9 and pin 27 on cab mount systems and between 10 and 12 on the 19-pin connector on frame-mounted ECUs with the ignition on.

Sensor Resistance

The sensor circuit resistance must be 700-3000 ohms. Resistance can be measured at the sensor connector when it is removed from the ECU, or right at the sensor when the extension cable is removed.

Sensor Adjustment

NOTE: On the steering axle the sensor is accessible on the in-board side of the steering knuckle.

On the drive axle the wheel and drum assembly must be pulled to gain access to the sensor.

Gently push the sensor in toward the tooth wheel until it contacts the tooth wheel.

ABS Valve

- The resistance across each valve solenoid coil terminal and the ground on the ABS valve connector must be 4 to 8 ohms. Figure 3.22.

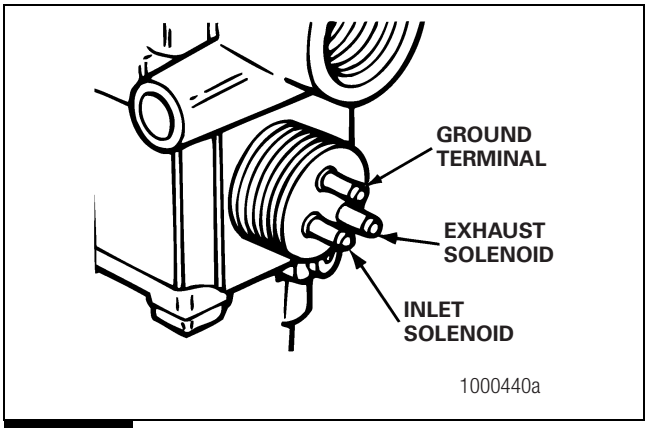


Figure 3.22

- When the resistance is greater than 8 ohms, clean the electrical contacts in the solenoid.
- Check the resistance again.
- To check the cable and the ABS valve as one unit, measure across the pins on the ECU connector of the cab harness. Reference the diagram of the system you are testing for pin numbers in Section 5.

ATC Valve

The resistance across the two electrical terminals on the ATC valve must be 8 to 14 ohms. Figure 3.23.

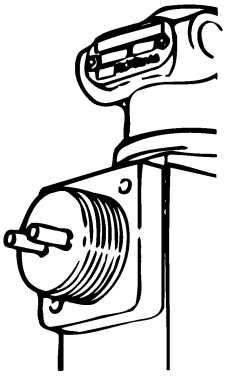


Figure 3.23

- If the resistance is greater than 14 ohms, clean the electrical contacts on the solenoid.
- Check the resistance again.
- To check the cable and ATC valve as one unit, measure the resistance across the pins.
  - — Use the connector at the connection point of the ECU for frame mounts
  - — Use the WABCO test adaptor for cab mounts
- Reference the diagram of the system you are testing for pin numbers in Section 5.

Dynamometer Testing Vehicles with ATC

⚠ WARNING

Failure to disable the ATC before dynamometer testing could result in serious personal injury and damage to the vehicle.

Vehicles with the ATC option must have the ABS system power disabled to test the vehicle on a dynamometer. The method requires removing the ABS circuit breaker/fuse or removing the ECU main connector. Disconnect connector or breaker with ignition in the OFF position.

Tire Size Range

⚠ CAUTION

For proper ABS/ATC operation with the standard Electronic Control Unit (ECU), front and rear tire sizes must be within ± 5% of each other. When this tire size range is exceeded without electronically modifying the ECU, the system performance can be affected and the warning lamp can illuminate. Call WABCO North America Customer Care at 855-228-3203 when you plan a tire size difference greater than 5%.

Calculate tire size with the following equation:

% Difference = (RPM Steer ÷ RPM Drive –1) x 100

RPM = tire revolutions per mile

Hazard Alert Messages

Read and observe all Warning 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.

⚠ CAUTION

Use the following procedures to avoid damage to the electrical system and ABS/ATC components.

When welding on an ABS- or ABS/ATC-equipped vehicle is necessary, disconnect power and ground leads from the ECU.

Component Replacement

Sensors

⚠ WARNING

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 result.

Wheel Speed Sensor Removal — Front Axle

Use the following procedure to remove the sensor from the front axle.

1. Park the vehicle on a level surface. Block the wheels to prevent the vehicle from moving. Apply the parking brake.
2. Raise the front tires off the ground. Place safety stands under the axle.
3. Remove the sensor from the steering knuckle. Use a twisting motion if necessary. Figure 4.1.

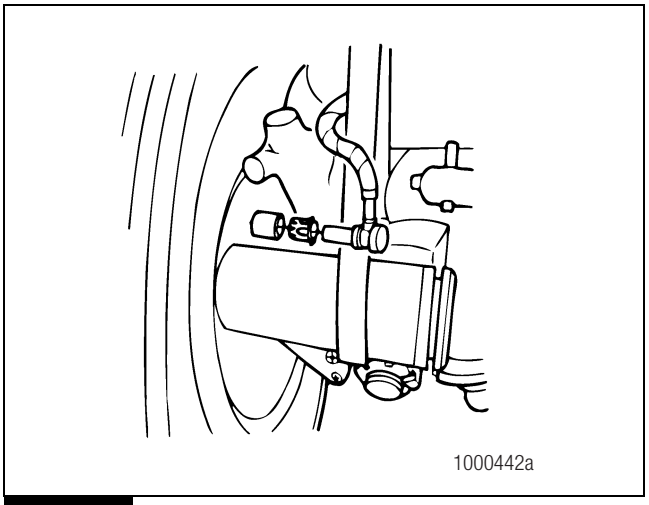


Figure 4.1

4. Disconnect the fasteners that hold the sensor cable to other components.
5. Disconnect the sensor cable from the chassis harness.

Refer to Section 3for additional sensor information.

Wheel Speed Sensor Installation — Front Axle

Use the following procedure to replace the sensor in the front axle.

1. Connect the sensor cable to the chassis harness.
2. Install the fasteners used to hold the sensor cable in place.
3. Apply a mineral oil-based lubricant that contains molydisulfide to the sensor spring clip and to the body of the sensor. The lubricant should have excellent anti-corrosion and adhesion characteristics, and be capable of continuous function in a temperature range of –40° to 300°F (–40° to 150°C).
4. Install the sensor spring clip. Verify that the flange stops are on the inboard side of the vehicle.
5. Push the sensor spring clip into the bushing in the steering knuckle until the clip stops.
6. Push the sensor completely into the sensor spring clip until it contacts the tooth wheel.
7. Remove the blocks and safety stands.

Wheel Speed Sensor Removal — Rear Axle

Use the following to remove the sensor from the rear axle.

