

SMARTTRAC™ HYDRAULIC ANTI-LOCK BRAKING SYSTEMS

MAINTENANCE MANUAL



WABCO



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Asbestos and Non-Asbestos Fibers



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 properly 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.

1 General Information

Symbols used in this document

DANGER

Description of an immediate situation which will result in irreversible injury or death if the warning is ignored.

WARNING

Description of a possible situation which may result in irreversible injury or death if the warning is ignored.

CAUTION

Description of a possible situation which may result in irreversible injury if the warning is ignored.

NOTICE

Description of a possible situation which may result in material damage if the warning is ignored.



Important information, notes and/or tips



Reference to information on the internet

How to Obtain Additional Maintenance, Service and Product Information

If you have any questions about the material covered in this publication, or for more information about the WABCO product line, please contact the WABCO Customer Care Center at 855-228-3203, by email at wnacustomercare@wabco-auto.com, or visit our website: www.wabco-na.com.

General Information

WABCO Academy



<https://www.wabco-academy.com/home/>

EN

WABCO online product catalog



<http://inform.wabco-auto.com/>

Your direct contact to WABCO

**WABCO North America
WABCO USA LLC
1220 Pacific Drive
Auburn Hills, MI 48326
Customer Care Center: (855) 228-3203
www.wabco-na.com**

2 Safety Information

Provisions for a safe work environment

- Only trained and qualified technicians may carry out work on the vehicle.
- Read this publication carefully.
- Follow all warnings, notices and instructions to avoid personal injury and property damage.
- Always abide by the vehicle manufacturer's specifications and instructions in the vehicle manual.
- Observe all accident regulations of the respective company as well as regional and national regulations.
- The workplace should be dry, sufficiently lit and ventilated.
- Use personal protective equipment if required (safety shoes, protective goggles, respiratory protection and ear protectors).

Read and observe all Danger, 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.

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 or fall over. Serious personal injury and damage to components can result.

3 Introduction

3.1 About This Manual

This manual provides service and repair procedures for WABCO's SmartTrac™ hydraulic anti-lock braking system for medium-duty trucks, buses and motor home chassis.

3.2 Manual Information

This manual contains service information for the WABCO SmartTrac™ hydraulic ABS. For earlier versions of WABCO hydraulic ABS, refer to:

- MM38 C Version HABS
- MM39 D Version HABS
- MM0677 E Version HABS
- MM0401 HPB Hydraulic Power Brake
- MM1543 SmartTrac™ HABS

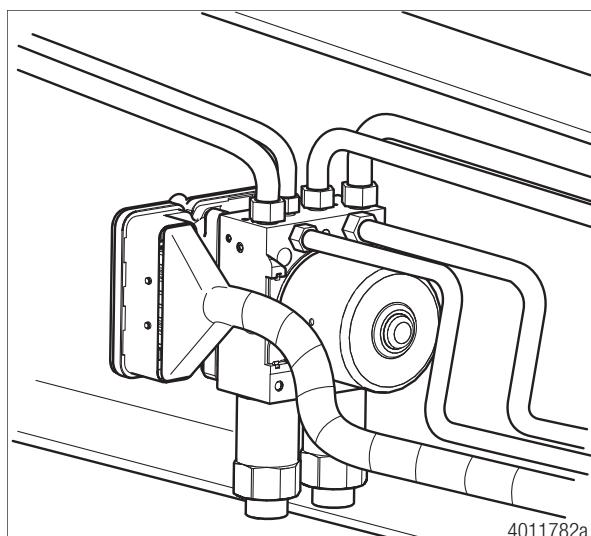
Copies of these manuals are posted on our website: wabco-na.com.

3.3 Overview

WABCO SmartTrac™ Hydraulic Anti-lock Braking System (HABS) is an electronic wheel speed monitoring and control system used on medium-duty trucks, buses and motor home chassis equipped with a hydraulic brake system. Features included with SmartTrac™ are:

- Anti-Lock Braking System (ABS)
- Drag Torque Control (DTC)
- Electronic Brake Force Distribution (EBD)
- Automatic Traction Control (ATC)
- Electronical Stability Control (ESC)
- Typically, the hydraulic ABS unit is mounted on the frame rail of the vehicle. Fig. 3.1.

Fig. 3.1



3.3.1 How ABS Works

The ABS uses wheel speed sensors to measure wheel speeds. The sensors generate signals that are transmitted to an ECU. If the wheels start to lock, the ECU signals the modulator assembly to regulate the brake pressure of each locking wheel.

During an ABS stop, a solenoid valve in the modulator assembly is rapidly pulsed; that is, it opens and closes several times per second to control the brake pressure. When this occurs, drivers may notice a pulsation of the brake pedal.

An ABS warning lamp on the vehicle instrument panel alerts the driver to a possible system fault.

If the ABS warning lamp comes on during normal vehicle operation, drivers may complete their trip, but are instructed to have their vehicle serviced as soon as possible.

In the unlikely event of an ABS malfunction, the ABS in the affected wheel will be disabled and will return to normal braking. The other sensed wheels may retain their ABS function. Do not rely on the ABS functioning for any of the sensed wheels. Have the vehicle serviced as soon as possible.

3.3.2 How ATC Works

ATC uses the same wheel sensors mentioned in the above ABS description, ATC monitors drive axle wheel speeds to detect wheel spin that can occur on slippery surfaces. ATC works automatically in three different ways:

- A. If a drive wheel starts to spin, ATC pulses hydraulic pressure to reduce the wheel spin. This transfers engine torque to the wheels with better traction.
- B. If all drive wheels spin, ATC reduces engine torque to provide improved traction.
- C. When needed, the SmartTrac™ system will combine hydraulic pressure pulses and engine torque reduction simultaneously.

ATC turns itself on and off; drivers do not have to select this feature. If drive wheels spin during acceleration, the ATC indicator lamp comes on, indicating ATC is active. It goes out when the drive wheels stop spinning.

3.3.3 How DTC Works

DTC prevents the driven wheels from locking on slippery surfaces under a condition that would result from an engine braking event. This condition can happen if the driver releases the accelerator abruptly or shifts down a gear quickly. The braking effect of the engine may cause the driven wheels to slip and they temporarily lose traction resulting in the vehicle becoming unstable. In this situation, DTC maintains directional stability by slightly increasing engine speed until the driven wheels match the road speed again.

3.3.4 How EBD Works

EBD provides constant review of the vehicle's load status and monitoring of each wheel end. Based on wheel slip observed by the ABS during braking, braking forces at the axles are automatically adjusted to achieve a balanced, efficient use of the brakes. This results in improved stopping performance and allows the vehicle to adjust for consistent brake feel independent of the load.

Introduction

3.3.5 Deep Snow and Mud Switch

A deep snow and mud option switch is included with ATC. This function increases available traction on extra soft surfaces like snow, mud or gravel, by slightly increasing the permissible wheel spin.

Drivers use a deep snow and mud switch to select this feature. When this function is in use, the ATC indicator lamp blinks continuously.

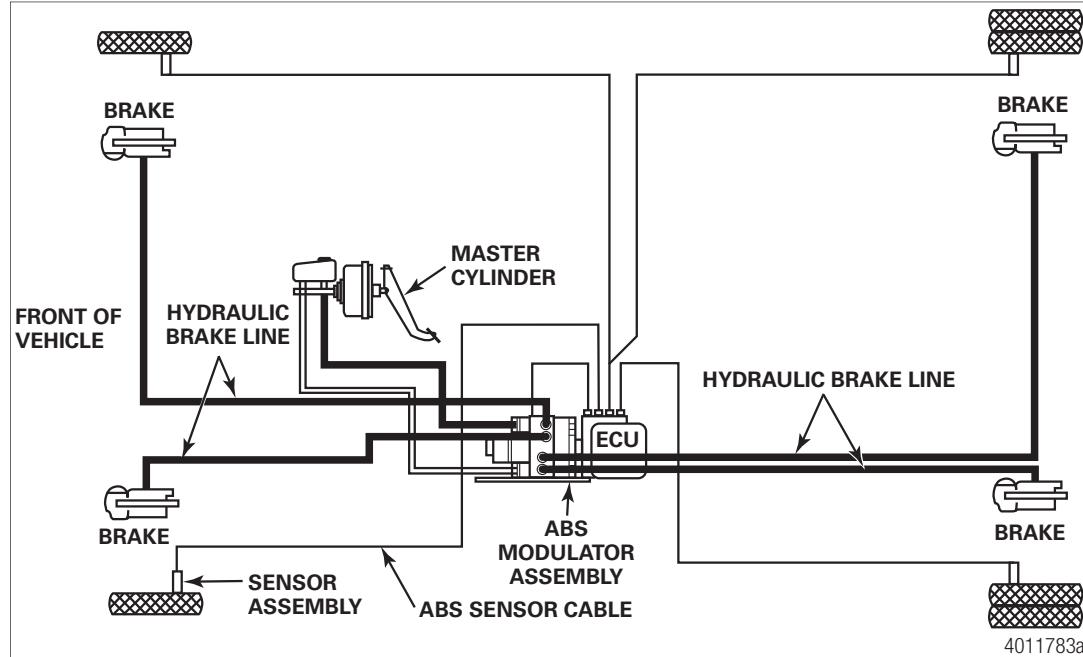
3.3.6 How ESC Works

If a vehicle becomes unstable, this intelligent system automatically intervenes to reduce rollover, skidding and jackknifing risk. The system detects instability through the use of onboard sensors measuring vehicle dynamics and selectively applies foundation braking to correct vehicle heading and/or prevent rollover.

3.3.7 System Layout

A typical WABCO SmartTrac™ hydraulic ABS installation is illustrated in Fig. 3.2.

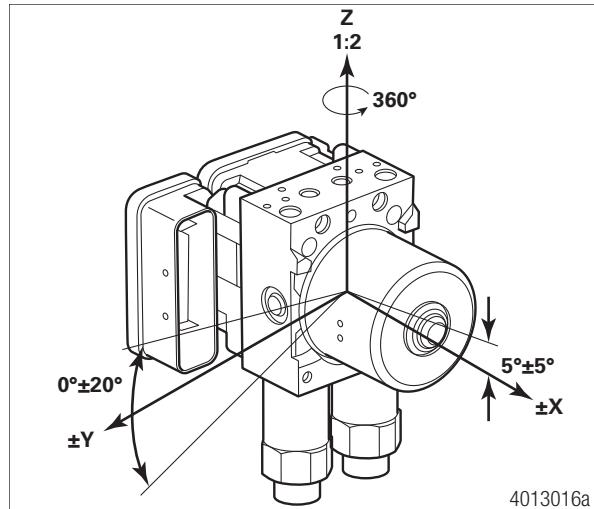
Fig. 3.2



The ABS modulator assembly must be mounted below the master cylinder and above the brake calipers and wheel cylinders.

WABCO requires that the motor axis is positioned at an angle between +0 degrees and +10 degrees with the horizontal plane, with the motor end pointing up and between -20 degrees and +20 degrees of rotation of the motor axis. Fig. 3.3. Contact the OEM or WABCO for additional information regarding the modulator assembly's orientation.

Fig. 3.3



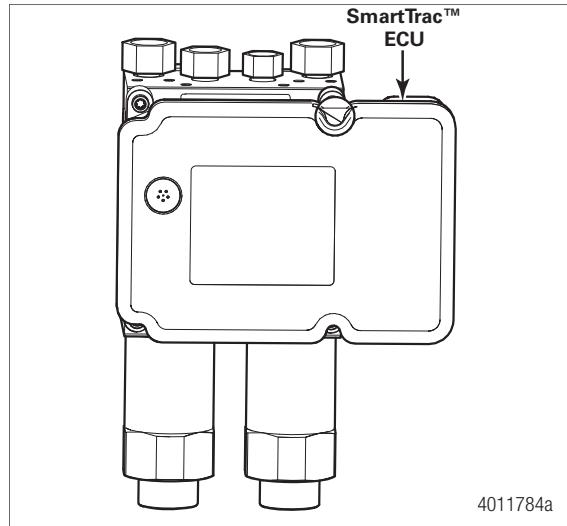
3.4 System Components

The SmartTrac™ hydraulic ABS unit consists of an electronic control unit (ECU) mounted directly on a modulator assembly. The assembly is manufactured and sold as one part. Replacement of the individual components is not available.

3.4.1 Electronic Control Unit (ECU)

The electronic control unit (ECU) processes sensor signals and generates solenoid valve commands to reduce, maintain or reapply brake pressure. Fig. 3.4.

Fig. 3.4



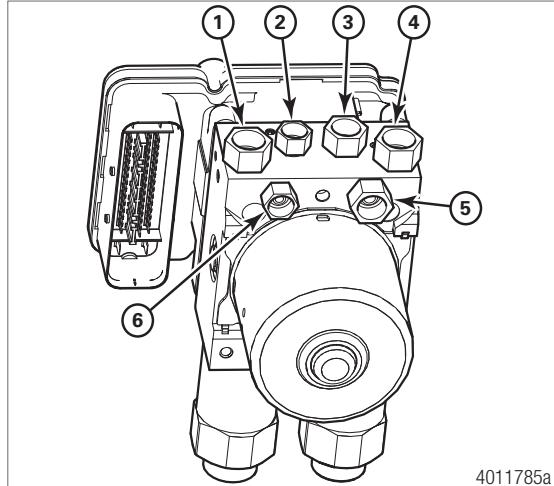
3.4.2 Modulator Assembly

⚠ CAUTION

The modulator assembly contains brake fluid. Handle the modulator assembly with appropriate care. Do not expose the modulator assembly to impact loads or excessive vibrations. Do not blow compressed air into the hydraulic ports. Mishandling the modulator assembly may lead to component damage and system failure.

