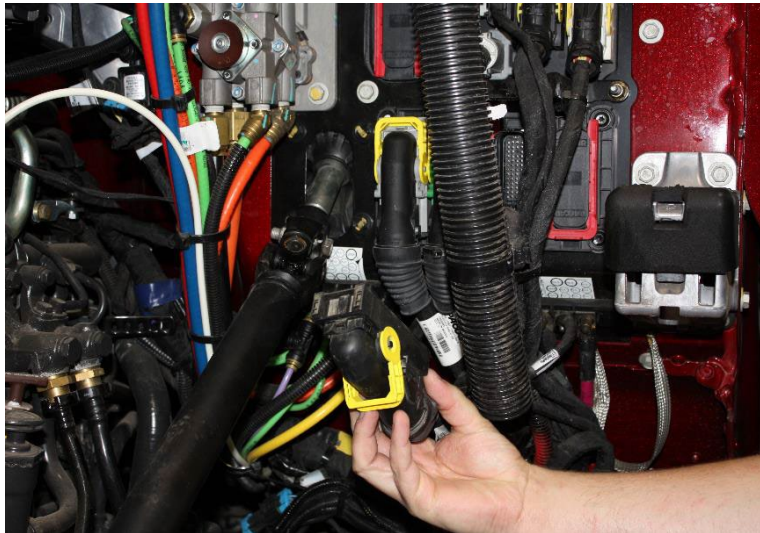


ABS Harness R&R Procedure

1. Disconnect the ABS Harness connector from the firewall (Figure 1). Cut all cable ties that secure the harness under the cab until it splits between the front and rear sections of the harness. This location is usually under the cab, just rearward of where the harness crosses over the frame rail.

Figure 1



2. Find the harness at the furthest point from the cab and begin removing it. The furthest point is usually the rear wheel speed sensor on the RH side forward drive axle.
3. Carefully unplug all connectors on the ABS harness and cut all cable ties securing the ABS harness from the RH side forward drive axle toward the rear of the truck. Continue around the back of the truck and up the LH frame rail to the cab.
4. When the harness is removed past the back of cab crossmember, move to the front half of the harness. Start at the right front wheel and continue rearward to the back of cab crossmember. Completely remove the harness from the chassis.
5. Reinstallation in reverse order of removal. The new harness can be secured to the bottom of the harness bundle and can be routed under crossmembers instead of through the gussets. Add protective nylon wrap where the harness comes into contact with the bottom of the crossmember.
6. Route the harness to avoid sharp edges and moving parts. Any portions of the harness that were covered with protective wrap need to be re-wrapped.