1. Park the vehicle on a level surface. Block the wheels to prevent the vehicle from moving. Apply the parking brake.

2. Raise the rear tire off the ground. Place safety stands under the axle.
3. Release the parking brake and back off the slack adjuster to release the brake shoes.
4. Remove the wheel and tire assembly from the axle.
5. Remove the brake drum.
6. Remove the sensor from the mounting block in the axle housing. Use a twisting motion if necessary. Do not pull on the cable.
7. Remove the sensor spring clip from the mounting block.
8. Disconnect the fasteners that hold the sensor cable and the hose clamp to other components.
9. Disconnect the sensor cable from the chassis harness.

Wheel Speed Sensor Installation — Rear Axle

1. Apply a mineral oil-based lubricant that contains molydisulfide to the sensor spring clip and to the body of the sensor. The lubricant should have excellent anti-corrosion and adhesion characteristics, and be capable of continuous function in a temperature range of –40° to 300°F (–40° to 150°C).
2. Install the sensor spring clip. Verify that the flange stops are on the inboard side of the vehicle.
3. Push the sensor spring clip into the mounting block until it stops.
4. Push the sensor completely into the sensor spring clip until it contacts the tooth wheel. Figure 4.2.

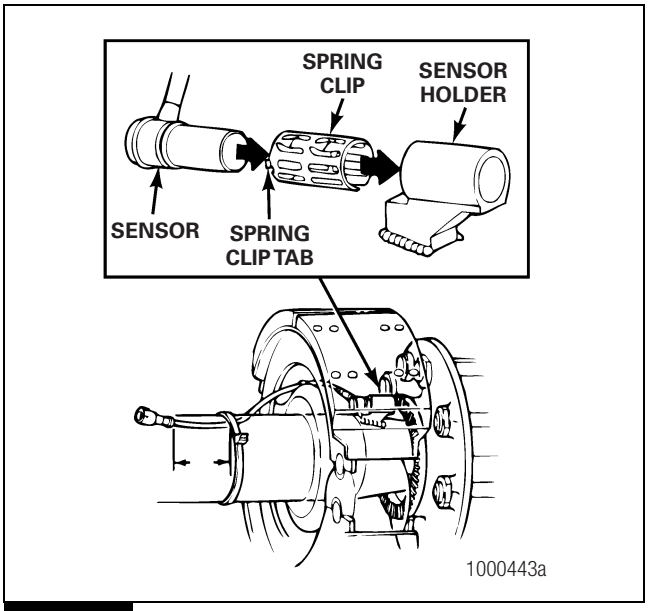


Figure 4.2

5. Insert the sensor cable through the hole in the spider and axle housing flange. Route the cable to the frame rail. Ensure that cables are routed in a way that will prevent pinching or chafing and will allow sufficient movement for suspension travel.
6. Connect the sensor cable to the chassis harness.
7. Install the fasteners that hold the sensor cable in place.
8. Install the brake drum on the wheel hub.
9. Complete the installation per the vehicle manufacturer's manual.

Valves

⚠ WARNING

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 result.

ABS Modulator Valve Removal

1. Park the vehicle on a level surface. Turn the ignition switch to the OFF position and apply the parking brake.
2. Block the wheels to prevent the vehicle from moving.
3. If necessary, raise the vehicle off the ground and place safety stands under the axle.

4. Disconnect the wiring connector from the ABS valve.
5. Disconnect the air lines from port 1, air supply, and port 2, air discharge, of the ABS valve. Figure 4.3.

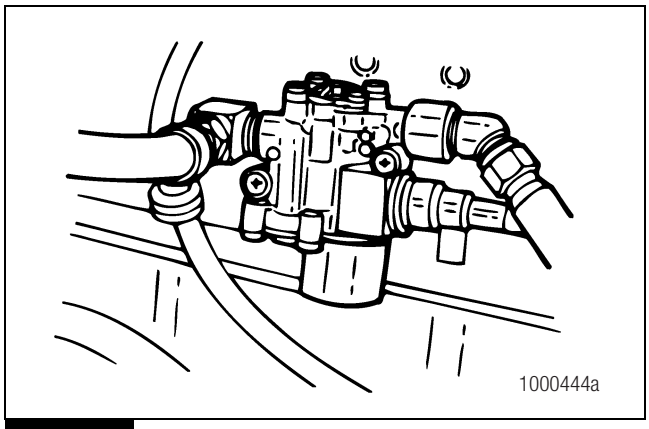


Figure 4.3

6. Remove the two mounting capscrews and nuts.
7. Remove the ABS valve.

ABS Modulator Valve Installation

⚠ CAUTION

Moisture can affect the performance of all ABS/ATC systems, as well as the standard braking system. Moisture in air lines can cause air lines to freeze in cold weather.

NOTE: Use thread sealant correctly to avoid air line leaks in pneumatic connections. Follow the supplier recommendations.

1. Install the ABS valve with two mounting capscrews and nuts. Tighten the capscrews per the manufacturer's recommendation.
2. Connect the line to the brake chambers to port 2 of the ABS valve. Connect the air supply line to port 1 of the ABS valve.
3. Connect the wiring connector to the ABS valve.
4. Remove the blocks and stands.

ATC Valve Removal

1. Park the vehicle on a level surface. Turn the ignition switch to the OFF position and apply the parking brake.
2. Block the wheels to prevent the vehicle from moving.
3. If necessary, raise the vehicle off the ground and place safety stands under the axle.
4. Disconnect the wiring from the ATC valve.
5. To relieve line pressure, bleed the air from the appropriate supply tank.
6. Disconnect the air lines from port 1, air supply, and port 2, air discharge, of the ATC valve.
7. Remove the two mounting capscrews and nuts.
8. Remove the ATC valve.

ATC Valve Installation

NOTE: Use thread sealant correctly to avoid air line leaks in pneumatic connections. Follow the supplier recommendations.