The modulator assembly houses the system's solenoid control valves. There are three valves per wheel, including an inlet and outlet for controlling ABS and the third to control ATC (rear axle only). The modulator assembly also includes a pump motor, two low pressure accumulators and six fittings. Fig. 3.5. Details about the fittings can be seen below.

Fig. 3.5



Recommended tightening torque for the above mentioned fittings, known as thread savers, is 15 +2.2 ft-lb (20 +3 Nm).



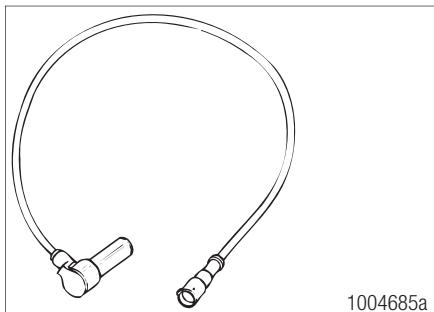
Recommended tightening torque for brake line tube nuts is 11 +2.2 ft-lb (15 +3 Nm).

3.4.3 Sensors

3.4.3.1 Sensor with Molded Socket

- Used to measure the speed of a tooth wheel rotating with the vehicle wheel.
- Produces an output voltage proportional to the wheel speed. Fig. 3.6.

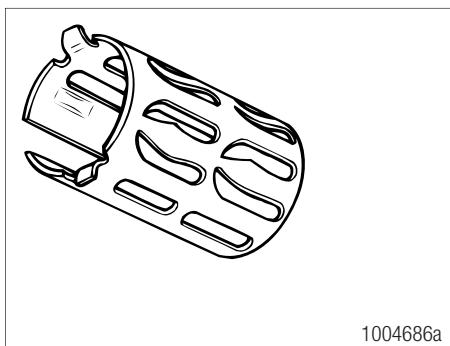
Fig. 3.6



3.4.3.2 Sensor Spring Clip

- Holds the wheel speed sensor in close proximity to the tooth wheel. Fig. 3.7.

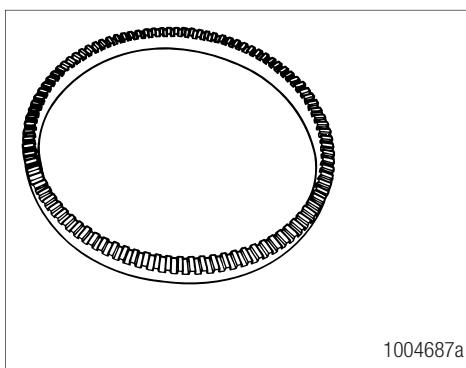
Fig. 3.7



3.4.3.3 Tooth Wheel

- A machined or stamped ring mounted to a machined surface on the hub of each ABS-monitored wheel. This can also be referred to as a tone ring. Fig. 3.8.

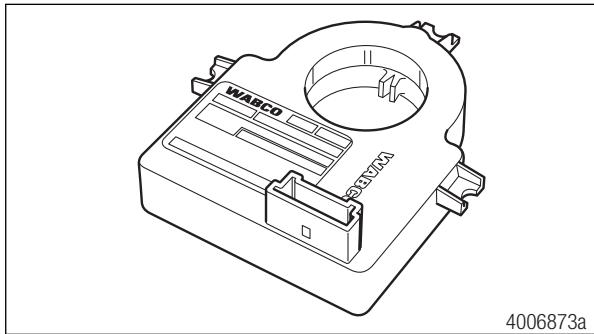
Fig. 3.8



3.4.3.4 Steering Angle Sensor

- The steering angle sensor (SAS) is part of the ESC system. The SAS delivers the driver's steering input (steering wheel position) to the ECU using a dedicated ESC system internal datalink. The ECU supplies the sensor with voltage and ground. The SAS must be calibrated using diagnostic tools whenever it is replaced, or when any vehicle steering components are replaced or adjusted. Fig. 3.9.

Fig. 3.9



3.4.3.5 Electronic Stability Control (ESC) Module

- The ESC module is part of the ESC system. It measures the vehicle yaw rate as well as vehicle lateral acceleration. The ESC module includes part of the ESC control algorithm. It exchanges data with the ECU via the ESC system internal data link. The ECU supplies the module with voltage and ground. The ESC module must be initialized by diagnostic tools whenever the ECU or the ESC module is replaced. Fig. 3.10.

Fig. 3.10



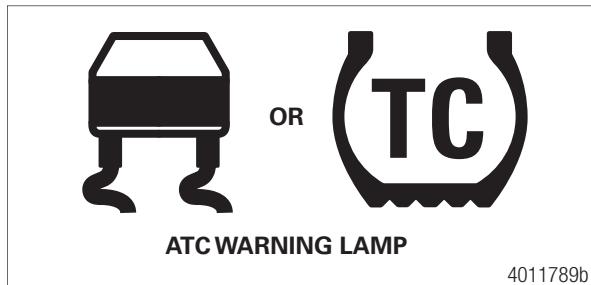
3.4.3.6 ABS and ATC Warning Lamps

- Located on the vehicle instrument panel.
- The ABS warning lamp illuminates for 3 seconds while performing a self check when the ignition is turned on. It also illuminates when there is a fault. Fig. 3.11.
- The ATC warning lamp will remain on continuously if ATC is disabled due to a failure. The ATC lamp will flash when ATC is active. See the "How ATC Works" section of this manual for details about ATC. Fig. 3.12.
- ABS and ATC warning lamps are included as part of the instrument cluster provided by the vehicle manufacturer. Indicators are activated through the J1939 CAN system.
- ESC and ATC may share the same lamp or separate lamps depending on the OEM and vehicle. Please refer to OEM documentation for lamp operation on your vehicle.

Fig. 3.11



Fig. 3.12



4 Troubleshooting and Testing

4.1 Maintenance

4.1.1 General Information

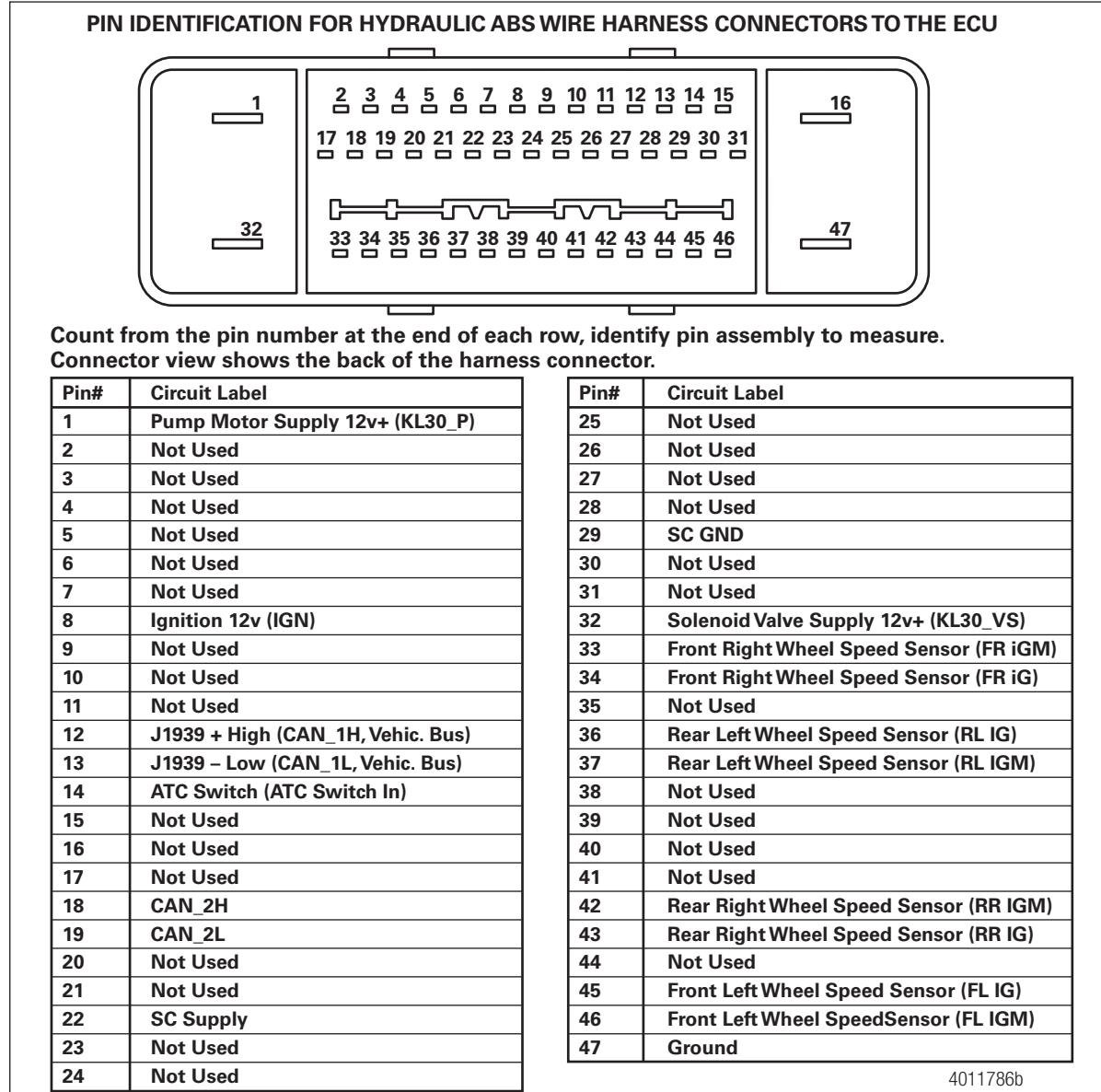
There is no regularly scheduled maintenance required for the WABCO SmartTrac™ hydraulic ABS unit. However, ABS does not change current vehicle maintenance requirements. For example, it is important that the vehicle brake fluid level be correctly maintained and regularly changed per the vehicle manufacturer's maintenance requirements.

4.2 Wiring Diagrams

4.2.1 System Wiring Information

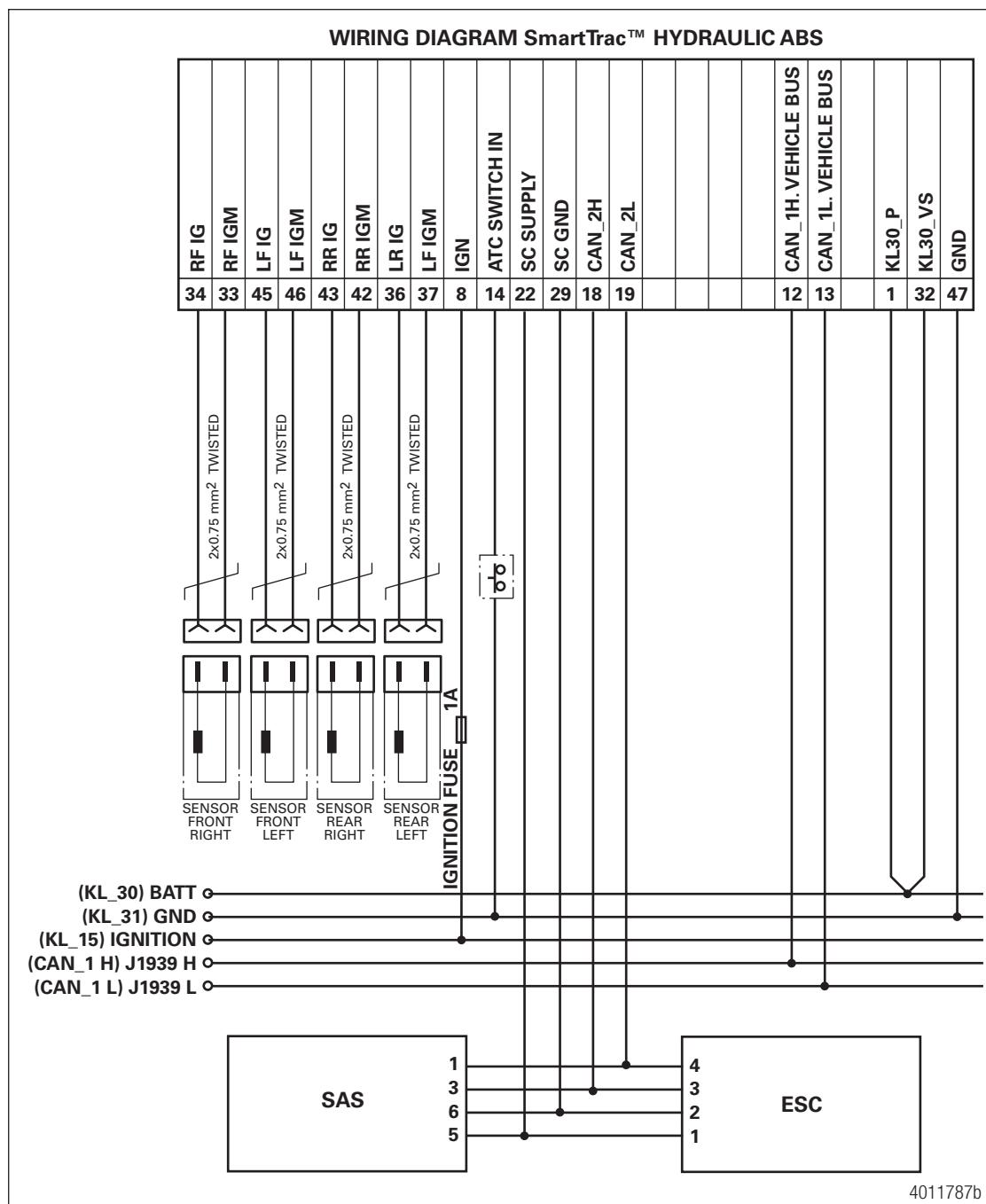
The SmartTrac™ hydraulic ECU connector pin identification is shown in Fig. 4.1. Wiring may vary according to the vehicle. Refer to the vehicle specifications in the vehicle manual for specific wiring diagrams. The SmartTrac™ hydraulic ABS wiring diagram appears in Fig. 4.2.