Bendix® WS-24™ Antilock Wheel Speed Sensor

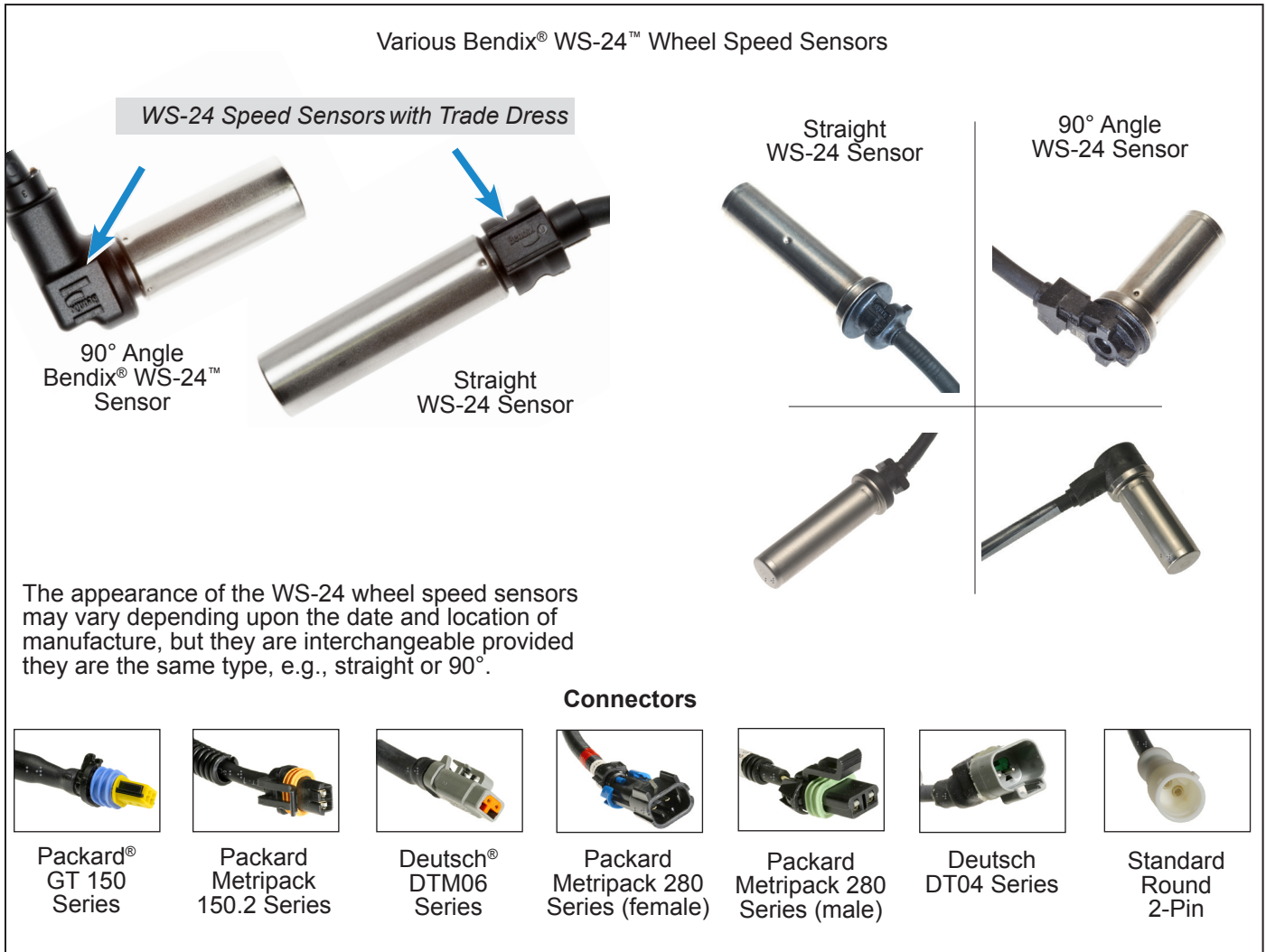


Figure 1 – Wheel Speed Sensors and Connectors

DESCRIPTION

The Bendix® WS-24™ wheel speed sensor is an electromagnetic device used to obtain vehicle speed information for an antilock controller. When the wheel rotates, the sensor and an exciter ring (sometimes called a “rotor” or “tone” wheel) generate a simple AC signal. This signal is sent to the controller, which analyzes the data and commands the antilock system accordingly.

Specifically, the speed sensor consists of a coil, pole piece, and a magnet. The exciter is a steel ring or gear-like device

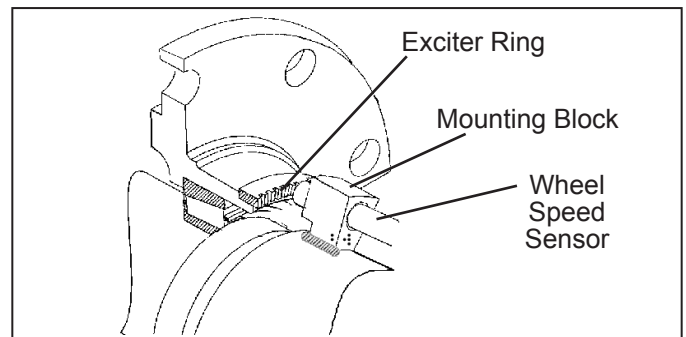


Figure 2 – Wheel End ABS Components



GENERAL SAFETY GUIDELINES

WARNING! PLEASE READ AND FOLLOW THESE INSTRUCTIONS

TO AVOID PERSONAL INJURY OR DEATH:

When working on or around a vehicle, the following guidelines should be observed **AT ALL TIMES**:

- ▲ Park the vehicle on a level surface, apply the parking brakes and always block the wheels. Always wear personal protection equipment.
- ▲ Stop the engine and remove the ignition key when working under or around the vehicle. When working in the engine compartment, the engine should be shut off and the ignition key should be removed. Where circumstances require that the engine be in operation, **EXTREME CAUTION** should be used to prevent personal injury resulting from contact with moving, rotating, leaking, heated or electrically-charged components.
- ▲ Do not attempt to install, remove, disassemble or assemble a component until you have read, and thoroughly understand, the recommended procedures. Use only the proper tools and observe all precautions pertaining to use of those tools.
- ▲ If the work is being performed on the vehicle's air brake system, or any auxiliary pressurized air systems, make certain to drain the air pressure from all reservoirs before beginning **ANY** work on the vehicle. If the vehicle is equipped with a Bendix® AD-IS® air dryer system, a Bendix® DRM™ dryer reservoir module, or a Bendix® AD-9si® air dryer, be sure to drain the purge reservoir.
- ▲ Following the vehicle manufacturer's recommended procedures, deactivate the electrical system in a manner that safely removes all electrical power from the vehicle.
- ▲ Never exceed manufacturer's recommended pressures.
- ▲ Never connect or disconnect a hose or line containing pressure; it may whip and/or cause hazardous airborne dust and dirt particles. Wear eye protection. Slowly open connections with care, and verify that no pressure is present. Never remove a component or plug unless you are certain all system pressure has been depleted.
- ▲ Use only genuine Bendix® brand replacement parts, components and kits. Replacement hardware, tubing, hose, fittings, wiring, etc. must be of equivalent size, type and strength as original equipment and be designed specifically for such applications and systems.
- ▲ Components with stripped threads or damaged parts should be replaced rather than repaired. Do not attempt repairs requiring machining or welding unless specifically stated and approved by the vehicle and component manufacturer.
- ▲ Prior to returning the vehicle to service, make certain all components and systems are restored to their proper operating condition.
- ▲ For vehicles with Automatic Traction Control (ATC), the ATC function must be disabled (ATC indicator lamp should be ON) prior to performing any vehicle maintenance where one or more wheels on a drive axle are lifted off the ground and moving.
- ▲ The power **MUST** be temporarily disconnected from the radar sensor whenever any tests **USING A DYNAMOMETER** are conducted on a vehicle equipped with a Bendix® Wingman® system.
- ▲ You should consult the vehicle manufacturer's operating and service manuals, and any related literature, in conjunction with the Guidelines above.