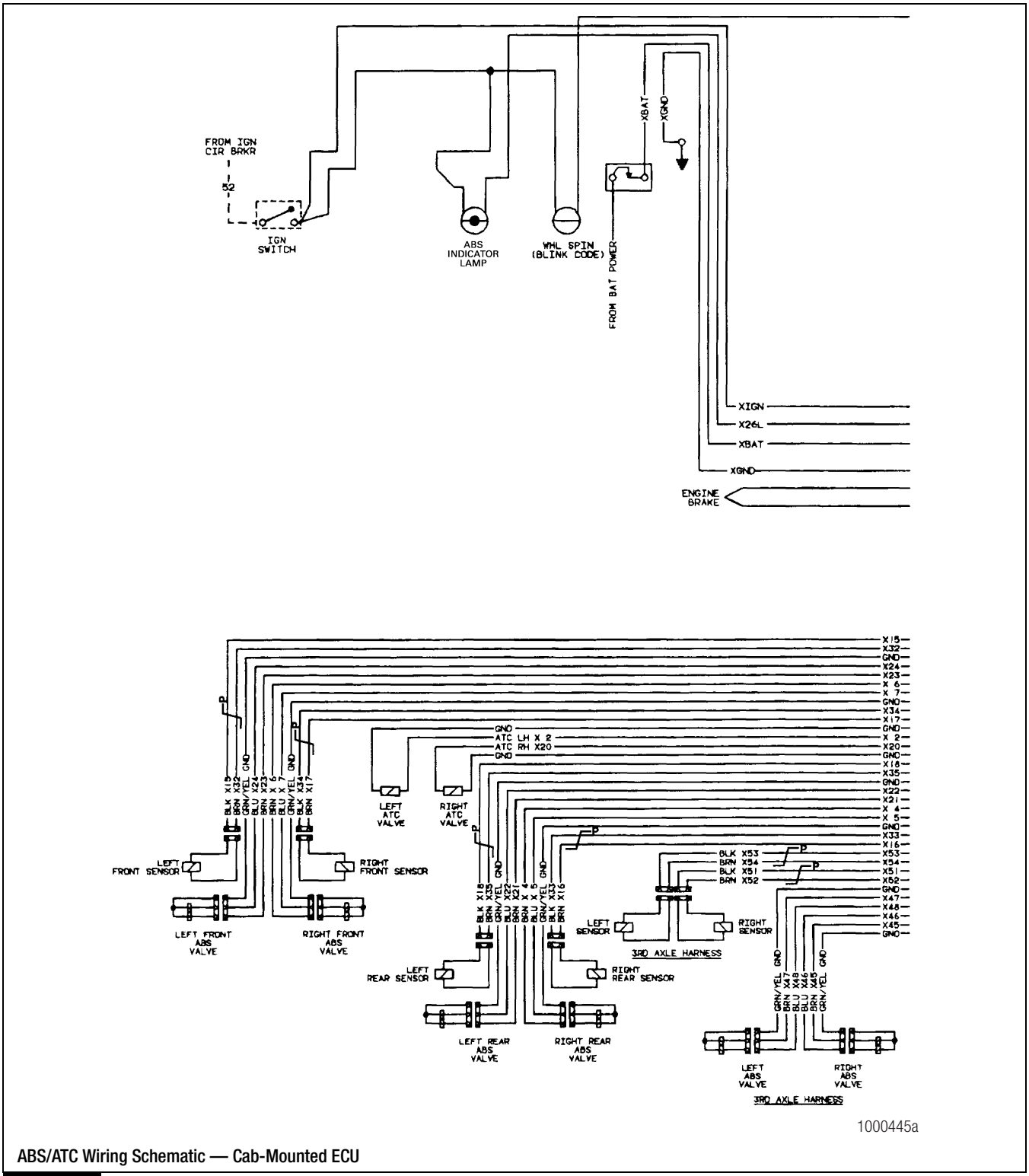
1. Install the ATC valve with two mounting capscrews and nuts. Tighten the capscrews per the manufacturer's recommendation.
2. Connect the line from the double check valve to port 2 of the ATC valve. Connect the air supply line to port 1 of the ATC valve.
3. Connect the harness connector to the ATC valve.
4. Remove the blocks and stands.

ABS Valve Package

If you are servicing a vehicle with an ABS Valve Package, you will need TP-95144, Servicing the ABS Valve Package. Contact WABCO North America Customer Care at 855-228-3203 for this literature.

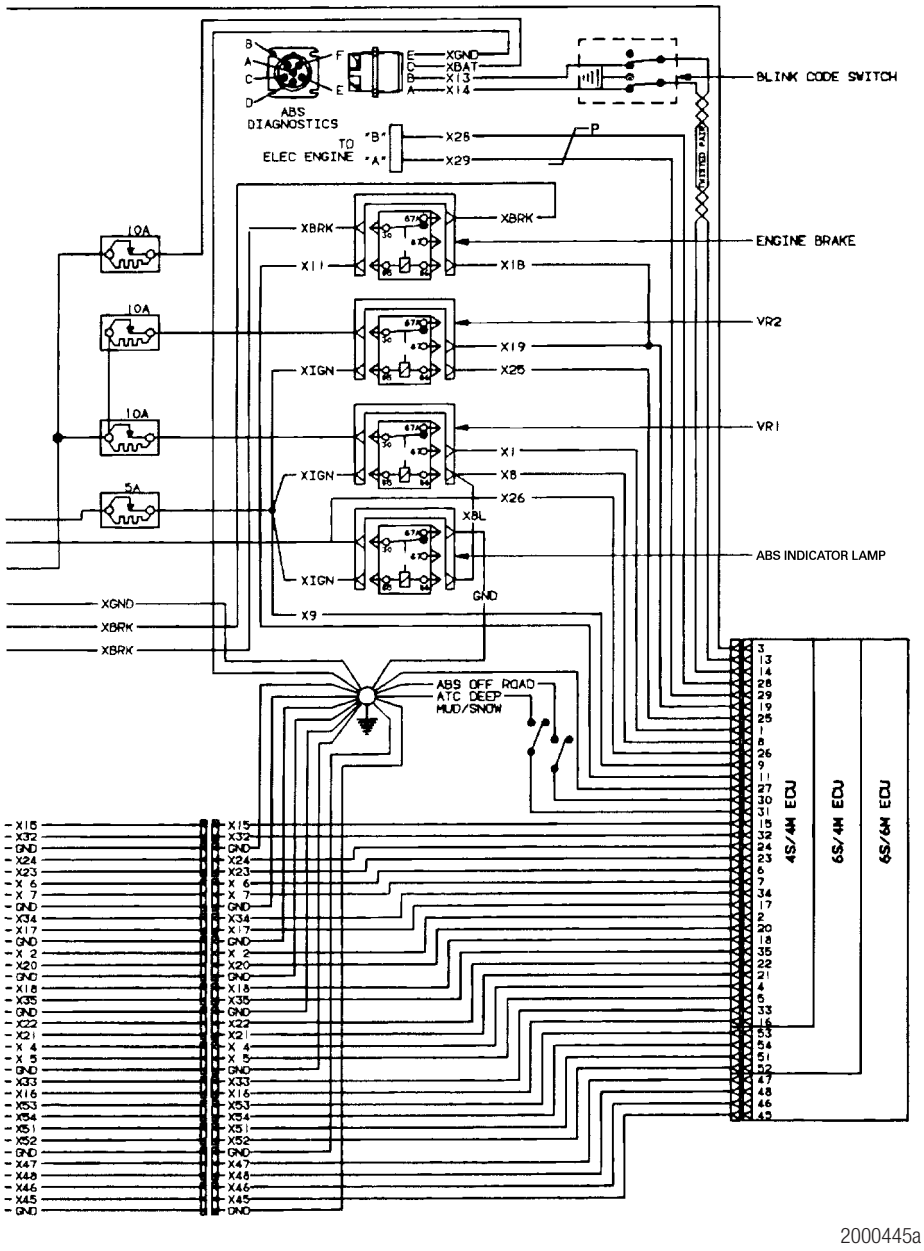
Wiring Diagrams

This section contains ABS wiring diagrams and connector pin callouts. If you have any questions, please contact WABCO North America Customer Care at 855-228-3203.