Fig. 4.1



Troubleshooting and Testing

Fig. 4.2



4.3 System Diagnostics

4.3.1 WABCO TOOLBOX™ Software

Use WABCO's PC-based diagnostic program, TOOLBOX™ Software, to diagnose SmartTrac™ hydraulic ABS faults and trouble codes. The software runs in Windows® XP, Vista, Windows® 7, 8 and 10. It is used to display system faults, wheel speed data, test individual components, verify installation wiring, enable and disable system functions, view counters and more.

The TOOLBOX™ Software is available for purchase at <https://wabco.snapon.com>. Follow the instruction and correctly install the software. Once you have TOOLBOX™ Software installed on your computer, follow the on-screen repair information to make the necessary repairs or replacements. See the following section for basic fault identifying and system testing instructions.



A J1939 cable and USB vehicle communication interface adapter are required to connect the PC to the J1939 vehicle bus while performing diagnostics.



For complete instructions for using this program, refer to the User's Manual at wabco-na.com under Service and Support, TOOLBOX™ Software. Contact the WABCO Customer Care Center at 855-228-3203 for information about TOOLBOX™ Software.

4.3.2 SmartTrac™ Hydraulic ABS Main Screen and Menus

Select Hydraulic ABS from the TOOLBOX™ Software Main Menu. TOOLBOX™ Software will read and identify the type of ECU being used and displays the SmartTrac Hydraulic screen.

4.3.2.1 Main Screen

This screen provides product information (ECU part number, serial number, software version, etc.), component data, wheel sensor data, sensor status and pull-down menu selections.



ECU information is read once from the ECU and does not change. All other information (e.g., wheel sensors, voltages and fault information) is read and updated continuously.

4.3.2.2 Pull-Down Menu Selections

System

Adapter Selection: Select the adapter used to interface between the vehicle, the communication connector and the laptop. The protocol for SmartTrac™ hydraulic is J1939.

Exit: Exit the program.

Troubleshooting and Testing

Display

Diagnostic Trouble Codes: Displays the faults and trouble codes, along with SPN and FMI numbers that can be referenced in the system reaction codes and repair instructions listed in Appendix.



The log will display the stored and active faults. Active faults that occur after the screen is displayed will not appear until a screen update is requested. After making the necessary repairs, use the Clear DTCs button to clear the fault. Cycle the ignition and restart the program to check for faults that are still active.

Use the Generate DTC Report button to generate a fault report (.txt file). The DTCs report can be saved on the connected PC.



Most faults require an ignition cycle and/or test drive above 5 mph (8.05 kph) to verify the fault resolution. Also check the ABS warning lamp to ensure the system functions correctly.

Counter Information: Displays the counter information such as pump motor hrs, ABS events, ESC events, ATC events, etc.

Air Gap Size: Displays the wheel speed sensor air gap condition.

Components

Activate Valves: Allows the valves to be selected and activated in a sequence typically used for bleeding the brake system. The software will execute a process of opening and closing the selected valves for a set time and the activation status will appear in the box below the valve selection box.

ESC: Displays ATC status, event counters, ESC measurement data, steering ratio data and ESC End of Line (EOL) Calibration procedure.

Miscellaneous Components: Allows the ABS and ATC lamps to be toggled on and off. Also allows ABS pump activation. All vehicles may not have an ATC lamp.

Enable ATC: Allows enabling of ATC.

Disable ATC: Allows disabling of ATC. The control status on the ATC Brake and ATC Engine fields on the Main Screen will display "N/A" instead of "Off."

EOL



Many of the features found in the EOL section of this menu must be used in conjunction with the instructions listed in the Brake Bleed Procedures of this manual.

Bleed Procedure: This screen allows functions such as pump flush and the ESC switching sequences for the front and rear axles to be utilized.

System Checked Bit: This is a function that must be performed after flashing parameters into the unit's ECU. It performs a checksum to detect if there are any errors which may have been introduced while flashing.

Parameters

Save Parameters to File: Allows saving of most recent parameter settings to PC as a (.par) file.

Utility

Active Outputs: This screen allows for the engineering testing of individual ABS valves (in and out), the ABS and ATC lamps, the ABS pump and other individual components.

Troubleshooting and Testing

Reset ECU: Allows the resetting of the ECU clearing at installed software and parameters.

Engineering Data: This screen displays the status of the STC, DTC and EBD systems along with the system type and master cylinder pressure.

Help

SmartTrac™ Maintenance Manual: Opens SmartTrac™ Hydraulic ABS Maintenance Manual.

Contact Information: Displays the WABCO contact information.

About: Displays the version information about the SmartTrac™ hydraulic software in TOOLBOX™ Software.

4.4

Testing the System

This section of the manual contains information for testing the SmartTrac™ hydraulic unit with TOOLBOX™ Software, as well as procedures for conducting standard hydraulic and electrical tests.

WARNING

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

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.

WARNING

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

CAUTION

When testing, set the parking brake and place the gear selector in NEUTRAL (manual transmission) or PARK (automatic transmission) unless otherwise directed.



Refer to, and follow, the vehicle manufacturer's warnings, cautions and service procedures.



TOOLBOX™ Software must be connected to the vehicle and the vehicle ignition must be ON in order to display information.

Troubleshooting and Testing

4.5 Testing with TOOLBOX™ Software

Use TOOLBOX™ Software to test and verify the activation of various system components:

- Turn valves and pump motor on and off (Components Menu/ Activate Valves).
- Turn ABS warning lamp on and off (Components Menu/ Miscellaneous Components).
- See the "System Diagnostics" section of this manual for other tests and verifications that can be performed with TOOLBOX™ Software.

4.6 Standard Testing

4.6.1 System Requirement

Tire Size Range

For correct hydraulic ABS operation, front and rear tire sizes must be within 8% of each other.

Contact the WABCO Customer Care Center at 855-228-3203 if you plan a tire size difference greater than 8%.

Calculate the tire size with the following equation:

% Difference =

$((\text{RPM Steer}/\text{RPM Drive}) - 1) \times 100$

RPM = tire revolutions per mile

CAUTION

When troubleshooting or testing the ABS, do not damage the connector terminals. Damaged connector terminals may cause system malfunction.

4.7 Component Testing

4.7.1 ABS and ATC Warning Lamp

If the ABS and ATC warning lamps do not come on after the ignition is turned on, or come on but do not go out after three seconds, check all ABS fuses. See the "System Diagnostics" section of this manual to check lamp function using TOOLBOX™ Software.



Not all vehicles are equipped with an ATC lamp. See the vehicle manufacturer's manual for more information.

4.7.2 Wheel Speed Sensor Adjustment

On steering axles, the sensor is typically accessible on the in-board side of the steering knuckle.

On drive axles, the sensor is typically accessible on the in-board side of the rear axle spindle.

To adjust the sensor, push the sensor in until it contacts the tooth wheel.

- Do not pry or push sensors with sharp objects.
- Sensors will self-adjust during wheel rotation.

See the "System Diagnostics" section of this manual to check the wheel speed sensor air gap condition using TOOLBOX™ Software.



No sensor gap is allowable at installation. During normal operation, a gap of up to 0.028-inch (0.7 mm) is allowable.

4.8 Voltage Check

4.8.1 Test Equipment: Volt-Ohm Meter (VOM)

Use of a VOM with automatic polarity sensing is recommended. This eliminates the concern of the polarity of the meter leads during voltage measurements.

4.8.2 ECU Voltage, Ground and Load Check

Voltage must be between 9.5 and 14 volts for the 12-volt hydraulic ABS to function correctly.

Check the ECU voltage, ground and load as follows:

1. Disconnect the harness connected to the ECU.
2. Turn the ignition ON.
3. Check for battery voltage across the following pins:
 - Pins 1 to 47
 - Pins 32 to 47
 - Pins 8 to 47
4. Check for correct ground:
 - Verify that the resistance between pin 47 and chassis ground is less than 1 ohm.
5. Perform load (impedance) test.
 - Contact the WABCO Customer Care Center at 855-228-3203 for simple ways to perform load tests.

Troubleshooting and Testing

4.8.3 Sensor Output Voltage Check

Sensor output voltage must be at least 0.2 volt AC at 30 rpm. Test the sensor output voltage as follows:

1. Turn the ignition OFF.
2. Disconnect the ECU harness so that the voltage at the pins in it can be measured.
3. Place blocks under the front and rear tires to stop the vehicle from moving.
4. Raise the vehicle off the ground. Place safety stands under the axle.
5. Rotate the wheel by hand at 30 rpm (1/2 revolution per second).
6. Measure the voltage at the pins indicated in Table A. Voltage tolerance is >0.2 volts alternating current (VAC).

Table A: Sensor Check Pins

Sensor	47-Pin Harness Connector
Left Front	45 and 46
Right Front	33 and 34
Left Rear	36 and 37
Right Rear	42 and 43

4.8.4 Sensor Resistance

The sensor circuit resistance must be between 900 and 2000 ohms. Measure the resistance at the sensor connector, or at the pins on the ECU connector, as follows:

1. Turn the ignition OFF.
2. To measure the resistance at the pins on the ECU connector, disconnect the ECU connector from the ECU. Measure the output at the ECU pins indicated in Table A. Refer to Figure 4.1 for pin identification.
3. To measure the resistance at the sensor connector, disconnect the sensor from the sensor extension cable. Measure across each set of sensor extension cable pairs. Check all four wheel end sensors.



ECU pin locations are identical to harness connector pins when viewed from the back of the harness connector.

- If measurement is not between 900 and 2000 ohms: Replace the sensor.

4.8.5 Sensor Circuit Short Verification

Each of the wheel sensors should be a closed circuit. Verify this in the below order. Use an ohmmeter to verify if there are any shorts or continuity to ground at the:

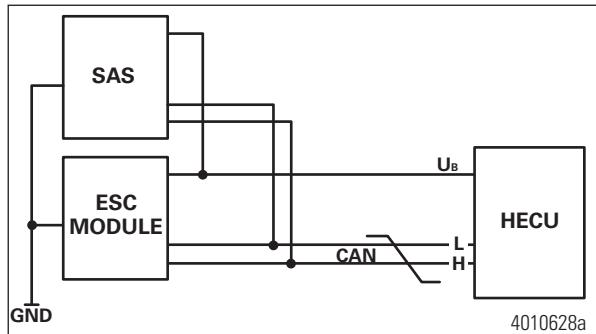
- ECU harness connector/wire harness
- Wheel speed sensor

4.9 ESC Testing

4.9.1 ESC CAN Network Testing

The ECU, SAS and ESC module are all connected on propriety CAN network with internal terminating resistors on each one of these components. A failure to one of the components will cause others to fault out. Fig. 4.3.

Fig. 4.3



4.9.1.1 ESC Module Testing

Electrical Checks

For the following checks, all of the ECU connectors must be plugged in as well as the SAS. The ECU provides voltage, ground and CAN communication to ESC module.

- Take measurements at the ESC module harness connector. Fig. 4.4.
- Measure voltage supply Key ON.
- Measure CAN High voltage Key ON.
- Measure CAN Low voltage Key ON.
- Measure terminating resistance across CAN High and Low with Key OFF.
- Frame-mounted ECU only: Measure ground resistance Key OFF to chassis ground.

With ECU and ESC Module disconnected: Verify continuity end to end on each line.

- Verify no shorts to ground or battery on all lines.
- Verify no continuity between pins.

Troubleshooting and Testing

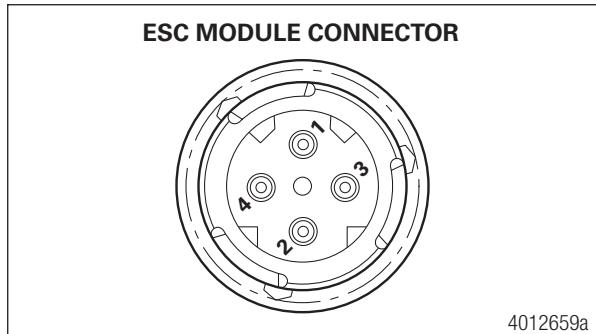
Measurements should read as follows:

Pins	Circuit	Measurement
1	Voltage Supply to Chassis Ground	8.0-16.0V
2	(Frame-mounted only) ESC Ground to Chassis Ground	Less than 1 ohm resistance
3 and 4	Terminating Resistance between ESC CAN-High to ESC CAN-Low	Approximately 90 ohms
1	With ECU disconnected, check power supply for battery voltage or ground.	No continuity
2	With ECU disconnected, check ground for battery voltage or ground.	No continuity
3 and 4	With ECU disconnected, check CAN lines for battery voltage or ground.	No continuity
3	CAN High Voltage to Chassis Ground	2.5-5.0V
4	CAN Low Voltage to Chassis Ground	0.1-2.4V



Do not load test across power and ground at the ESC Module.

Fig. 4.4



4.9.1.2 ESC Information Available in WABCO TOOLBOX™ Software 12.7 or Higher

ESC Information can be accessed through WABCO TOOLBOX™ Software 12.7 or higher under Components, ESC.