WARNING: Not all wheels and valve stems are compatible with Bendix® Air Disc Brakes. Use only wheels and valve stems approved by the vehicle manufacturer to avoid the risk of valve stem shear and other compatibility issues.



WARNING: AVOID CREATING DUST. POSSIBLE CANCER AND LUNG DISEASE HAZARD.

While Bendix Spicer Foundation Brake LLC does not offer asbestos brake linings, the long-term affects of some non-asbestos fibers have not been determined. Current Occupational Safety and Health Administration (OSHA) Regulations cover exposure levels to some components of non-asbestos linings, but not all. The following precautions must be used when handling these materials.

Avoid creating dust. Compressed air or dry brushing must never be used for cleaning brake assemblies or the work area.

- ▲ Bendix recommends that workers doing brake work must take steps to minimize exposure to airborne brake lining particles. Proper procedures to reduce exposure include working in a well-ventilated area, segregation of areas where brake work is done, use of local filtered ventilation systems or use of enclosed cells with filtered vacuums. Respirators approved by the Mine Safety and Health Administration (MSHA) or National Institute for Occupational Safety and Health (NIOSH) should be worn at all times during brake servicing.
- ▲ Workers must wash before eating, drinking, or smoking; shower after working, and should not wear work clothes home. Work clothes should be vacuumed and laundered separately without shaking.
- ▲ OSHA & EPA Regulations regarding testing, disposal of waste, and methods of reducing exposure for asbestos are set forth in 29 & 40 Code of Federal Regulations §1910.1001 & 61.150, respectively. These Regulations provide valuable information which can be utilized to reduce exposure to airborne particles.
- ▲ Safety Data Sheets on this product, as required by OSHA, are available from Bendix. Call 1-800-247-2725 and speak to the Tech Team or e-mail techteam@bendix.com.

that has regularly spaced high and low spots called "teeth." The sensor is mounted in a fixed position, while the exciter is installed on a rotating member so that its "teeth" move, in close proximity, past the tip of the sensor.

The Bendix® WS-24™ sensor is available in both straight and 90° versions, to accommodate axle/wheel space limitations. (See Figure 1.)

OPERATION

The sensor's magnet and pole piece form a magnetic field. As the exciter ring passes by the sensor, the magnetic field is altered, which generates AC voltage in the sensor coil. Each time an exciter tooth and its adjacent space move past the tip of the sensor, an AC voltage "cycle" is generated.

The number of AC cycles per revolution of the vehicle's wheel depends on the number of teeth in the exciter ring, which is programmed into the antilock controller. Using the programmed data, the controller can calculate "vehicle speed" by analyzing the frequency of AC cycles sent by the speed sensor. (The frequency of AC cycles is directly proportional to wheel speed.) See *Figure 4*.

AC voltage is also proportional to speed, but voltage is not used to determine speed. It is only an indication of AC signal strength. The amount of AC voltage generated by a specific speed sensor depends on the distance, or "gap" between the tip of the sensor and the surface of the exciter. Voltage increases as the sensor gap decreases.

Typically, the Bendix® WS-24™ wheel speed sensor is installed in mounting blocks that are welded to the axle housing. (See *Figure 2*.) The WS-24 wheel speed sensors are protected by a stainless steel sheath. The sensors are designed to be used with beryllium copper or stainless steel clamping sleeves (sometimes referred to as a "retainer bushing", "friction sleeve" or "clip") (See *Figure 3*). The clamping sleeve provides a friction fit between the mounting block bore and the WS-24 wheel speed sensor.

Note that Bendix® sleeve part number 5006849 can not be used with the WS-24 wheel speed sensors. Always use the correct clamping sleeves to avoid problems associated with reduced retention force, such as unwanted sensor movement and resulting ABS trouble codes.

TECHNICAL INFORMATION

Electrical connector - 2 Pin
Sensor resistance (-40°C - 220°C) 1100 - 3400 ohms
Output voltage - At a minimum of 100 Hz (approximately 7 mph) at a gap of .028 inches should produce a sensor voltage of 0.350 VAC
Sensor body outer diameter - 0.627 inch
Sensor resistance (20°C) 1575 - 2100 ohms
Note: Previous model Bendix® WS-20™ sensor's normal resistance range across pins at room temperature was rated at 2000 - 5000 ohms.

The friction fit allows the WS-24 sensor to "slide" back and forth under force but to retain its position when the force is removed.

When the WS-24 sensor is inserted all the way into the mounting block and the wheel is installed on the axle, the hub exciter contacts the sensor, which pushes the sensor back. Also, normal bearing play will "bump" the sensor away from the exciter. The combination of these two actions will establish a running clearance or air gap between the sensor and the exciter.