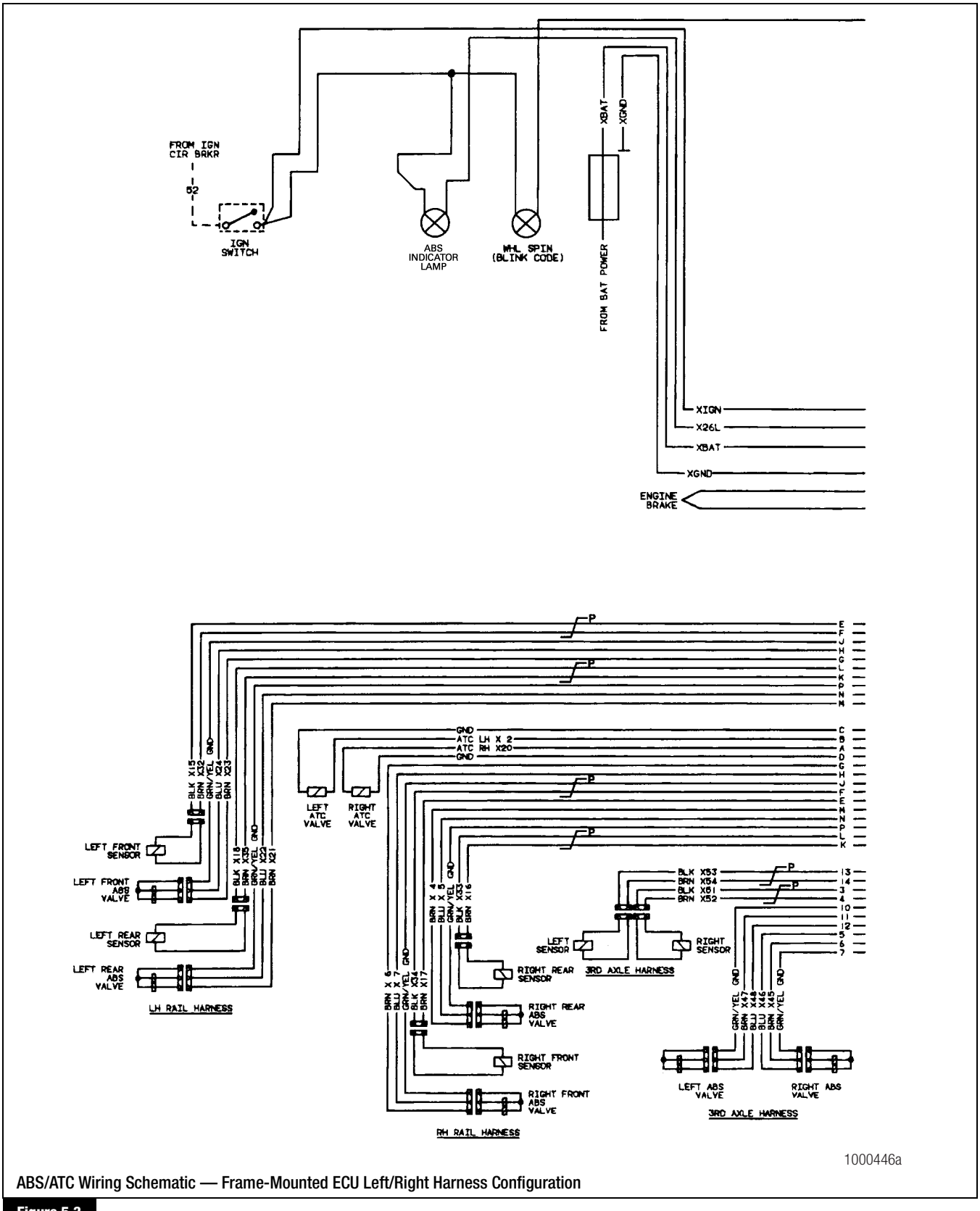
ABS/ATC Wiring Schematic — Cab-Mounted ECU

Figure 5.1



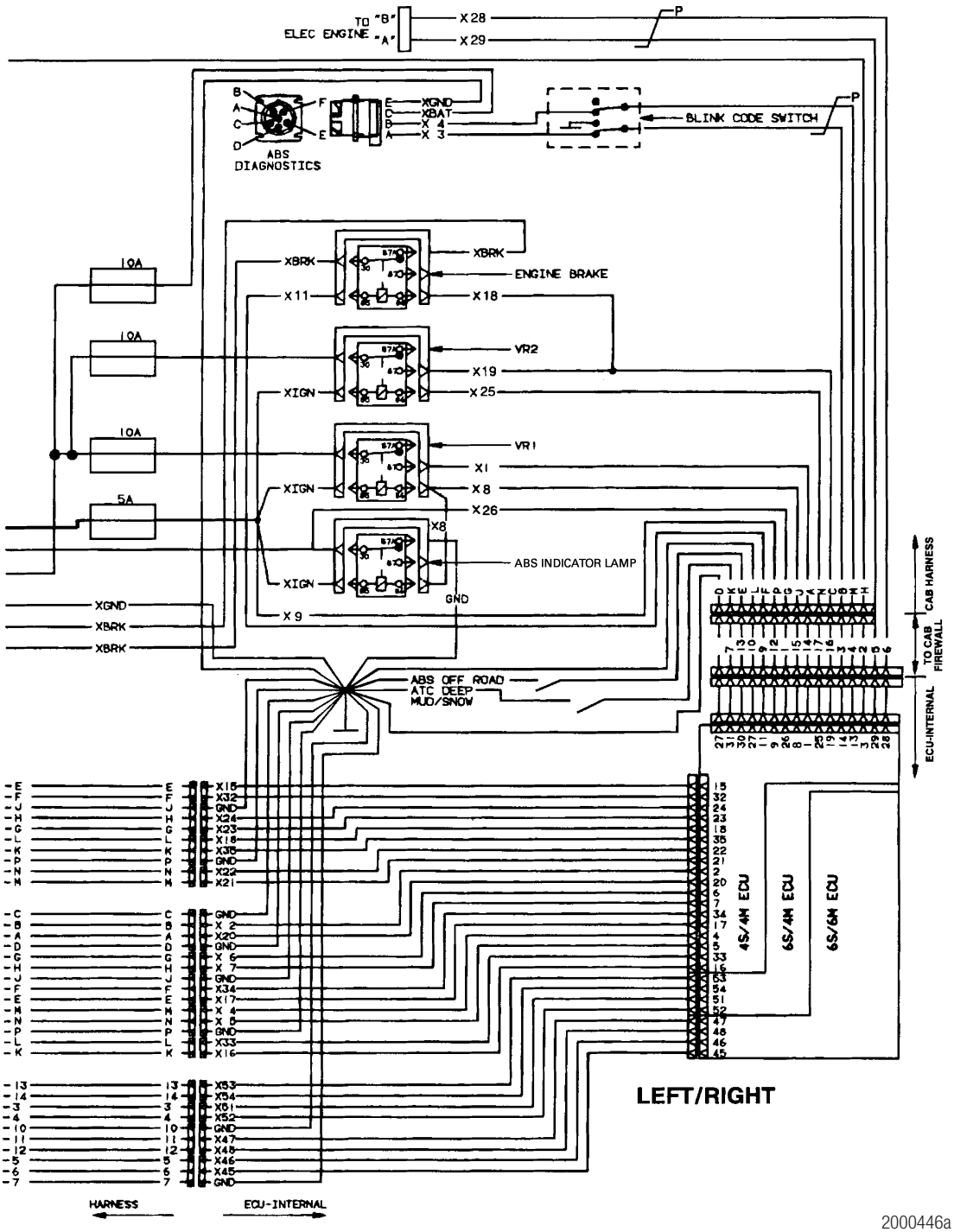
ABS/ATC Wiring Schematic — Cab-Mounted ECU