Troubleshooting and Testing

To access the ESC Information:

- If you are using TOOLBOX™ Software version 12.7 or higher, click on the “Components” button. A drop-box will appear. Select “ESC” then select “ESC Info”. Fig. 4.5 and Fig. 4.6.

Fig. 4.5

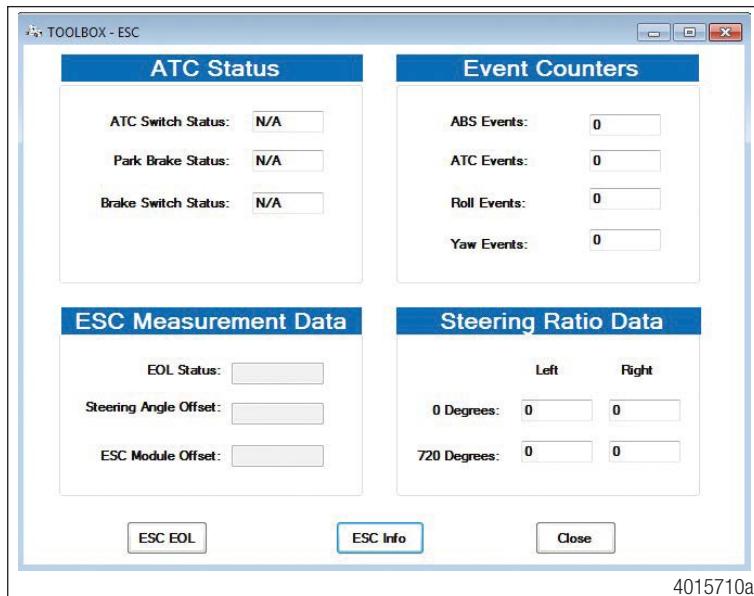
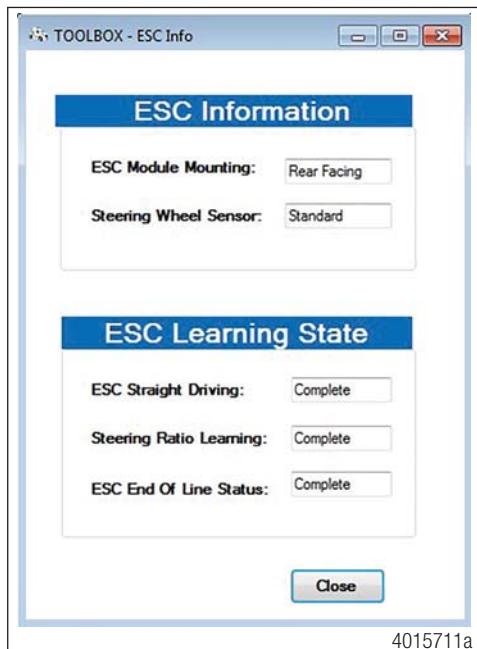


Fig. 4.6



4.10 Steering Angle Sensor (SAS) Testing

Electrical Checks

The following tests are for WABCO SAS Only.

- Disconnect SAS and check terminating resistance across Pin 1 and Pin 2 of the SAS. Fig. 4.7 and Fig. 4.8.

For the following checks, all the ECU and ESC module connectors must be plugged in as the ECU provides all voltage, ground and CAN communications. Fig. 4.10.

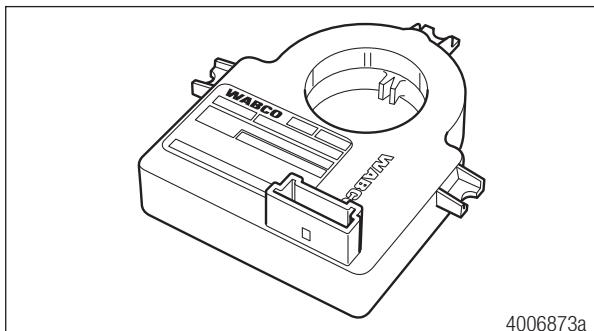
- Take measurements at the SAS harness connector side. Fig. 4.9.
 - Check Key On CAN Low voltage on Pin 1.
 - Check Key On CAN High voltage on Pin 4.
 - Check Key On Voltage Supply on Pin 5.
 - Check Key Off resistance across CAN low Pin 1 and CAN High Pin 4.

Location	Measurement
Wabco SAS terminating resistor on sensor	Approximately 180 ohms
CAN High Voltage	2.5-5.0V
CAN Low Voltage	0.1-2.4V
Voltage Supply to Ground	8.0-16.0V
ESC CAN-High to ESC CAN-Low	Approximately 90 ohm
SAS harness jumper (Pin 2 to Pin 4 or Pin 2 to Pin 3)	Continuity
ESC CAN-High or CAN-Low to Power or Ground (with ECU, ESC Module and SAS unplugged)	No continuity



For correct sensor operation, there must be a jumper wire on the harness side across either Pin 2 to Pin 3 or Pin 4 so terminating resistor is connected as shown in Fig. 4.8.

Fig. 4.7



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Troubleshooting and Testing

Fig. 4.8

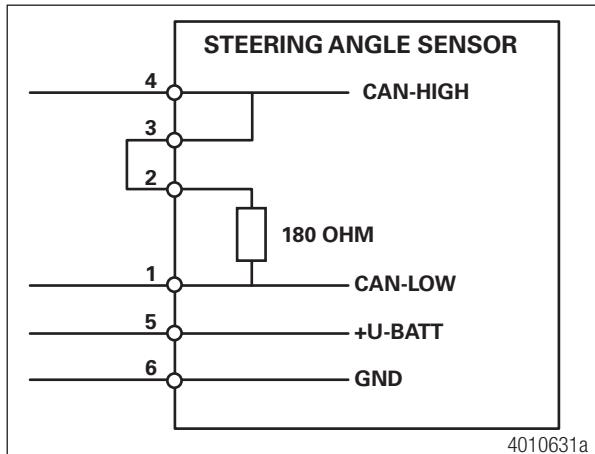
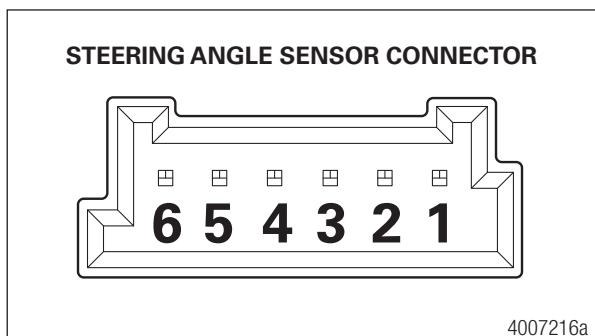


Fig. 4.9

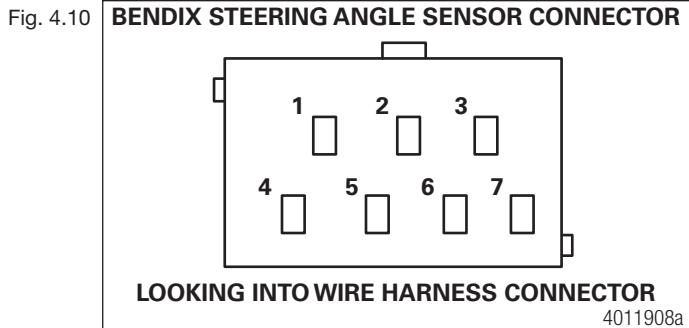


Pin	Circuit
1	CAN-LOW
2	Terminating Resistor
3	CAN-High
4	CAN-High
5	Power
6	Ground



Do not load test across power and ground at the SAS.

Troubleshooting and Testing



Pin	Circuit
1	Ground
2	Power
3	CAN-High
4	CAN-Low

4.11 ECU Circuit Testing

Electrical Checks

- Verify vehicle batteries, charging system and fuses are in good working condition.
- Load test battery and ignition circuits to ground at the ECU harness using a 2-4 amp sealed lamp and verify lamp does not flicker and it is on steady.
- Take measurements at the ECU harness pins.

Measurements should read as follows:

Location	Measurement
Supply Voltage, Battery to chassis Ground	9.0-16.0V for 12V system 18.0-32.0V for 24V system
Supply Voltage, Ignition to chassis Ground	9.0-16.0V for 12V system 18.0-32.0V for 24V system
ECU ground to chassis ground	Less than 1 ohm resistance
Main ground to chassis ground	Less than 1 ohm resistance

4.12 J1939 Serial Communications Testing

Electrical Checks

- If the ABS ECU is the only ECU on the J1939 datalink which cannot communicate, then take measurements at the ABS ECU connector. If other ECUs are not communicating, then troubleshoot the vehicle datalink backbone and contact the vehicle OEM for technical assistance if required.
- Check for devices that could be overloading the J1939 datalink slowing down communications.
- Verify J1939 High and Low have correct voltage readings, Key ON, while datalink communications are active.
- For resistance measurements, the vehicle battery must be disconnected and the ignition must be OFF.

Measurements should read as follows:

Location	Measurement
Across J1939 High and Low	Approximately 60 ohms
J1939 Low voltage	0.1V-2.4V
J1939 High voltage	2.5V-5.0V
J1939 High or J1939 Low to Ground or Power Supply	No continuity

5 Component Replacement

5.1 Component Removal and Installation

5.1.1 Sensors

5.1.1.1 Sensor Lubricant Specification

WABCO specifications call for a sensor lubricant with the following characteristics.

Lubricant must be mineral oil-based and contain molydisulfide. It 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).

WABCO provides sensor lubricant in a packet with each sensor service part. Lubricants approved for use on WABCO sensors and spring clips are as follows.

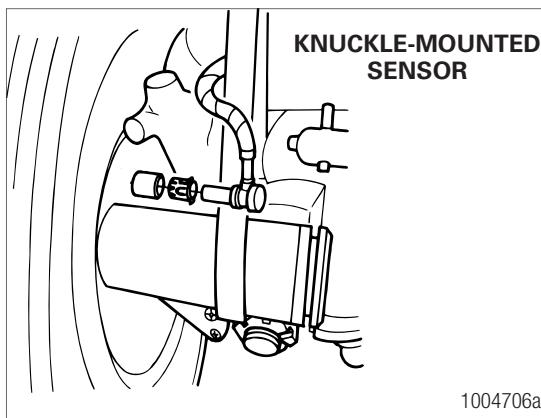
- Mobilith SHC-220 (Mobil)
- TEC 662 (Roy Dean Products)
- Staburags NBU 30 PTM (Kluber Lubrication)
- Valvoline EP 633

5.1.2 Wheel Speed Sensor Replacement — Front Axle

Removal

1. Park the vehicle on a level surface. Apply the parking brakes. Block the rear tires to prevent the vehicle from moving. If necessary, raise the front tires off the ground. Place safety stands under the axle.
2. Disconnect the fasteners that hold the sensor cable to other components.
3. Disconnect the sensor cable from the chassis harness.
4. Remove the sensor from the sensor holder. Twist and pull the sensor to remove it from the sensor bracket. Do not pull on the cable. Fig. 5.1.

Fig. 5.1



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Component Replacement

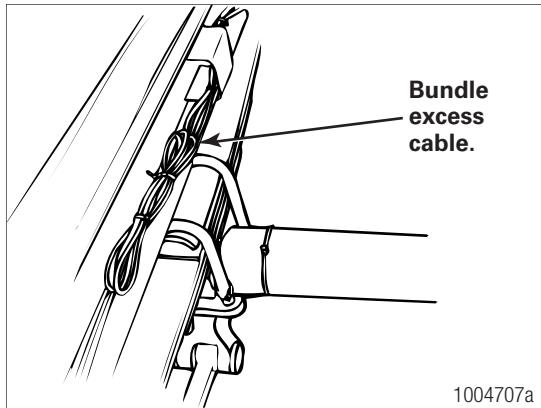


When the wheel speed sensor is replaced, the sensor spring clip must also be replaced.

Installation

1. Connect the sensor cable to the chassis harness.
2. Install the fasteners used to hold the sensor cable in place.
3. Apply a WABCO-recommended lubricant to the sensor spring clip and sensor.
4. Install the sensor spring clip. Verify that the spring clip tabs are on the inboard side of the vehicle.
5. With the tabs on the inboard side, 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. Fasten the sensor cable with the first fastening point four-inches (100 mm) away from the sensor and then every 12-inches (304.8 mm) afterwards. Correctly bundle and store any excess cable in the sub-frame at a minimum of a 0.6-inch (15 mm) radius. Fig. 5.2.

Fig. 5.2



8. Remove the blocks and safety stands.
9. Perform a voltage output check to ensure correct installation. See the "Sensor Output Voltage Check" section of this manual.

5.1.3 Wheel Speed Sensor Replacement – Rear Axle

Removal

1. Park the vehicle on a level surface. Apply the parking brakes. Block the front tires to prevent the vehicle from moving.
2. Raise the rear tires off the ground. Place safety stands under the axle.
3. If the rear tire must be removed to gain access to the sensor, release the parking brake to release the brake shoe. Remove the wheel and tire assembly from the axle.
4. Remove the sensor from the mounting block. Use a twisting motion if necessary. Do not pull on the cable. Fig. 5.1.
5. Disconnect the sensor cable from the chassis harness.
6. Remove the sensor cable from any cable clamps or clips.
7. Remove the sensor spring clip from the sensor bracket.