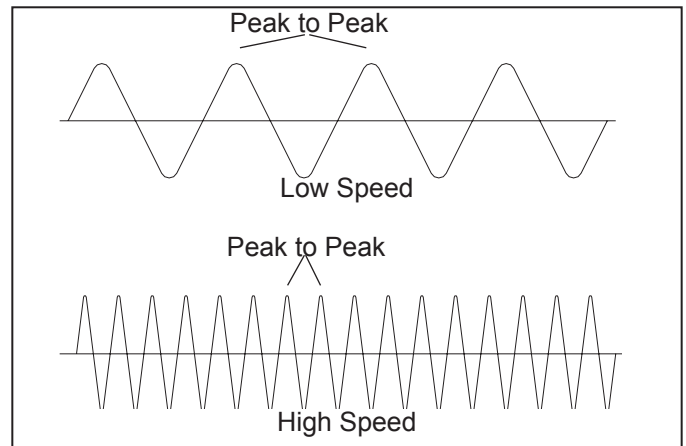


Figure 4 – Speed Sensor Voltage Cycle Output

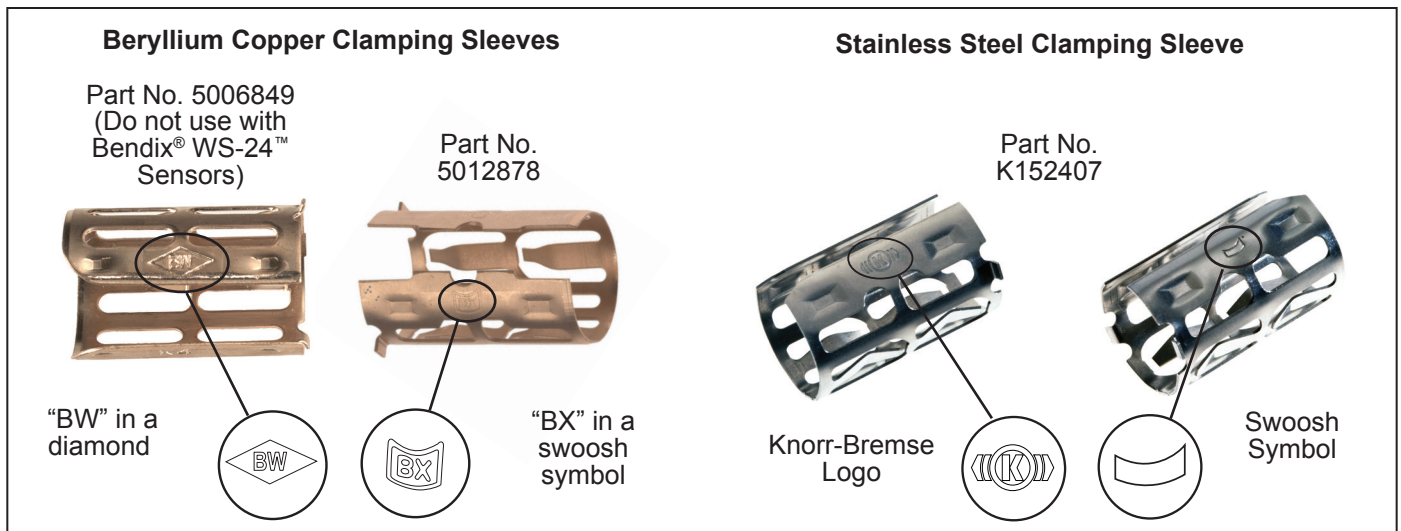


Figure 3 – Clamping Sleeves

PREVENTIVE MAINTENANCE

1. Every 3 months; 25,000 miles; 900 operating hours; or during the vehicle chassis lubrication interval, make the visual inspections noted in "SERVICE CHECKS" below.
2. Every 12 months; 100,000 miles; or 3600 operating hours, perform the OPERATIONAL TEST in this manual.

SERVICE CHECKS

Check all wiring and connectors. Make sure connections are free from visible damage.

Examine the sensor. Make sure the sensor, mounting bracket, and foundation brake components are not damaged. Repair/replace as necessary.

SENSOR IDENTIFICATION

Use Bendix® ACom® diagnostic software to identify the suspected sensor. To verify the correct wheel sensor or axle has been identified, the ACom software can be used to view real time wheel speed sensor outputs. To determine which axle has been identified as drive or additional, lift the axle in question and hand spin the wheel at least ½ revolution per second. The wheel speed will be displayed via the ACom software.

INSPECT FOR PHYSICAL DAMAGE

Inspect the sensor cable for cuts, evidence of pinching or wear, or abrasions with wiring exposed. Make sure the block is securely attached to the axle housing. If any of the above conditions are noted, replace the sensor and clamping sleeve, then clear the Diagnostic Trouble Code (DTC) according to the Electronic Control Unit (ECU) Service Data sheet directions. Re-check the system before returning the vehicle to service.

ELECTRICAL TESTING

The vehicle should be at an ambient temperature to achieve a nominal resistance, or AC voltage, value. Be observant of the wheel end temperature when taking measurement readings. At extreme temperature ranges, -40°F to 428°F (-40° to 220°C), the sensor resistance can vary from 1100 to 3400 ohms. To avoid possible connector seal damage it is recommended to first check sensor resistance, or AC voltage output, at the ECU connections. If the resistance or voltage output is not within the stated parameters at this location, perform the test at the next connector, typically the wheel end. Before disconnecting any electrical connections at the wheel end, remove as much contamination from the connector as possible to preserve the sealing integrity of the connection.