Figure 5.2



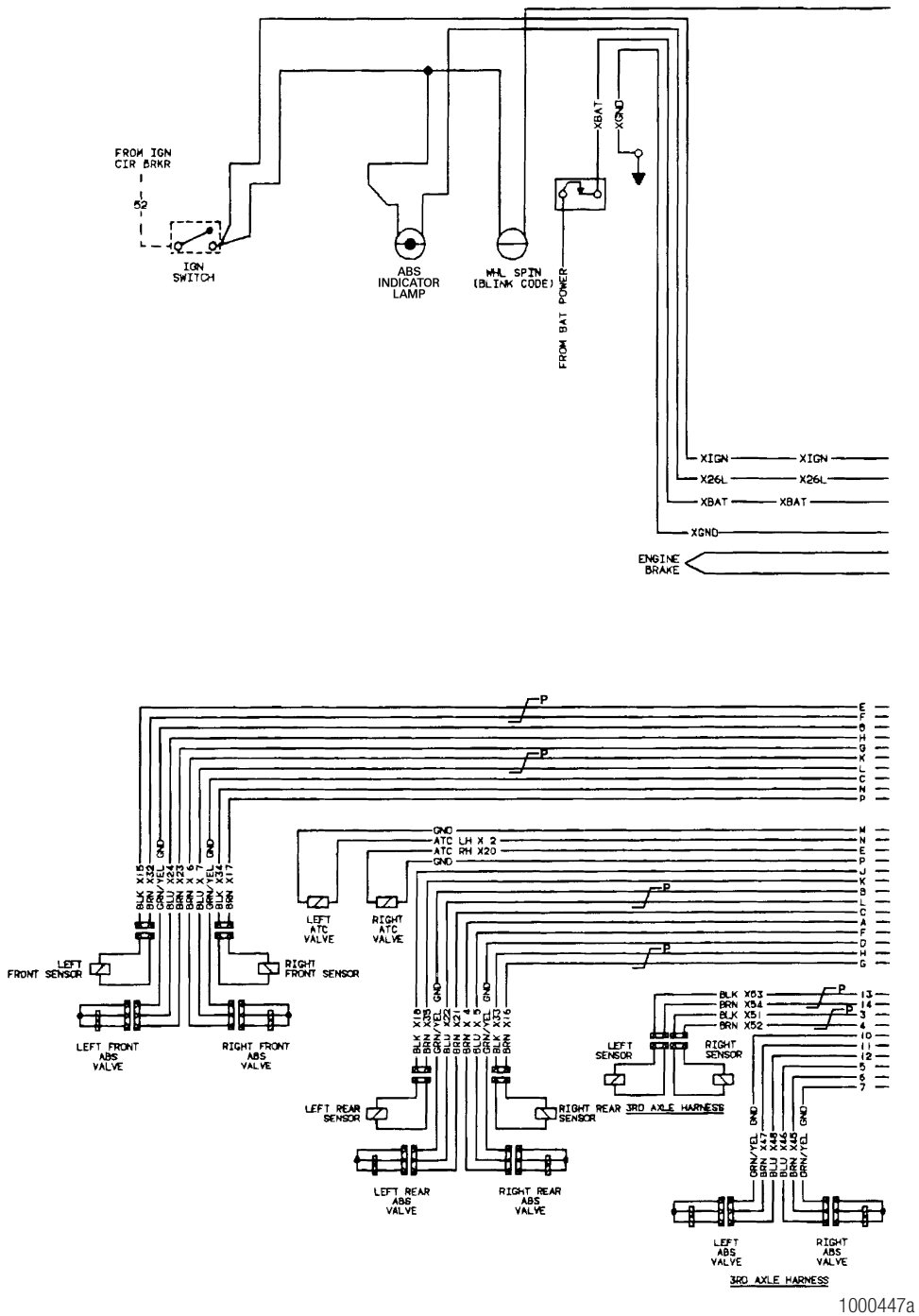
ABS/ATC Wiring Schematic — Frame-Mounted ECU Left/Right Harness Configuration