Component Replacement

Installation

1. Connect the new sensor cable to the chassis harness.
2. Press the sensor spring clip into the sensor bracket, located on the rear axle, until it stops. Verify that the tabs are on the inboard side.
3. Apply a WABCO-recommended lubricant to the sensor.
4. Push the sensor completely into the spring clip until it contacts the tooth wheel.
5. Reattach the sensor cable to the cable clamps or clips.
6. Fasten the sensor cable every 12-inches (304.8 mm). Correctly bundle and store excess cable in the sub-frame. Fig. 5.2.
7. Reinstall the tire and remove the safety stands. Lower the vehicle and remove the blocks from the front tires.
8. Perform a voltage output check to ensure correct installation. See the "Sensor Output Voltage Check" section of this manual.

5.1.4 SmartTrac™ Hydraulic ABS Unit

Removal

CAUTION

The modulator assembly contains hydraulic brake fluid, a caustic substance. Remove the module carefully so that fluid does not leak and cause skin irritation or damage to components.



If there is interference, the entire bracket and valve assembly can be removed.



The SmartTrac™ hydraulic ABS assembly is manufactured and sold as one part. Replacement of the individual components is not available.

1. Apply the parking brakes. Block the front and rear tires to prevent vehicle movement.
2. Place a container under the modulator assembly to catch leaking brake fluid and discard the fluid correctly.
3. Unlock and disconnect the 47-pin electrical harness connector from the ECU.
4. Label the six brake lines for easier re-installation then disconnect them from the modulator assembly.
5. Remove the bracket-to-frame fasteners and remove the entire SmartTrac™ assembly from the vehicle.
6. Remove the three mounting bolts that attach the modulator assembly to the bracket.



Save the splash shield, mounting and mounting assist bracket and fasteners for re-assembly to the replacement module. The replacement module will only be supplied with the fittings which will be pre-torqued prior to arrival.

Component Replacement



Whenever any hydraulic system fitting is loosened or disconnected, the entire system must be bled to remove any air that may have entered. Refer to "Brake Bleeding Procedures" in this section.

7. Remove the SmartTrac™ hydraulic ABS unit.

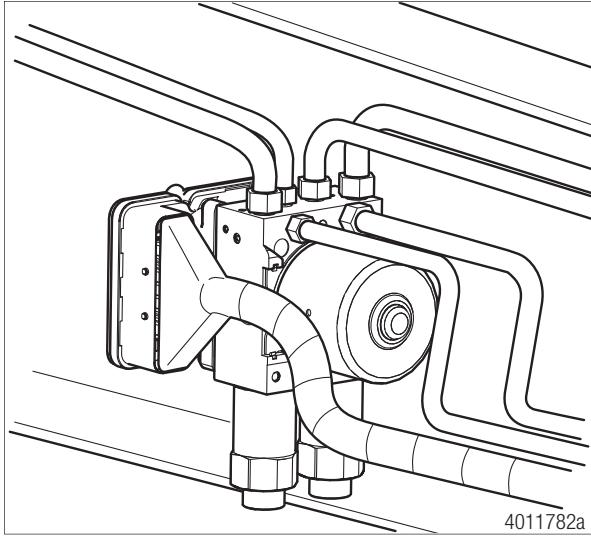
Installation



WABCO recommends that the motor axis makes an angle between +0 degrees and +10 degrees with the horizontal plane, with the motor end pointing up and between -20 degrees and +20 degrees of rotation of the motor axis. Figure 3.3. Contact the OEM or WABCO for additional information regarding modulator assembly orientation.

1. Secure the replacement SmartTrac™ hydraulic module to the original bracket using the three mounting bolts and tighten to $70.8 +12/0$ in-lb ($8 +2/-0$ Nm). Install the splash shield and mounting assist bracket using the two splash shield bolts and tighten to $19 +2.2$ ft-lb (25 +3 Nm). Ensure the assist bracket is sandwiched between the ABS module mounting bracket and the splash shield is positioned as it was originally installed. Fig. 5.3.

Fig. 5.3



2. Position the replacement SmartTrac™ assembly in place on the vehicle as shown in Figure 5.3. Install and tighten the bracket-to-frame fasteners to the OEM specification.
3. Connect and tighten the brake line connections to $11 +2.2$ ft-lb (15 +3 Nm). Ensure that the thread savers are not tightened beyond $15 +2.2$ ft-lb (20 +3 Nm).
4. Connect and lock the electrical harness to the ECU.
5. Bleed the brake system, per the following instructions.

5.1.5

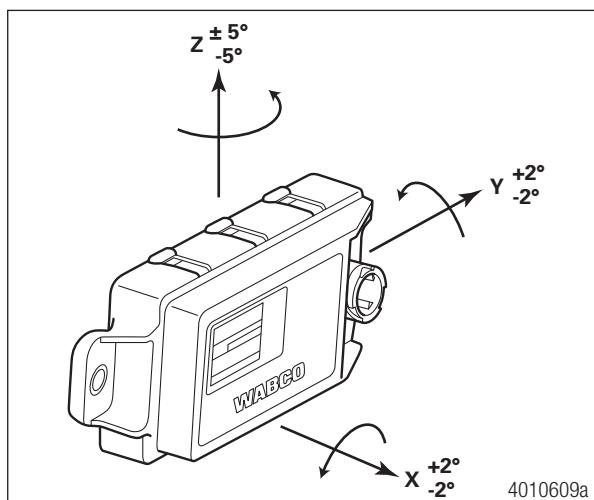
ESC Module Mounting

The ESC module contains sensors which measure both lateral acceleration and yaw rate. Thus, it is critical that the module is securely mounted, leveled and in correct location to the vehicle and that the module is mounted as expected by the ECU and as per vehicle OEM specifications.

Component Replacement

The module should be installed in a manner where the label is right side up. The module must be mounted perpendicular to the vehicle frame rails on a cross member or cross member bracket. The module connector could be facing the front or rear of the vehicle depending on the OEM's specified mounting. It is critical that the unit be mounted in the exact location and manner as originally installed by the vehicle manufacturer. Fig. 5.4.

Fig. 5.4



5.2 Brake Bleeding Procedures

5.2.1 General

The following brake bleeding methods explain how to bleed the hydraulic ABS modulator assembly. The brake bleeding methods include both pressure bleeding and manual bleeding instructions. The manual bleeding procedure may require a second person in the vehicle to help apply the brake pedal.

In some cases, for example, if you are replacing only the modulator assembly, it may not be necessary to bleed the master cylinder. If you have any questions, please contact the WABCO Customer Care Center at 855-228-3203.



The modulator assembly must be handled with appropriate care and should not be exposed to excessive impact or compressed air at the hydraulic ports prior to assembly. Use DOT 3 or DOT 4 brake fluid. Refer to the vehicle specifications in the vehicle manual to determine which fluid to use.



WARNING

Failure to bleed the system whenever any hydraulic system fitting is loosened or disconnected will allow air to enter and remain in the system. Air in the system can cause increased stopping distance and can result in serious personal injury or property damage.



WARNING

Correctly discard or recycle hydraulic brake fluid that is removed from the brake system. The removed brake fluid can be contaminated and can cause brake system damage, loss of braking and serious personal injury or property damage and is not to be reused in a brake system.

⚠️ WARNING

Use only the type of hydraulic brake fluid specified by the equipment manufacturer. Do not use or mix different types of hydraulic brake fluid in the same system. Using the wrong hydraulic brake fluid will damage the rubber parts of the brake system and can cause damage, loss of braking and serious personal injury or property damage.

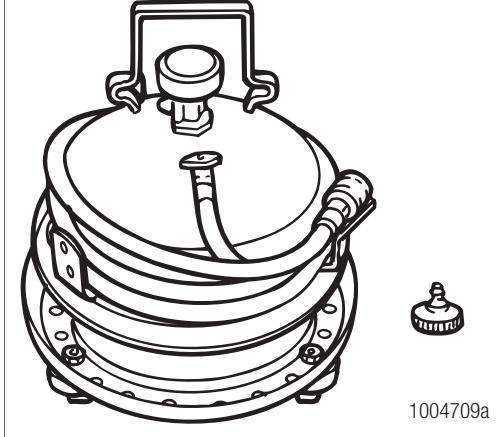
⚠️ CAUTION

Hydraulic brake fluid is a caustic substance. Skin contact with hydraulic brake fluid can cause irritation. Do not let hydraulic brake fluid touch any painted surfaces, as it will remove the paint. Hydraulic brake fluid may also damage certain non-metal surfaces. Do not let brake fluid get on brake pads, rotors, shoes, or drum.

5.2.2 Pressure Fill and Bleed Procedure

Pressure fill and bleed is the preferred method for bleeding the service brake system. It requires the use of a special pressure bleeder kit, consisting of a tank, pressure pump and valve, gauge, tubing and adapter. These kits are available from a number of manufacturers and include instructions for use. Fig. 5.5.

Fig. 5.5



5.2.3 Service Replacement Bleed Procedure

If a service replacement ABS module was purchased these units have been pre-filled from the factory and can be bled using either the pressure or manual bleed procedure.

⚠️ WARNING

Do not let the brake fluid in the master cylinder get below the minimum level during the bleeding operation. Keep the master cylinder reservoir filled with new DOT-approved brake fluid, as specified by the original equipment manufacturer. Failure to keep the fluid in the brake reservoir above the minimum level could result in more air entering the system, making it difficult to effectively bleed the system resulting in increased stopping distance.

Component Replacement

CAUTION

Incorrect bleeding may result in system malfunction due to the presence of air in the closed hydraulic system.

Below are the steps for the pressure fill, bleed process and using the WABCO TOOLBOX™ Software version 12.7 to bleed the hydraulic brake system and SmartTrac™ ABS Module.



The WABCO TOOLBOX™ Software version 12.7 and beyond will support the following bleed procedure.

1. Apply the parking brake and block the tires.
2. Fill the pressure bleeder with new DOT 3 or DOT 4 hydraulic brake fluid. Refer to the vehicle specifications to determine which fluid to use.
3. Follow the vehicle manufacturer's instructions to connect the pressure bleeder to the brake master cylinder reservoir.
4. Set the filling pressure to 20 to 30 psi (1.5 to 2.0 bar). Do not exceed 30 psi pressure or damage to the master cylinder reservoir may occur.
5. Turn on the bleed equipment until the fluid level in the reservoir reaches the max fill line.
6. Release pressure for three to five seconds. Apply pressure for five to 10 seconds.
7. Repeat Step 5 and Step 6 approximately 10 times. If necessary, add fluid to the reservoir, making sure that the fluid does not fall below the minimum level. After releasing the pressure, air bubbles may rise up into the reservoir.



Repeatedly verify that the fluid in the reservoir does NOT fall below the minimum level. Add brake fluid when necessary.

8. Start the bleeding procedure of all four wheel ends of the brake system by starting with the bleeder fitting farthest from the SmartTrac™ module (typically the right rear).
 - Ensure the reservoir is filled with brake fluid to the MAX level and set the filling pressure to 20 to 30 psi (1.5 to 2.0 bar).
 - Place a wrench on the brake actuator bleeder fitting and then attach a length of clear plastic tubing to the bleeder fitting. Verify that the tube fits snugly.

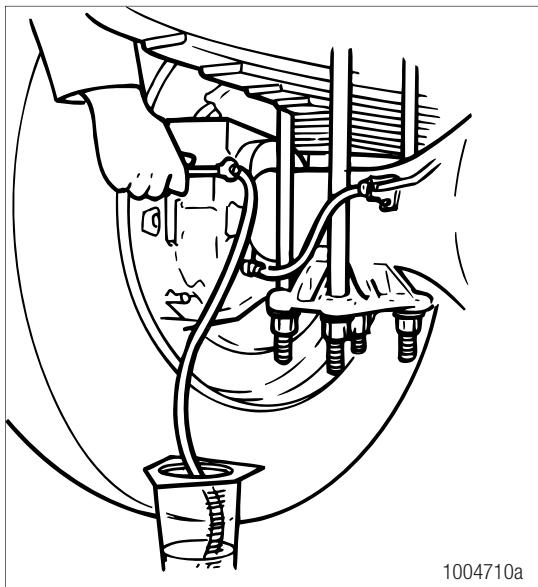


The tools, tubing and container used for bleeding should be brake fluid safe and must be able to withstand the effects of brake fluid.

Component Replacement

9. Submerge the loose end of the tubing in a container of clean hydraulic brake fluid. Loosen the bleeder fitting until fluid begins to flow (about 3/4 turn). Allow the hydraulic brake fluid flow out of the fitting until it is free of air bubbles. Ensure that all four wheel ends are free of air bubbles and the bleeder fittings are closed. Fig. 5.6.

Fig. 5.6



10. Open the TOOLBOX™ Software using the icon (Fig. 5.7), then open the SmartTrac™ screen by selecting the Tractor icon (Fig. 5.8).

Fig. 5.7



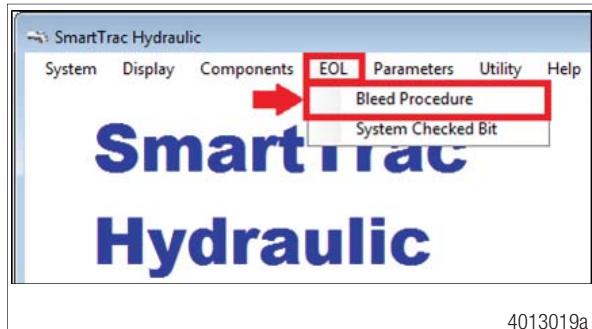
Fig. 5.8



Component Replacement

11. After opening the SmartTrac™ screen, select the EOL menu and then select Bleed Procedure. Refer to the "System Diagnostics" section of this manual for additional information. Fig. 5.9.