1. Inspect the connectors and terminals for corrosion, physical damage (bent) or loose connections. If possible, repair and/or clean the connector and terminals.

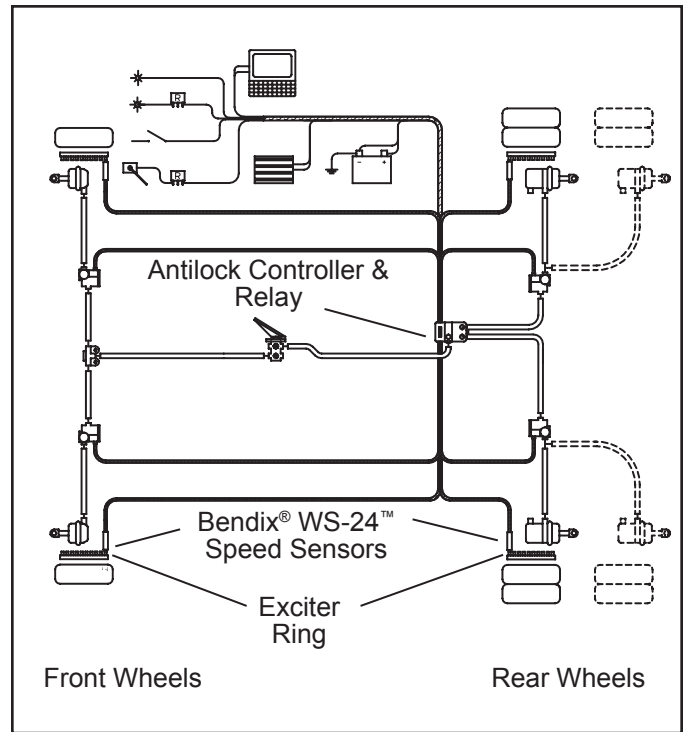


Figure 5 – Typical Antilock System

2. Use a volt-ohm meter to measure the resistance across the connector terminals, at an ambient temperature range of 0°F to 100°F (-18°C to 38°C) sensor resistance range can be 1200 to 2700 ohms. Record your measurements.

OK - between 1200 and 2700 ohms.

Not OK - less than 1200 or more than 2700 ohms.

Resistance measurement = _____.

If OK, continue to Step 3.

If Not OK, replace the sensor and clamping sleeve.

3. Confirm that wheel chocks are in place on the vehicle. Raise the wheel off the ground to test the suspect wheel speed sensor.

4. Release the parking brakes.

5. By hand, slowly rotate the wheel at a rate of at least ½ revolution per second. Using an AC rms voltage meter, measure the voltage at the ECU across the sensor terminals and record your measurement.

OK - Output voltage is 0.25 Volt AC minimum.

Not OK - Output voltage is less than 0.25 Volt AC.

AC voltage measurement = _____.

6. If voltage is not OK, reposition the sensor by gently pushing it closer toward the wheel until it touches the exciter ring. Repeat the voltage measurement.

AC voltage measurement = _____.

If still not OK, replace the sensor and the clamping sleeve.