Figure 5.3



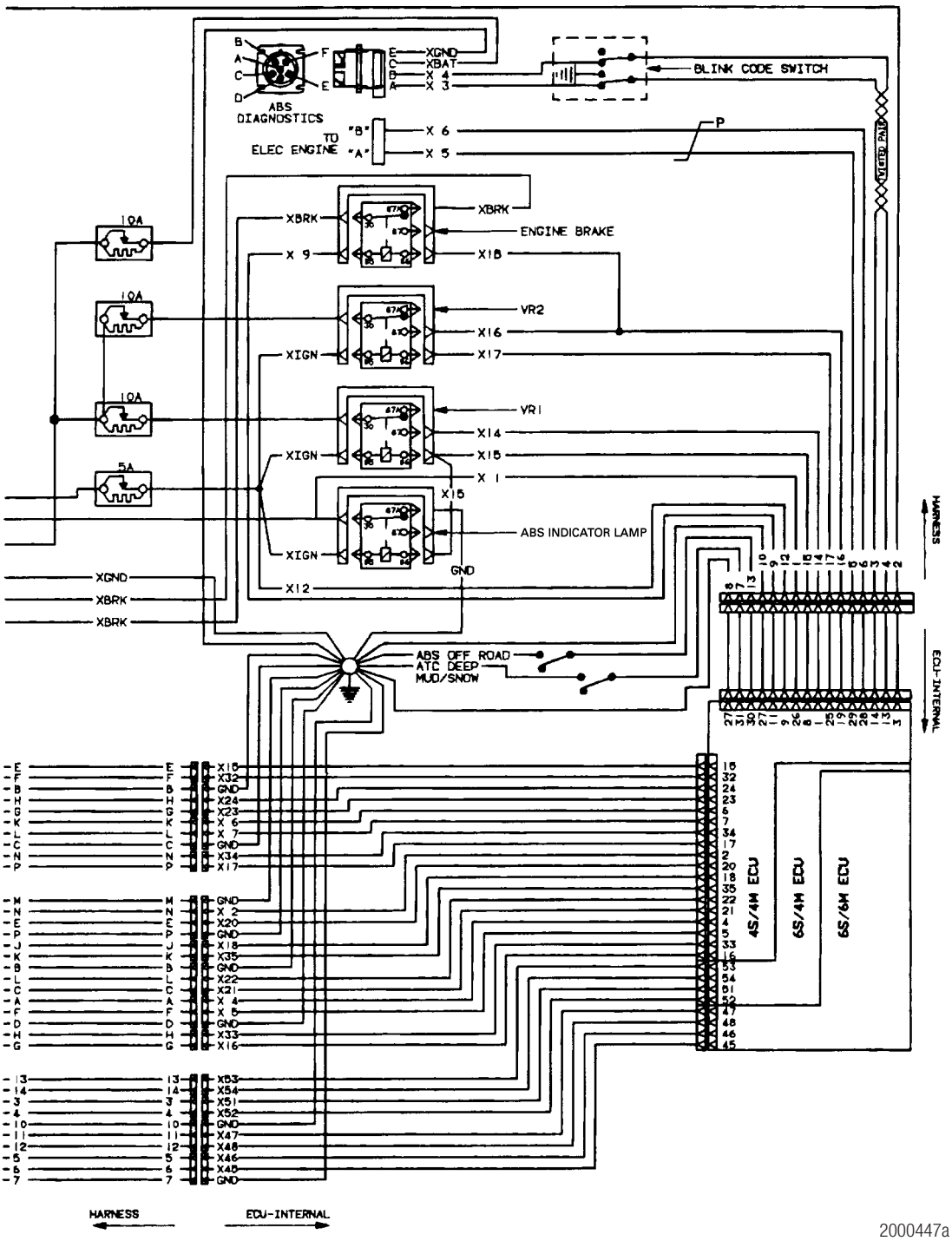
ABS/ATC Wiring Schematic — Frame-Mounted ECU Left/Right Harness Configuration

Figure 5.4



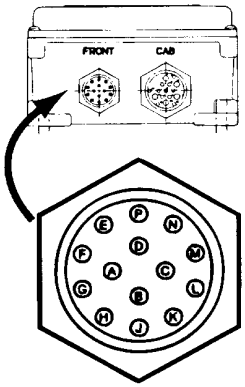
ABS/ATC Wiring Schematic — Frame-Mounted ECU Front/Rear Harness Configuration

Figure 5.5

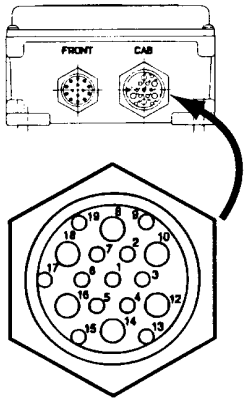


ABS/ATC Wiring Schematic — Frame-Mounted ECU Front/Rear Harness Configuration

Figure 5.6

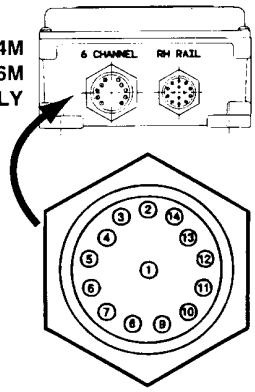


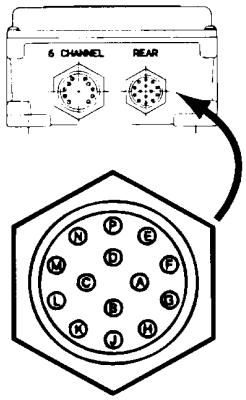
FRONT RAIL HARNESS	
PIN #	**DESCRIPTION**
A	NOT USED
B	LEFT FRONT ABS VALVE COMMON
C	RIGHT FRONT ABS VALVE COMMON
D	NOT USED
E	LEFT FRONT SENSOR
F	LEFT FRONT SENSOR
G	LEFT FRONT ABS VALVE INLET
H	LEFT FRONT ABS VALVE EXHAUST
J	NOT USED
K	RIGHT FRONT ABS VALVE INLET
L	RIGHT FRONT ABS VALVE EXHAUST
M	NOT USED
N	RIGHT FRONT SENSOR
P	RIGHT FRONT SENSOR



CAB HARNESS	
PIN #	**DESCRIPTION**
1	ABS INDICATOR LAMP
2	ATC/BLINK CODE LAMP
3	J1587 A (+)
4	J1587 B (–)
5	J1922 A (+)
6	J1922 B (–)
7	ATC DEEP SNOW/MUD SWITCH
8	GROUND
9	RETARDER
10	GROUND
11	NOT USED
12	+12V IGNITION
13	ABS OFF ROAD SWITCH
14	DIAGONAL 1 VALVE POWER SUPPLY
15	DIAGONAL 1 VALVE RELAY
16	DIAGONAL 2 VALVE POWER SUPPLY
17	DIAGONAL 2 VALVE RELAY
18	NOT USED
19	NOT USED

6S/4M
6S/6M
ONLY





6-CHANNEL HARNESS			
PIN #	**DESCRIPTION**	**6S/4M**	**6S/6M**
1	NOT USED		
2	NOT USED		
3	THIRD AXLE RIGHT SENSOR	✓	✓
4	THIRD AXLE RIGHT SENSOR	✓	✓
5	THIRD AXLE RIGHT ABS VALVE EXHAUST		✓
6	THIRD AXLE RIGHT ABS VALVE INLET		✓
7	THIRD AXLE RIGHT ABS VALVE COMMON		✓
8	NOT USED		
9	NOT USED		
10	THIRD AXLE LEFT ABS VALVE COMMON		✓
11	THIRD AXLE LEFT ABS VALVE INLET		✓
12	THIRD AXLE LEFT ABS VALVE EXHAUST		✓
13	THIRD AXLE LEFT SENSOR	✓	✓
14	THIRD AXLE LEFT SENSOR	✓	✓