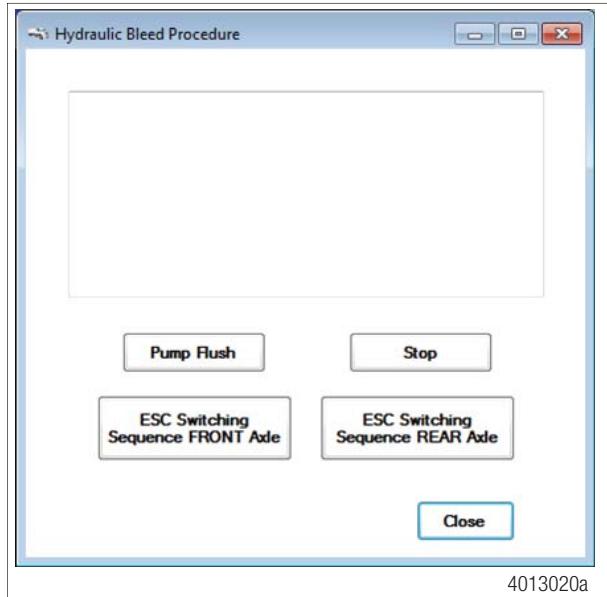
Fig. 5.9



The bleed procedures Pump Flush, ESC Switching Sequence FRONT Axle and ESC Switching REAR Axle will actuate the SmartTrac™ valves to ensure all air trapped inside and behind the valves is removed.

12. Follow the on screen bleed procedure instructions as they are displayed to ensure correct bleeding sequence. The sequence is: Pump Flush, ESC Switching Sequence REAR Axle then ESC Switching Sequence FRONT Axle. Fig. 5.10.

Fig. 5.10



13. Repeat Steps 8 and 9 to bleed all four wheel ends again to ensure any air released from the ABS module has been pushed out of the system. Bleed in sequence of the longest to shortest distance from the SmartTrac™ ABS unit.
14. Check the brake pedal travel and feel. If firm resistance is not felt (pedal is spongy), repeat the bleeding procedure.
15. Turn off the bleed equipment and remove pressure. Uninstall the bleed device and refill the fluid level in the reservoir if required. Replace the reservoir cap and correctly dispose of used brake fluid.
16. Remove the tire blocks.

5.2.4 Manual Bleed Procedure

Below are the steps for the manual fill and bleed procedure using the WABCO TOOLBOX™ Software version 12.7 to bleed the hydraulic brake system and SmartTrac™ ABS module.

WARNING

Do not let the brake fluid in the master cylinder get below the minimum level during the bleeding operation. Keep the master cylinder reservoir filled with new DOT-approved brake fluid, as specified by the original equipment manufacturer. Failure to keep the fluid in the brake reservoir above the minimum level could result in more air entering the system, making it difficult to effectively bleed the system resulting in increased stopping distance.

CAUTION

Incorrect bleeding may result in system malfunction due to the presence of air in the closed hydraulic system.



The manual bleed procedure may require a second person to help apply the brake pedal.



The WABCO TOOLBOX™ Software version 12.7 and beyond will support the following bleed procedure.

1. Apply the parking brake and block the tires.
2. Fill the reservoir with new DOT 3 or DOT 4 hydraulic brake fluid. Refer to the vehicle specifications to determine which fluid to use.
3. Press the brake pedal five times using the stroke between 1/3 travel and maximum travel.
4. Release the pedal for five to 10 seconds. Air bubbles may rise into the reservoir while depressing and releasing the pedal.
5. Repeat Step 3 and Step 4 another three times or until sufficient pedal resistance is felt. Monitor the fluid in the brake reservoir during this step to make sure the fluid level stays above the minimum. Add brake fluid as necessary.



Repeatedly verify that the fluid in the reservoir does NOT fall below the minimum level. Add brake fluid when necessary.

6. Bleed the brake system starting with the fitting farthest from the SmartTrac™ module (typically the right rear).
Place a wrench on the brake actuator bleeder fitting and then attach a length of clear plastic tubing to the bleeder fitting. Verify that the tube fits snugly.

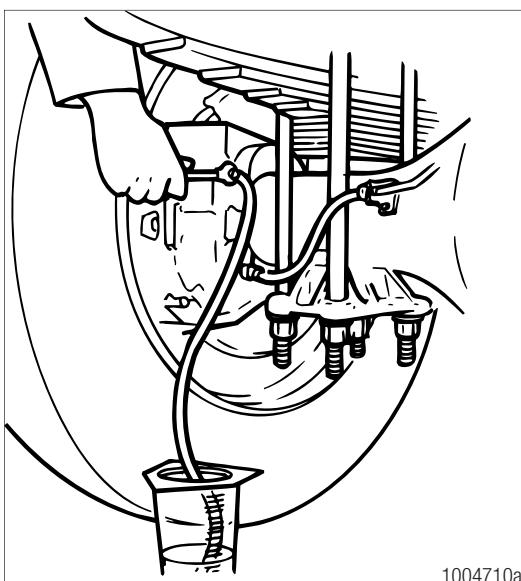


The tools, tubing and container used for bleeding should be brake fluid safe and must be able to withstand the effects of brake fluid.

Component Replacement

7. Submerge the tubing in a container of clean brake fluid. With the brake pedal pressed to maximum travel, loosen the bleeder fitting until fluid begins to flow (about 3/4 turn). When the brake pedal has reached the maximum stroke, tighten the bleed screw and allow the brake pedal to return to the top pedal position. Repeat this process until the hydraulic brake fluid flowing out of the fitting is free of air bubbles.
8. Repeat Step 7 for the remaining three wheel ends. Ensure all four wheel end bleed fittings are closed.
Fig. 5.11.

Fig. 5.11



9. Open the TOOLBOX™ Software using the icon (Fig. 5.12), then open the SmartTrac™ screen by selecting the Tractor icon (Fig. 5.13).

Fig. 5.12



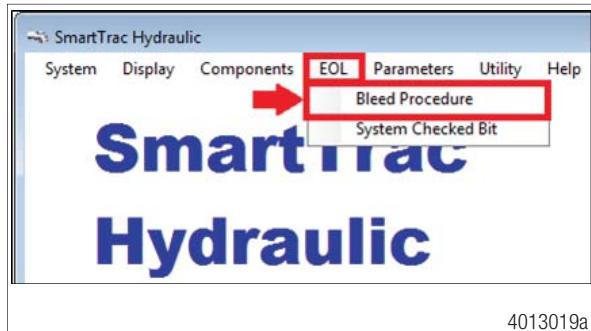
Fig. 5.13



Component Replacement

10. After opening the SmartTrac™ screen, select the EOL menu and then select Bleed Procedure. Refer to the "System Diagnostics" section of this manual for additional information. Fig. 5.14.

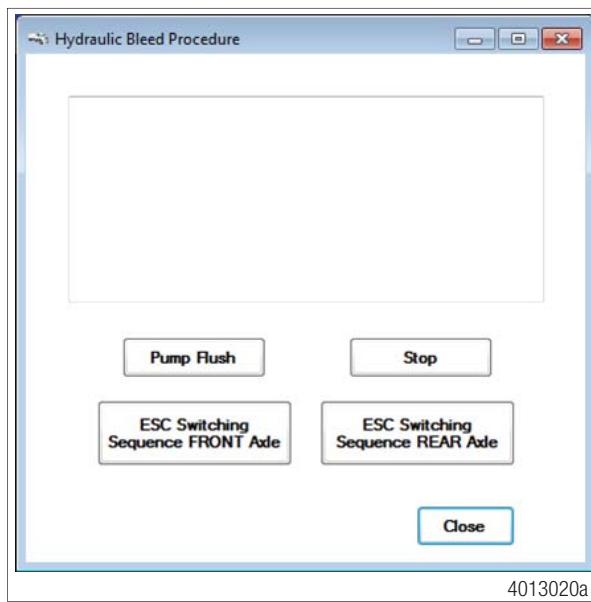
Fig. 5.14



The bleed procedures Pump Flush, ESC Switching Sequence FRONT Axle and ESC Switching REAR Axle will actuate the SmartTrac™ valves to ensure all air trapped inside and behind the valves is removed.

11. Follow the on screen bleed procedure instructions as they are displayed to ensure correct bleeding sequence. The sequence is: Pump Flush, ESC Switching Sequence REAR Axle then ESC Switching Sequence FRONT Axle. Fig. 5.15.

Fig. 5.15



12. Once the ABS and ESC valves are bled using TOOLBOX™ Software, repeat Steps 6 through 8 in this procedure to ensure all air is removed.
13. Check the brake pedal travel and feel. If firm resistance is not felt (pedal is spongy), repeat the bleeding procedure.
14. Replace the reservoir cap and correctly dispose of used brake fluid.
15. Remove the tire blocks.

5.2.5 Steering Angle Sensor (SAS) – WABCO Only

Removal

⚠ WARNING

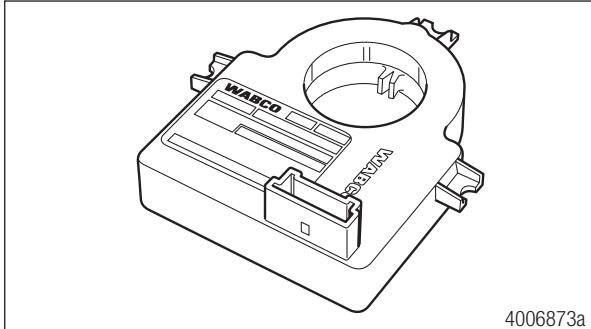
Park the vehicle on a level surface. Block the wheels to prevent the vehicle from moving. Support the vehicle with safety stands. Do not work under a vehicle supported only by jacks. Jacks can slip or fall over. Serious personal injury and damage to components can result..

⚠ WARNING

If equipped, disable the supplemental restraint system (air bag) to avoid serious personal injury. Refer to the vehicle manufacturer's service publication for further information. .

1. Center the steering wheel with the front wheels positioned straight ahead.
2. Turn the ignition switch to the OFF position. Apply the parking brake.
3. Place blocks under the front and rear tires to prevent the vehicle from moving.
4. Locate the SAS on the steering column shaft, either near the universal joint on the bottom of the column or under the steering wheel near the top of the column.
5. If the SAS is located at the top of the steering column, remove the vehicle steering wheel using the recommended steering wheel puller.
6. The SAS is attached by three screws to the steering column with the center tab located in the grooved steering column shaft. Fig. 5.16.

Fig. 5.16



7. Disconnect the wiring harness connector from the SAS. (Note the position of the connector either facing up or down.)
8. Remove the attaching screws and slide the SAS off of the steering column shaft.

Installation

⚠ CAUTION

If the SAS is not installed according to the instructions in this manual, it may not operate correctly or be damaged.

1. Apply a small amount of the supplied grease to the tab in the center of the SAS and to the machined groove on the steering shaft.

2. Install the SAS with the connector facing the same direction as the original. Place the SAS over the steering column shaft and slide it into place with the SAS tab placed in the groove that is machined on the steering column shaft.
3. Using the new furnished screws, replace the attaching screws and tighten to a maximum of 22 in-lb (2.5 Nm).
4. Install the SAS wiring harness connector by pushing the connector together until the small tab snaps into place.
5. Install the steering wheel and tighten per the manufacturer's recommendation.
6. Remove the blocks.
7. Test the installation.

Test the Installation

To test the SAS installation, the system must be calibrated.

1. Follow the ESC End of Line Calibration Procedure described in this manual.
2. When the ESC End of Line Calibration Procedure is completed, the ABS and ATC/ESC lamps should come on and go back off when ignition power is turned on. The ATC/ESC lamp may remain on briefly after the ABS lamp goes off.
3. There should not be any active faults displayed in the ECU memory.

5.2.6 Electronic Stability Control (ESC) Module

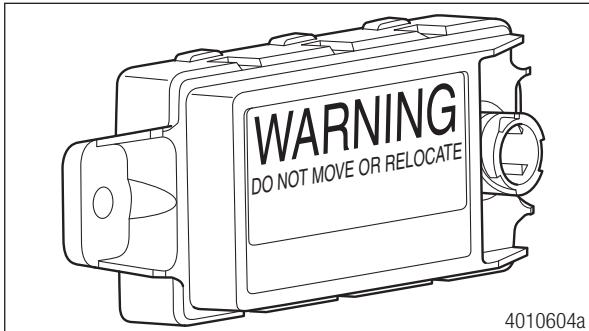
Removal

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 or fall over. Serious personal injury and damage to components can result.

1. Turn the ignition switch to the OFF position. Apply the parking brake.
2. Place blocks under the front and rear tires to prevent the vehicle from moving.
3. If necessary, raise the vehicle off the ground and place safety stands under the vehicle.
4. Disconnect the wiring harness connector from the ESC module. Fig. 5.17 and Fig. 5.18.

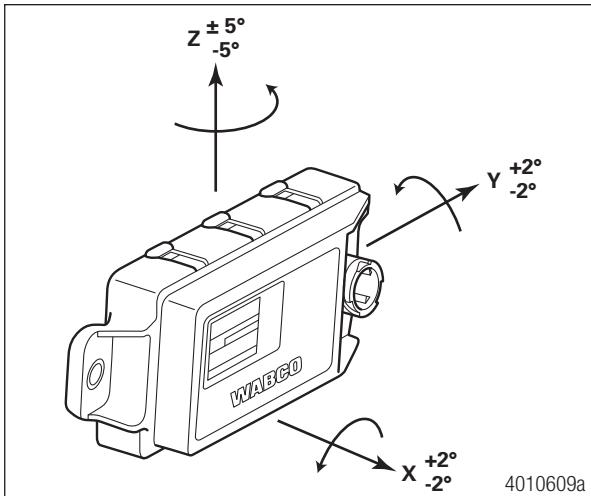
Fig. 5.17



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Component Replacement

Fig. 5.18



5. Remove the two mounting capscrews and nuts. Remove the ESC module.



ESC modules are installed by the vehicle manufacturer close to the vehicle center of gravity. Depending on the vehicle manufacturer, the ESC module might face towards the front of the vehicle or rear. For correct operation and the best performance, verify the ESC module is correctly leveled and securely mounted as per vehicle manufacturer specs. Do not move the module to a different location as this will affect the system performance.