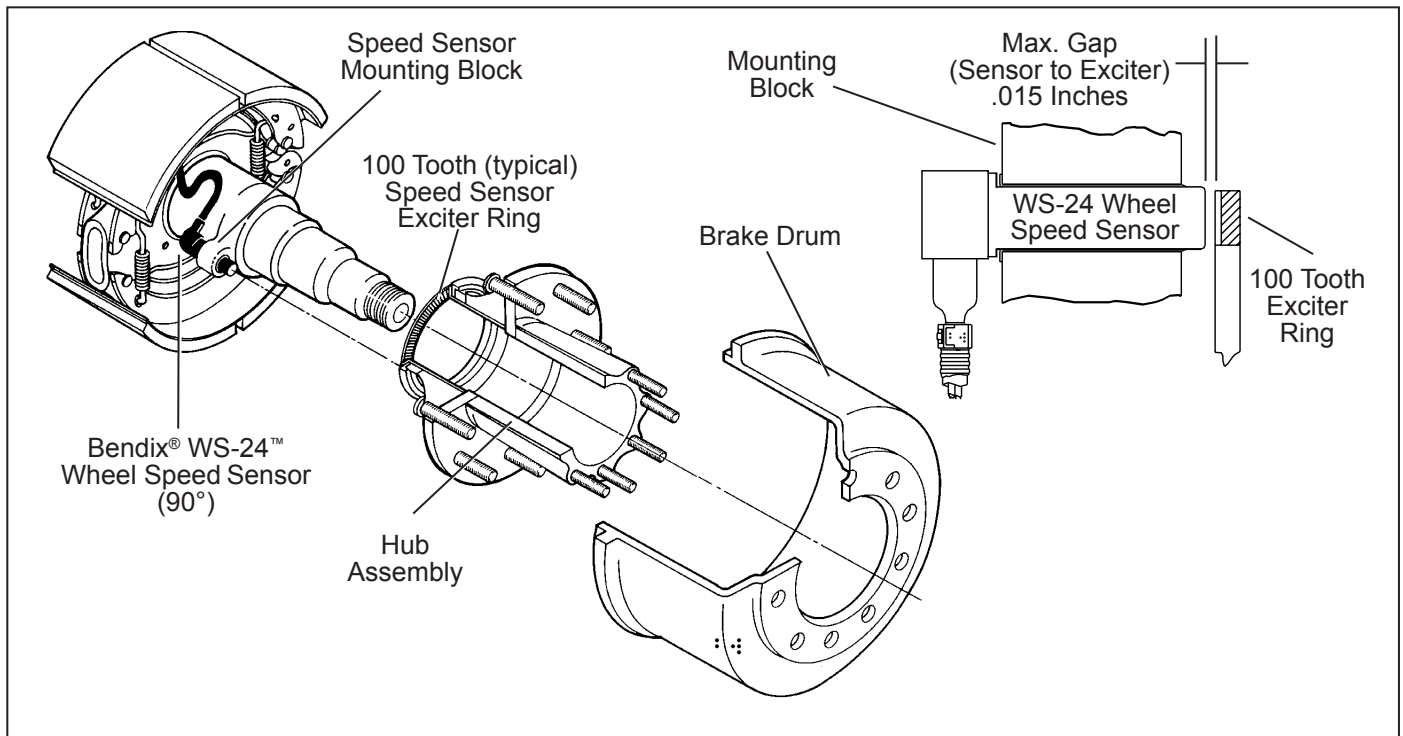


Figure 6 – WS-24 Wheel Speed Sensor Installation

7. If the resistance and voltage readings are OK, the sensor itself is not the cause of the Diagnostic Trouble Code (DTC). Reconnect the sensor and examine the wiring harness and ECU connector for causes of failure, such as pinched wires, loose pins, abrasions, exposed wires, etc.
8. After repair, re-check the system before returning the vehicle to service. If necessary, drive the vehicle to confirm the system is functioning correctly.

SENSOR REMOVAL

Before disconnecting any electrical connections at the wheel end, remove as much contamination from the connector as possible to preserve the sealing integrity of the connection.

1. Unplug the cable assembly connector from its lead. Lift the lock tab and pull on the connector until it disengages.
2. Gently pry the sensor and clamping sleeve from the mounting block.

SENSOR INSTALLATION

1. When using clamping sleeve—Bendix® part number 5012878—it is recommend a high-temperature rated silicon- or lithium-based grease be applied to the interior of the mounting block for better corrosion protection.
2. When using stainless steel clamping sleeve—Bendix® part number K152407—it is required to apply a high-temperature rated silicon- or lithium-based grease to the sensor body. This lubrication will keep the movement between the sensor and the clamping sleeve independent from one another.

3. Install the new clamping sleeve fully into the block, with the retaining tabs toward the inside of the vehicle.
4. Gently push (DO NOT STRIKE) the sensor into the mounting block hole until it bottoms out on the face of the tone ring. Secure the cable lead wire to the knuckle/ axle housing 3-6 inches from the sensor.
5. Apply a moderate amount of dielectric non-conductive grease to both the sensor connector and the harness connector.
6. Engage the connectors, and push together until the lock tab snaps into place.

NOTE: It is important for the wheel bearings to be adjusted per the manufacturer's recommendations. Excessive wheel end play can result in excessive air gap where the sensor is pushed too far away from the tone ring leading to loss of ABS or Stability Control systems.

OPERATIONAL TESTING

There are multiple ways to verify the wheel speed sensor has been installed properly.

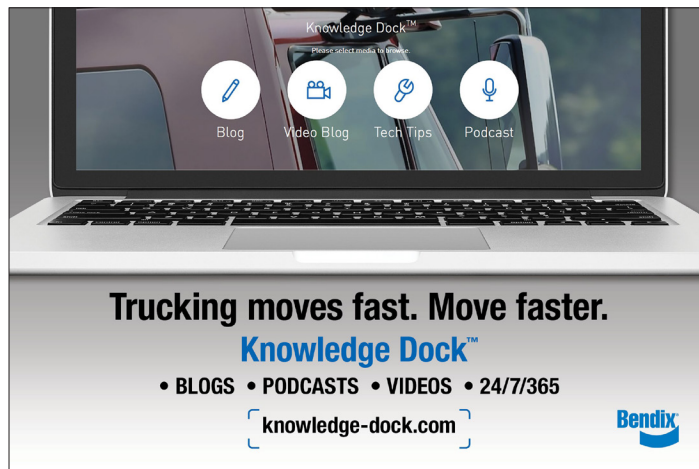
Prior to connecting the sensor to its mating connector, raise the vehicle wheel so it rotates easily. Connect a volt-ohm meter to the sensor leads, set the meter to AC volts, spin the wheel (approximately 0.5 revolutions per second). The output voltage should read greater than 0.250 V.

Test Drive: it is recommended to test drive the vehicle to verify the repair in a dynamic state. Test drive the vehicle in a safe area to a minimum speed of 15 mph. Be sure to make multiple right and left hand turns while driving, start and stop the vehicle with the brakes several times. Observe the following:

1. ABS dash lamp should not be illuminated after the test drive.

2. The Light Emitting Diode (LED) display on the Bendix controller, if so equipped, should only have the green LED illuminated.
3. If Bendix® ACom® diagnostic software is available: During the drive, wheel sensor output can be monitored and recorded in the ACom diagnostic wheel speed window. All sensors should record speeds.