REAR RAIL HARNESS	
PIN #	**DESCRIPTION**
A	RIGHT REAR ABS VALVE INLET
B	LEFT REAR ABS VALVE COMMON
C	LEFT REAR ABS VALVE INLET
D	RIGHT REAR ABS VALVE COMMON
E	RIGHT ATC VALVE APPLY
F	RIGHT REAR ABS VALVE EXHAUST
G	RIGHT REAR SENSOR
H	RIGHT REAR SENSOR
J	LEFT REAR SENSOR
K	LEFT REAR SENSOR
L	LEFT REAR ABS VALVE EXHAUST
M	LEFT ATC VALVE COMMON
N	LEFT ATC VALVE APPLY
P	RIGHT ATC VALVE COMMON

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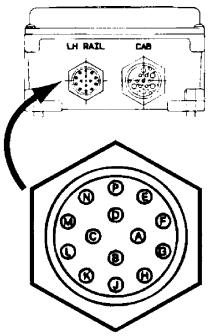
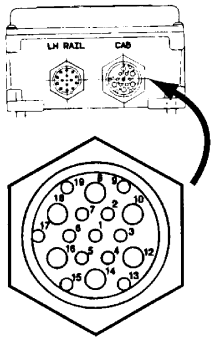
Front/Rear Configurations

Figure 5.7

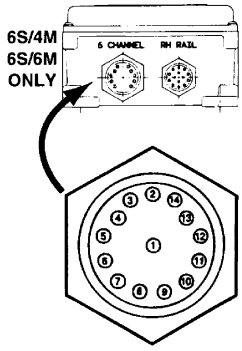


LEFT RAIL HARNESS	
PIN #	**DESCRIPTION**
A	NOT USED
B	NOT USED
C	NOT USED
D	NOT USED
E	LEFT FRONT SENSOR
F	LEFT FRONT SENSOR
G	LEFT FRONT ABS VALVE INLET
H	LEFT FRONT ABS VALVE EXHAUST
J	LEFT FRONT ABS VALVE COMMON
K	LEFT REAR SENSOR
L	LEFT REAR SENSOR
M	LEFT REAR ABS VALVE INLET
N	LEFT REAR ABS VALVE EXHAUST
P	LEFT REAR ABS VALVE COMMON

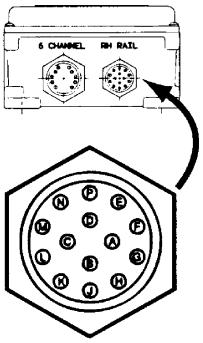


CAB HARNESS	
PIN #	**DESCRIPTION**
1	ABS INDICATOR LAMP
2	ATC/BLINK CODE LAMP
3	J1587 A (+)
4	J1587 B (–)
5	J1922 A (+)
6	J1922 B (–)
7	ATC DEEP SNOW/MUD SWITCH
8	GROUND
9	RETARDER
10	GROUND
11	NOT USED
12	+12V IGNITION
13	ABS OFF ROAD SWITCH
14	DIAGONAL 1 VALVE POWER SUPPLY
15	DIAGONAL 1 VALVE RELAY
16	DIAGONAL 2 VALVE POWER SUPPLY
17	DIAGONAL 2 VALVE RELAY
18	NOT USED
19	NOT USED

6S/4M
6S/6M
ONLY



6-CHANNEL HARNESS			
PIN #	**DESCRIPTION**	**6S/4M**	**6S/6M**
1	NOT USED		
2	NOT USED		
3	THIRD AXLE RIGHT SENSOR	✓	✓
4	THIRD AXLE RIGHT SENSOR	✓	✓
5	THIRD AXLE RIGHT ABS VALVE EXHAUST		✓
6	THIRD AXLE RIGHT ABS VALVE INLET		✓
7	THIRD AXLE RIGHT ABS VALVE COMMON		✓
8	NOT USED		
9	NOT USED		
10	THIRD AXLE LEFT ABS VALVE COMMON		✓
11	THIRD AXLE LEFT ABS VALVE INLET		✓
12	THIRD AXLE LEFT ABS VALVE EXHAUST		✓
13	THIRD AXLE LEFT SENSOR	✓	✓
14	THIRD AXLE LEFT SENSOR	✓	✓



RIGHT RAIL HARNESS	
PIN #	**DESCRIPTION**
A	RIGHT REAR ATC VALVE APPLY
B	LEFT REAR ATC VALVE APPLY
C	LEFT REAR ATC VALVE COMMON
D	RIGHT REAR ATC VALVE COMMON
E	RIGHT FRONT SENSOR
F	RIGHT FRONT SENSOR
G	RIGHT FRONT ABS VALVE INLET
H	RIGHT FRONT ABS VALVE EXHAUST
J	RIGHT FRONT ABS VALVE COMMON
K	RIGHT REAR SENSOR
L	RIGHT REAR SENSOR
M	RIGHT REAR ABS VALVE INLET
N	RIGHT REAR ABS VALVE EXHAUST
P	RIGHT REAR ABS VALVE COMMON