Installation



It is important that the module is aligned correctly and the tab on the ESC mounting surface fits into the appropriate hole.

1. Install the ESC module with the two capscrews and nuts. Tighten the capscrews per the manufacturer's recommendation.
2. Connect the wiring harness connector to the ESC module. Hand tighten only.
3. Remove the stands and blocks.
4. Test the installation.

Test the Installation

To test the ESC module installation, the system must be calibrated.

1. Follow the ESC End of Line Calibration Procedure described in this manual.
2. When the ESC End of Line Calibration Procedure is completed, the ABS and ATC/ESC lamps should come on and go back off when ignition power is turned on. The ATC/ESC lamp may remain on briefly after the ABS lamp goes off.
3. There should not be any active faults displayed in the ECU memory.

5.3 SmartTrac™ ESC End of Line Calibration Procedure

This procedure is performed as part of the final assembly of the vehicle at the manufacturing site. Also, this procedure must be performed in the field by a trained technician if components are replaced such as the Steering Angle Sensor (SAS), the Electronic Stability Control (ESC) module or the ESC Electronic Control Unit (ECU). This calibration should also be performed when a major steering repair or replacement has taken place.

The process consists of two operations. The first one is the SAS Calibration while the vehicle is stationary, followed by the ESC Initialization while driving the vehicle. The status of the ESC End of Line (EOL) procedure can be verified using one of the following allowed faults.

- SAS not calibrated — SPN 1807, FMI 08
- ESC initialization required — SPN 520210 FMI 14

⚠ CAUTION

Additional faults must not be active. Any other faults must be resolved before one of the main menu items is available.



To prevent incorrect activations, SAS Calibration and ESC Initialization must be done separately. It is necessary to perform the SAS calibration prior to the ESC initialization.

For any questions or assistance, please contact the WABCO Customer Care Center at 855-228-3203 or visit wabco-na.com for further details.

SAS Calibration



The SAS Calibration must be done after a front wheel alignment has been performed.

The E8 software version requires TOOLBOX™ Software version 12.7 or higher to communicate with the vehicle. Hydraulic ABS J1939 must be used to complete the end of line procedure.

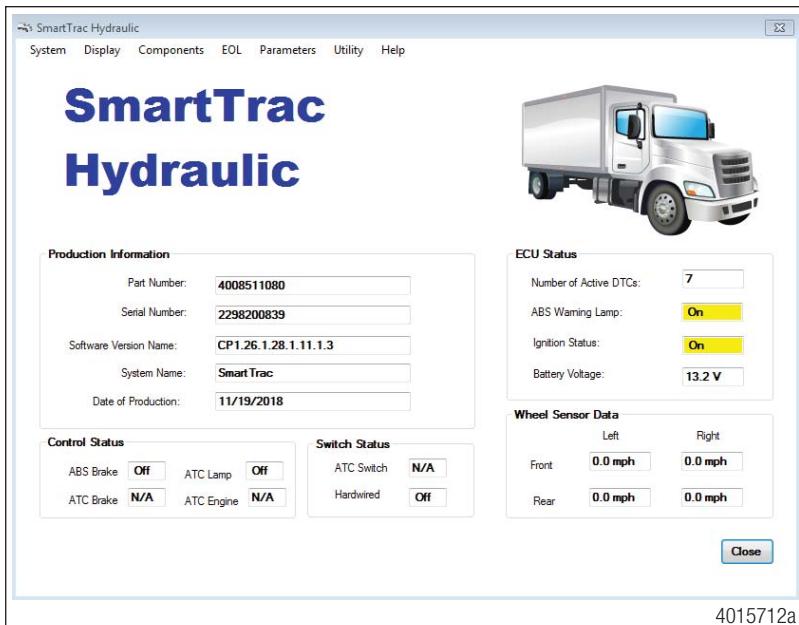
In the Main Menu, select Hydraulic ABS (J1939), the ABS Main Screen will appear. Fig. 5.19 and Fig. 5.20.

Fig. 5.19



Component Replacement

Fig. 5.20

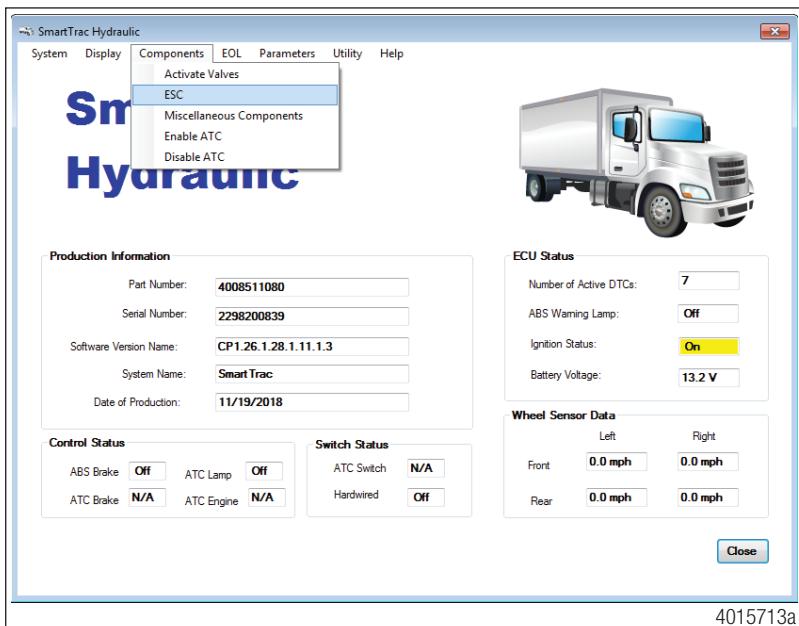


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To access the ESC EOL:

- From the bar menu at the initial screen, click on the “Components” button. A drop-down menu will appear. Select the option “ESC.” Fig. 5.21.

Fig. 5.21

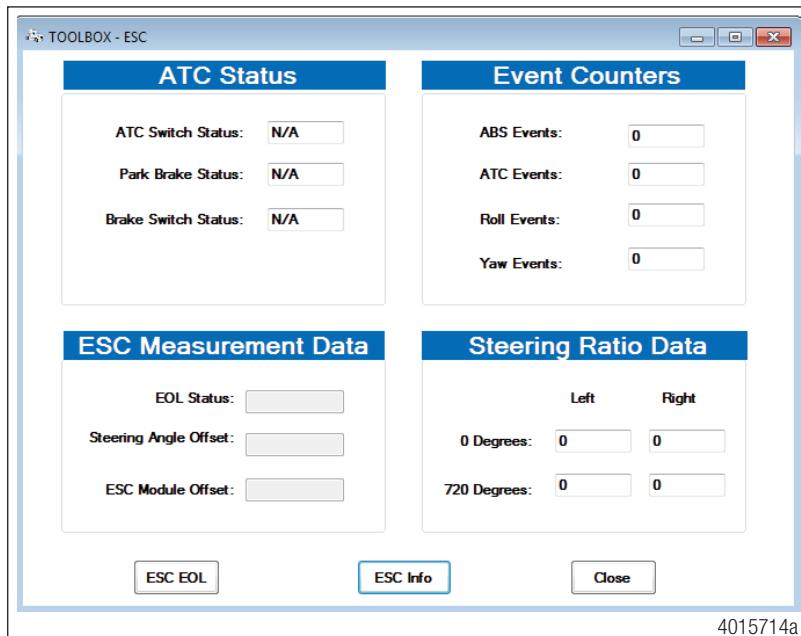


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Component Replacement

On the screen that appears, click the “ESC EOL” button. Fig. 5.22.

Fig. 5.22



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If SAS has NOT been replaced but vehicle has had an alignment performed or other steering components have been replaced, it is necessary to recalibrate SAS regardless of current calibration.

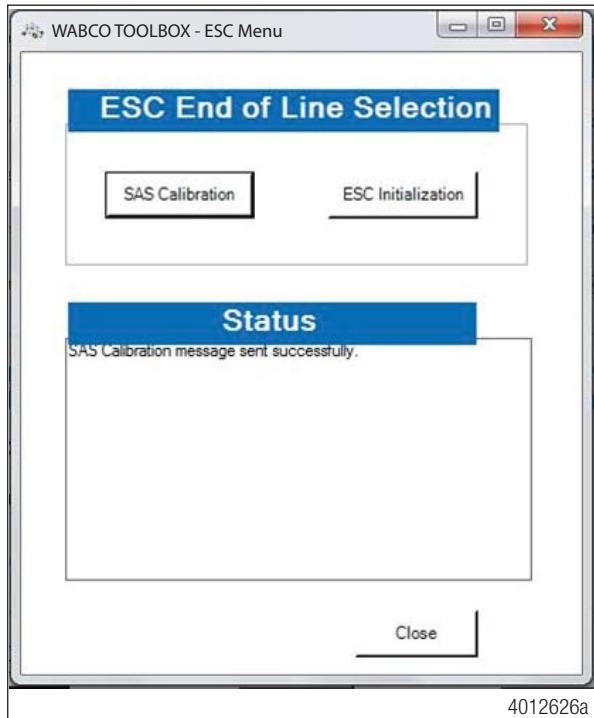


The vehicle needs to be sitting still during SAS calibration.

Component Replacement

To complete the SAS Calibration, position the steer axle tires straight ahead and click “SAS Calibration”. Upon successful calibration, the status box will display “SAS Calibration message sent successfully”. Fig. 5.23.

Fig. 5.23



The SAS calibration is now completed. Click the “Close” button to close the screen.

If SAS calibration fails, recheck the SAS connection and verify SAS mounting. Cycle the ignition and retry SAS calibration again.

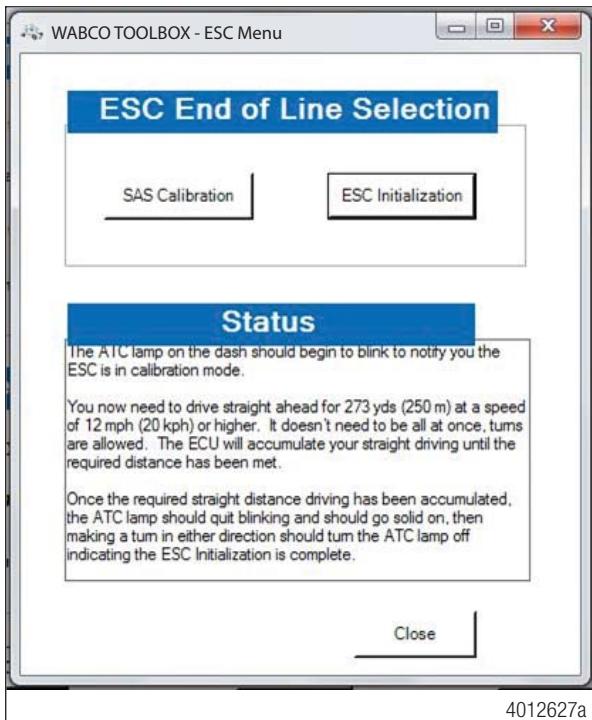
ESC Initialization

Access the ESC EOL menu as in SAS calibration, but instead in the message box that appears, click the “ESC Initialization” button.

Component Replacement

Check the message box that appears. The ATC lamp will start blinking to inform driver ECU is in learning mode. Fig. 5.24.

Fig. 5.24



Carefully follow the instructions that appear in the message box. Once the ESC initialization is started, the messages will automatically change as the requirements are met. DO NOT click the “continue” button again as this may cause the process to fail. The ESC Initialization procedure requires the vehicle to be driven.

The straight driving adjustment can be done in segments as the ECU will accumulate the information until the 273 yards is reached. Cornering and stopping is allowed as long as calibration is done within the same ignition cycle.

When the Straight Driving Adjustment is completed after ECU accumulated 273 yards of straight driving, the ATC lamp will stop blinking and will remain ON.

Once the straight driving portion of the calibration is completed, make a left or right turn to complete the initialization procedure. At this point the ATC lamp will turn off indicating the ESC initialization was successful.

For the ECU to be able to save ratios and ESC EOL data, the ignition MUST be cycled. With the vehicle stopped, close window that appeared and cycle the ignition for around 10 seconds.



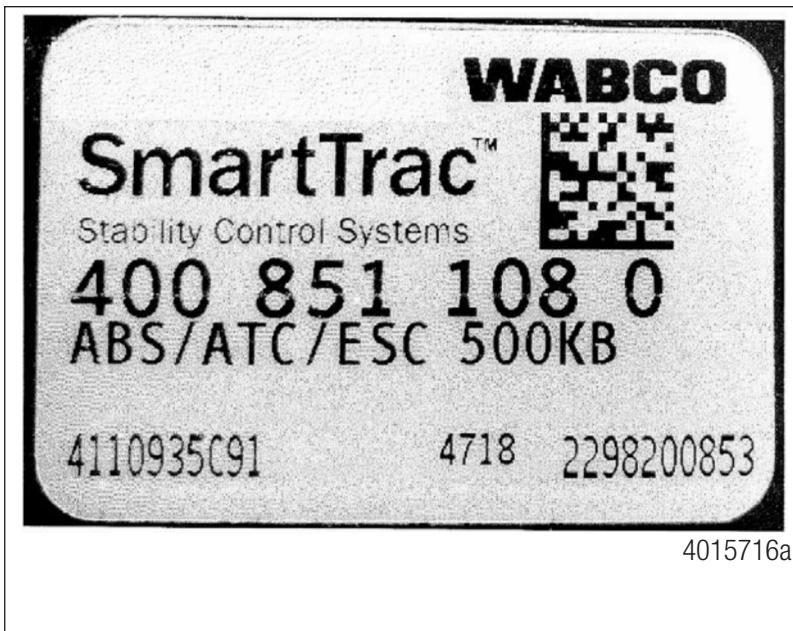
Power down cycle time and sequence will vary amongst vehicle manufacturers. Some vehicles might require the key to be removed from the ignition for ignition power to be completely turned off. Please follow the vehicle manufacturer procedure to make sure ignition is turned off.