If the sensor fails to operate as described, check the wiring from the controller to the sensor. Make sure all connectors are properly, and tightly, installed. Check for frayed or damaged wires. For additional troubleshooting information reference *Bendix® Wheel Speed Sensor Checklist* (BW2453 available for download on bendix.com), or see the troubleshooting procedure for the specific ABS system in use.



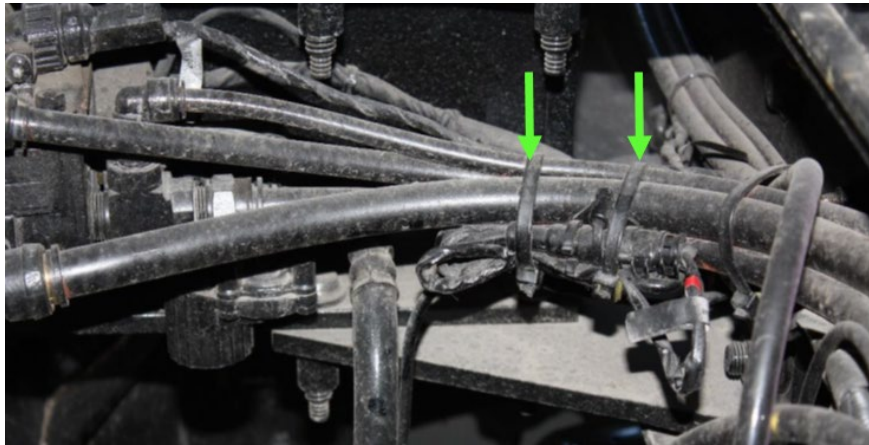
Log-on and Learn from the Best
On-line training that's available when you are –24/7/365.
Visit brake-school.com.



Wheel Speed Sensor Inspection

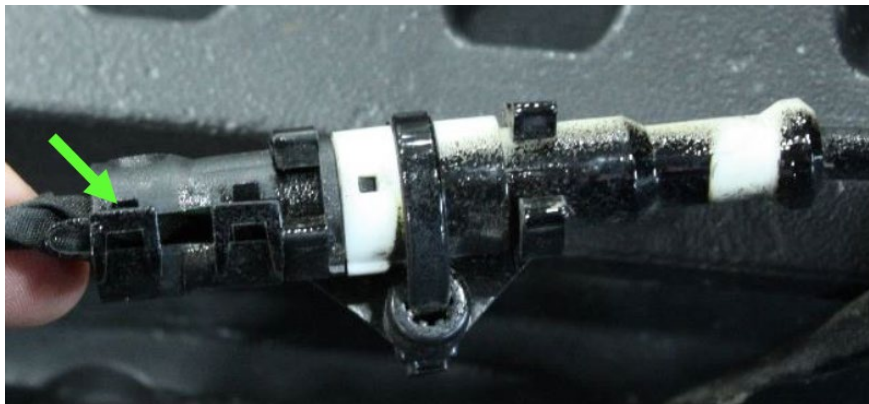
1. Cut the cable ties securing the connector to the harness as shown in Figure 1.

Figure 1



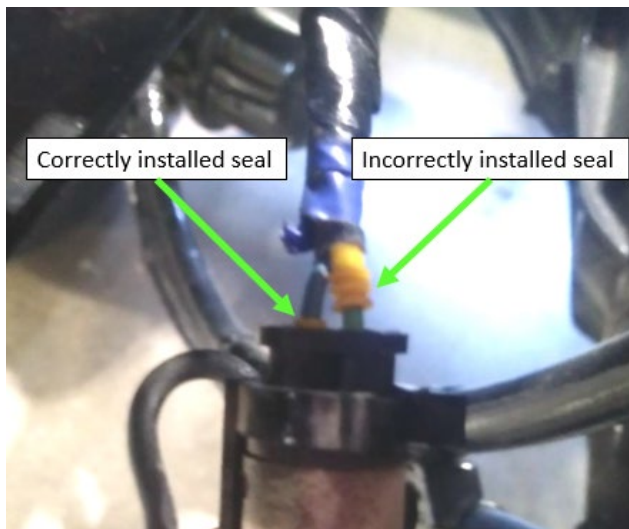
2. Remove the back shell of the connector as shown in Figure 2.

Figure 2



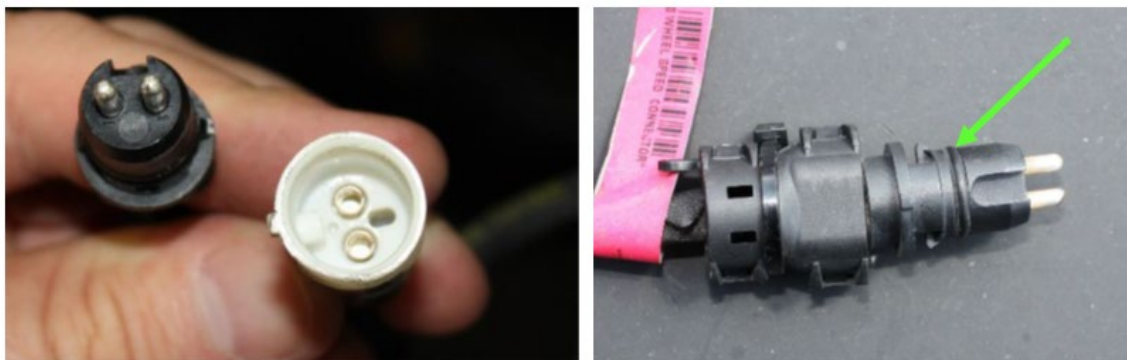
3. Visually inspect the rubber seals to make sure they are flush with the back of the connector as illustrated in Figure 3. If necessary, slide the seal(s) into place with your fingers.