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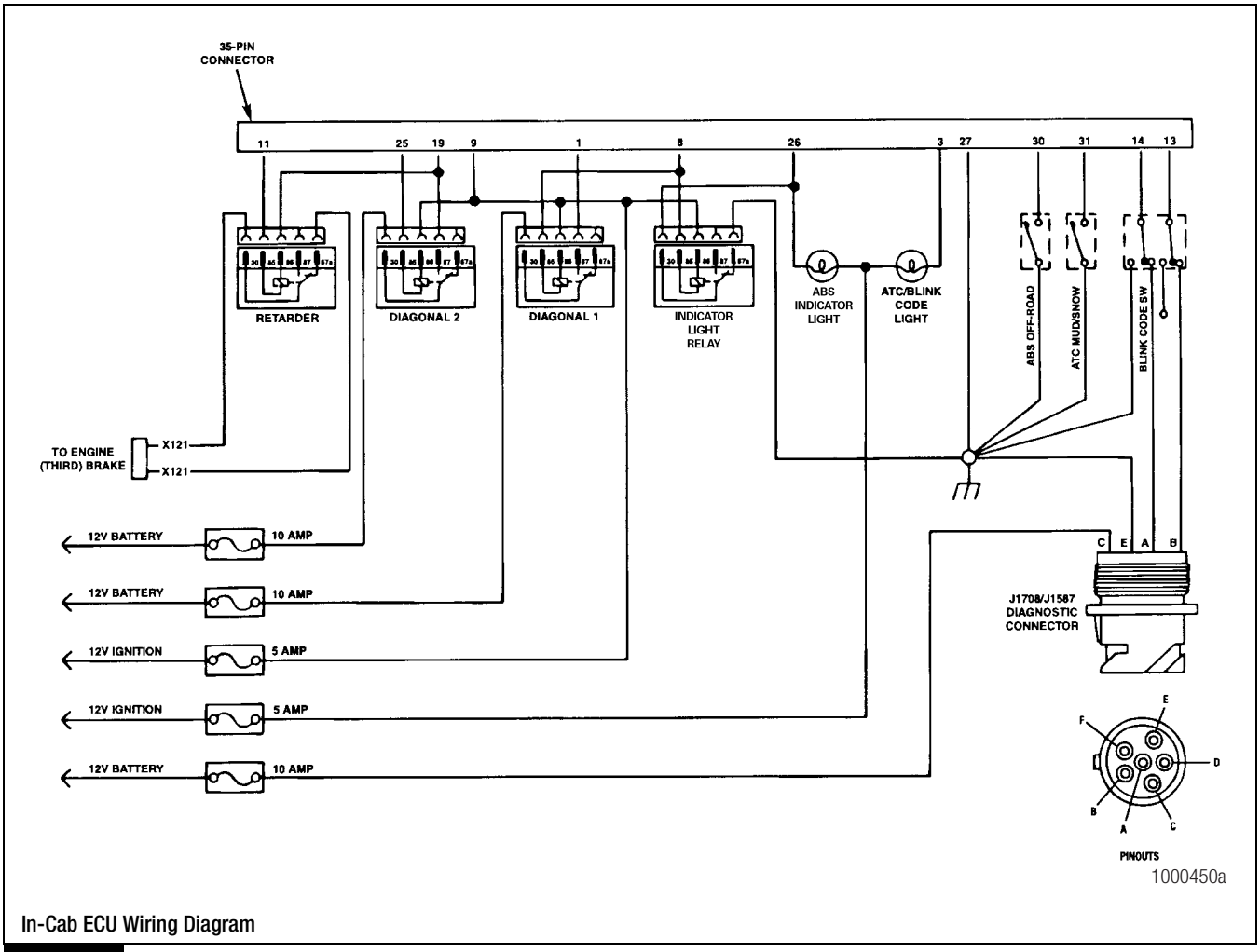
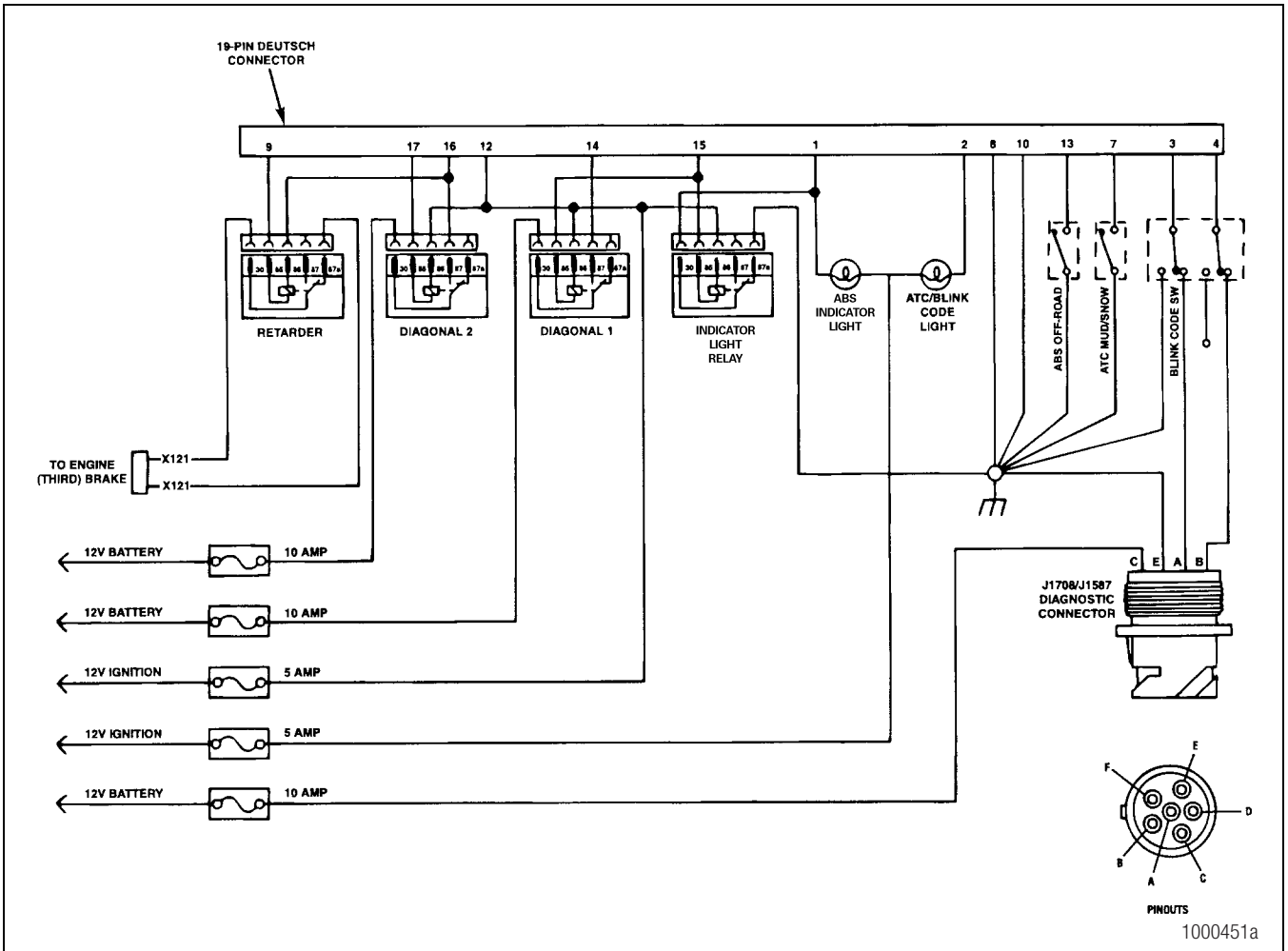
Left/Right Configurations

Figure 5.8



In-Cab ECU Wiring Diagram

Figure 5.9



In-Cab ECU Wiring Diagram

Figure 5.10

About WABCO

WABCO (NYSE: WBC) is the leading global supplier of braking control systems and other advanced technologies that improve the safety, efficiency and connectivity of commercial vehicles. Originating from the Westinghouse Air Brake Company founded nearly 150 years ago, WABCO is powerfully "Mobilizing Vehicle Intelligence" to support the increasingly autonomous, connected and electric future of the commercial vehicle industry. WABCO continues to pioneer innovations to address key technology milestones in autonomous mobility and apply its extensive expertise to integrate the complex control and fail-safe systems required to efficiently and safely govern vehicle dynamics at every stage of a vehicle's journey – on the highway, in the city and at the depot. Today, leading truck, bus and trailer brands worldwide rely on WABCO's differentiating technologies. Powered by its vision for accident-free driving and greener transportation solutions, WABCO is also at the forefront of advanced fleet management systems and digital services that contribute to commercial fleet efficiency. In 2019, WABCO reported sales of over $3.4 billion and has almost 14,000 employees in 40 countries. For more information, visit www.wabco-na.com.

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