Figure 3



4. If the seal was not correctly installed, carefully open the connector (Figure 4) and visually inspect for signs of corrosion. If any corrosion is found, replace the sensor and/or harness as necessary. Verify the O-ring is installed on the connector and undamaged.

Figure 4

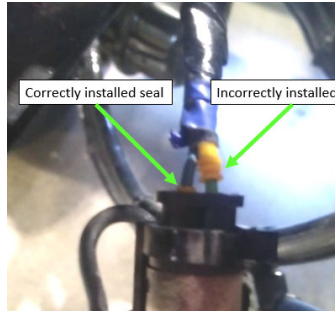


5. Reassemble the connector as it was found, with cable ties securing the connector together.
6. Secure the harness bundle in the original location with cable ties.
7. Using the same method, check all other wheel speed sensor connectors.



Technical Information Bulletin

34-085



Section

Wiring and Lighting - 34

Subject

ABS Wheel Speed Sensor Corrosion

Release Date

3/3/2020

Condition

Wheel speed sensor related fault codes might be present in the ABS system.

Chassis Affected

Chassis built from 09/14/2004 through 08/07/2018 with ABS.

Action

Information Only

This bulletin is to inform dealers of possible repair paths for incorrectly installed wheel speed sensor connector seals.

Warranty

Through Standard Warranty or any applicable active Extended Warranty, Kenworth will pay for parts at dealer net plus applicable mark-up and labor.

For repairs made while the chassis is covered by Kenworth Warranty, refer to Kenworth Warranty bulletin [Wire Harness Warranty and Claim Filing Requirements C-C-065](#) for claim filing instructions.

For visual defects and repairs, provide photos clearly showing the defect and the repair with your warranty claim. Providing the photos

greatly expedites the claim processing.

- 0.8 hours of labor to inspect all wheel speed sensors and connectors, and reseal the connector seals if necessary (SRT 013-199).
- 0.4 hours to R&R each front wheel speed sensor if corrosion is found on the sensor (SRT 013-200).
- 0.7 hours to R&R each rear wheel speed sensor if corrosion is found on the sensor (SRT 013-203).
- 3.7 hours of labor, **which includes 0.8 hours for inspection**, to remove and replace the ABS harness if corrosion is found on the connector (SRT 013-212).
- If multiple sensors are to be replaced, a picture for each sensor is required.
- File a long claim form referencing 34-085.

Take-Off Parts Disposition: Destroy take-off parts after claim is paid

CLAIM CODING			
Failure Location:	013-011-002	Work Accomplished:	35
Failure Type:	145	Responsibility Code:	01
SRT Code:	<p>SRT 013-199 0.8 hours To inspect the seals on the wheel speed sensor connector, and reseal the seals if necessary.</p> <p>SRT 013-200 0.4 hours To R&R each front wheel speed sensor. Includes completing diagnostic checklist, attach to packing tag, and adjustment.</p> <p>SRT 013-203 0.7 hour To R&R each rear wheel speed sensor. Includes adjustment.</p> <p>SRT 013-212 2.9 hours To remove and replace ABS Chassis Harness as needed. Includes wheel speed sensor inspection. For MX-13 add SRT 032-050 for starter R&R. For 6S/6M ABS add 1.9 hours.</p>	Claim Type:	N/E

Parts

Parts are available from PACCAR Parts.

Quantity	Part Number	Description
1 as needed	Varies – Refer to Web Ecat if harness replacement is necessary	ABS Harness
Up to 4 as needed	Varies – Refer to Web Ecat if Wheel Speed Sensor replacement is necessary	Wheel Speed Sensor
As Needed	Source Locally	Cable Ties
As Needed	V46-1003-1750200	Nylon Abrasion Shield

Procedure

Follow the proper troubleshooting steps for any fault code as usual. If upon visual inspection the connectors are not properly installed, correctly seat the seals if needed and check for corrosion.

1. Consult the Inspection Procedure in the Attachments section to perform the wheel speed sensor inspection.
2. Properly seat any seals that are outside of the connector, as shown in the Inspection Procedure.
3. As stated in the Inspection Procedure, if any corrosion is present on the harness or wheel speed sensor, refer the attached Removal and Replacement Procedure to replace the ABS harness. Refer to bulletin [34-081](#) for additional information on how to proceed if a harness is corroded or damaged.
4. If corrosion is found on the Wheel Speed Sensor side of the connection, refer to the Bendix SD-13-4860 Wheel Speed Sensor Service Data manual for replacement.
5. If corrosion is found, **provide photos clearly showing the corrosion**; refer to Kenworth Warranty bulletin [Wire Harness Warranty and Claim Filing Requirements C-C-065](#) for details.

Attachments

 [Inspection Procedure](#)

 [ABS Harness Removal and Replacement Procedure](#)

 [SD-13-4860 Wheel Speed Sensor Service Data](#)

Authored by: OF

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