When the ignition is turned back ON, check that no active or stored faults are logged in the ECU and that the ABS and ATC/ESC warning lamps are OFF.

To check ESC system status, open the ESC menu and click the “ESC Info” button. Figure 5.25.

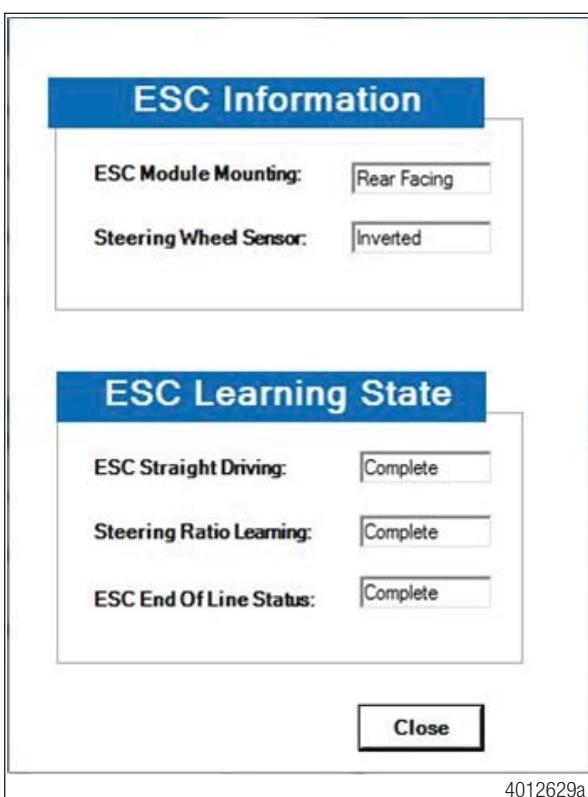
Component Replacement

Fig. 5.25



The ESC Information screen will display the ESC straight driving, Steering Ratio Learning, and ESC End of Line Status as "Complete". Fig. 5.26.

Fig. 5.26



The ESC EOL Initialization procedure is completed. Click the "Close" button to close the screen.



If ESC EOL initialization was not properly completed and/or ratios correctly saved, code SPN 520210 88 FMI 14 will be active. Follow the ESC initialization again and make sure each portion is successfully completed. Make sure ignition power down is completed for the ECU to successfully save data.

6 Appendix I

6.1 SPN/FMI Codes

Refer to the following SPN and FMI codes to diagnose SmartTrac™ hydraulic ABS-related issues.



You must contact the WABCO Customer Care Center at 855-228-3203 for all faults and approved repair instructions.

SPN	Component	FMI	Fault Description	Repair
627	ECU power supply – Battery	3	Supply voltage to ECU too high	<ul style="list-style-type: none"> – Measure battery voltage under load. Check the vehicle battery and associated components (alternator). – Check the battery and ensure it is correct for the ECU, i.e. ensure 12V battery is used with 12V ABS ECU. – Check for corroded or damaged wiring between the ECU and voltage supply as well as ground path.
		4	Supply voltage to ECU too low	
628	ECU Program memory	12	Incorrect ABS system configuration or parameter	<ul style="list-style-type: none"> – Reset the ECU by cycling the ignition or by using the reset option in the TOOLBOX™ Software. – Retry the programming that was being attempted/reload parameters.
		13	Incorrect parameter or checksum failure	
629	ECU/System component	2	ECU internal failure	<ul style="list-style-type: none"> – Reset the ECU by cycling the ignition or by using the reset option in the TOOLBOX™ Software. – If the fault persists, check the ABS ECU powers and grounds. – After checking powers and grounds, if the fault still persists, it may indicate the ECU has failed.
		8		
		9		
		10		
		11		
		12		
		14		
630	Calibration data memory	2	Incorrect ABS system configuration or parameter	<ul style="list-style-type: none"> – Reset the ECU by cycling the ignition or by using the reset option in the TOOLBOX™ Software. – Retry the programming that was being attempted/reload parameters.
		12	Incorrect parameter or checksum failure	
802	ECU power supply – Ignition	3	Supply voltage to ECU is too high, too low, or disturbed/erratic	<ul style="list-style-type: none"> – Measure the ignition voltage under load to ensure that it meets OEM specifications. – Check the battery and ensure it is correct for the ECU, i.e. ensure 12V battery is used with 12V ABS ECU. – Check for corroded or damaged wiring between the ECU and voltage supply as well as ground path.
		4		
		5		
		6		
		11		
		12		
		13		
		14		

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SPN	Component	FMI	Fault Description	Repair
803	ECU/System component	3	ECU internal failure	<ul style="list-style-type: none"> – Reset the ECU by cycling the ignition or by using the reset option in the TOOLBOX™ Software. – If the fault persists, check the ABS ECU powers and grounds. – After checking powers and grounds, if the fault still persists, it may indicate the ECU has failed.
		5		
		6		
806	Active brake valve – rear axle	5	Internal valve failure	<ul style="list-style-type: none"> – Reset the ECU by cycling the ignition or by using the reset option in the TOOLBOX™ Software. – If the fault persists, check the ABS ECU powers and grounds. – After checking powers and grounds, if the fault still persists, it may indicate the unit has failed.
807	Active brake valve – front axle	5	Internal valve failure	<ul style="list-style-type: none"> – Reset the ECU by cycling the ignition or by using the reset option in the TOOLBOX™ Software. – If the fault persists, check the ABS ECU powers and grounds. – After checking powers and grounds, if the fault still persists, it may indicate the unit has failed.
932	Inlet valve – left front	5	Internal valve failure	<ul style="list-style-type: none"> – Reset the ECU by cycling the ignition or by using the reset option in the TOOLBOX™ Software. – If the fault persists, check the ABS ECU powers and grounds. – After checking powers and grounds, if fault still persists, it may indicate the unit has failed.
933	Inlet valve – right front	5	Internal valve failure	
934	Inlet valve – left rear	5	Internal valve failure	<ul style="list-style-type: none"> – Reset the ECU by cycling the ignition or by using the reset option in the TOOLBOX™ Software. – If the fault persists, check the ABS ECU powers and grounds. – After checking powers and grounds, if the fault still persists, it may indicate the unit has failed.
935	Inlet valve – right rear	5	Internal valve failure	
938	Outlet valve – left front	5	Internal valve failure	<ul style="list-style-type: none"> – Reset the ECU by cycling the ignition or by using the reset option in the TOOLBOX™ Software. – If the fault persists, check the ABS ECU powers and grounds. – After checking powers and grounds, if fault still persists, it may indicate the unit has failed.
939	Outlet valve – right front	5	Internal valve failure	
940	Outlet valve – left rear	5	Internal valve failure	<ul style="list-style-type: none"> – Reset the ECU by cycling the ignition or by using the reset option in the TOOLBOX™ Software. – If the fault persists, check the ABS ECU powers and grounds. – After checking powers and grounds, if fault still persists, it may indicate the unit has failed.
941	Outlet valve – right rear	5	Internal valve failure	
1043	Pressure sensor reference voltage	13	Internal sensor failure	<ul style="list-style-type: none"> – Reset the ECU by cycling the ignition or by using the reset option in the TOOLBOX™ Software. – If the fault persists, check the ABS ECU powers and grounds. – After checking powers and grounds, if the fault still persists, it may indicate the unit has failed.

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SPN	Component	FMI	Fault Description	Repair
1044	Pump motor	4	Pump motor voltage supply problem	<ul style="list-style-type: none"> – Reset the ECU by cycling the ignition or by using the reset option in the TOOLBOX™ Software. – If the fault persists, check the ABS ECU powers and grounds. – After checking powers and grounds, if the fault still persists, it may indicate the unit has failed.
		3	Pump motor voltage supply problem	
		6	Pump motor defective, high current consumption	
		7	Pump motor or pump mechanical problem	
1049	Pressure sensor 1	5	Internal sensor failure	<ul style="list-style-type: none"> – Reset the ECU by cycling the ignition or by using the reset option in the TOOLBOX™ Software. – If the fault persists, check the ABS ECU powers and grounds. – After checking powers and grounds, if the fault still persists, it may indicate the unit has failed.
		10		
		2		
		13		
1052	Pressure sensor 2	5	Internal sensor failure	<ul style="list-style-type: none"> – Reset the ECU by cycling the ignition or by using the reset option in the TOOLBOX™ Software. – If the fault persists, check the ABS ECU powers and grounds. – After checking powers and grounds, if the fault still persists, it may indicate the unit has failed.
		8		
		13		
1079	Sensor supply voltage	2	Internal power supply failure	<ul style="list-style-type: none"> – Reset the ECU by cycling the ignition or by using the reset option in the TOOLBOX™ Software. – If the fault persists, check the ABS ECU powers and grounds. – After checking powers and grounds, if fault still persists, it may indicate the unit has failed.
1080	Wheel speed sensor supply voltage	3	Internal power supply failure	<ul style="list-style-type: none"> – Reset the ECU by cycling the ignition or by using the reset option in the TOOLBOX™ Software. – If the fault persists, check the ABS ECU powers and grounds. – After checking powers and grounds, if the fault still persists, it may indicate the unit has failed.
		4		
789	Wheel speed sensor/tone ring front axle left	1	Air gap too large Tone ring damaged or corroded	<ul style="list-style-type: none"> – Check for the correct sensor setting (air gap 0.2 to 1.7 mm). – Check the bearing clearance and tone ring run out. – Eliminate the cause of the increased air gap and correct the sensor setting. – Check the tone ring for damage (missing teeth and corrosion); replace if necessary.
		2	Tire mismatch	<ul style="list-style-type: none"> – Check for tire size mismatch. – Check for correct number of tone ring teeth. – Verify that ECU is programmed correctly for vehicle.
		5	Sensor defective Open connection Sensor impedance out of normal operating range	<ul style="list-style-type: none"> – Check sensor wiring harness and connection for damage/interruptions. – Replace sensor if necessary.
		7	Tone ring damaged or corroded	<ul style="list-style-type: none"> – Check for damaged or missing teeth on the tone ring. – Verify the tone ring is not corroded or contaminated.

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SPN	Component	FMI	Fault Description	Repair
789	Wheel speed sensor/tone ring front axle left	8	Air gap too large Tone ring damaged or corroded	<ul style="list-style-type: none"> – Check for the correct sensor setting (air gap 0.2 to 1.7 mm). – Check the bearing clearance and tone ring run out. Eliminate the cause of the increased air gap and correct the sensor setting. – Check the tone ring for damage (missing teeth and corrosion); replace if necessary. – Check the sensor for correct installation and bushing/clip for damage.
		9	Air gap too large Tone ring damaged or corroded Noise on sensor output signal	<ul style="list-style-type: none"> – Check for the correct sensor setting (air gap 0.2 to 1.7 mm). – Check the bearing clearance and tone ring run out. Eliminate the cause of the increased air gap and correct the sensor setting. – Check the tone ring for damage (missing teeth and corrosion); replace if necessary. – Check the sensor for correct installation and bushing/clip for damage.
		10	Noise on sensor output signal	<ul style="list-style-type: none"> – Check the correct sensor setting (air gap 0.2 to 1.7 mm). – Check the bearing clearance and tone ring run out. Eliminate the cause of the increased air gap and correct the sensor setting. – Check the tone ring for damage (missing teeth and corrosion); replace if necessary. – Check the sensor for correct installation and the bushing/clip for damage.
		11	Sensor signal noisy, brake chatter	<ul style="list-style-type: none"> – Check for the correct sensor setting (air gap 0.2 to 1.7 mm). – Check the bearing clearance and tone ring run out. Eliminate the cause of the increased air gap and correct the sensor setting. – Check the tone ring for damage (missing teeth and corrosion); replace if necessary. – Check the sensor for correct installation and bushing/clip for damage.
		12	Noise on sensor output signal	<ul style="list-style-type: none"> – Check for the correct sensor setting (air gap 0.2 to 1.7 mm). – Check the bearing clearance and tone ring run out. Eliminate the cause of the increased air gap and correct the sensor setting. – Check the tone ring for damage (missing teeth and corrosion); replace if necessary. – Check the sensor for correct installation and bushing/clip for damage.
790	Wheel speed sensor/tone ring front axle right	1	Air gap too large Tone ring damaged or corroded"	<ul style="list-style-type: none"> – Check correct sensor setting (air gap 0.2 to 1.7 mm). – Check the bearing clearance and tone ring run out. Eliminate the cause of the increased air gap and correct the sensor setting. – Check tone ring for damage (missing teeth and corrosion); replace if necessary.
		2	Tire mismatch	<ul style="list-style-type: none"> – Check for tire size mismatch. – Check for the correct number of tone ring teeth. – Verify that ECU is programmed correctly for vehicle.

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SPN	Component	FMI	Fault Description	Repair
790	Wheel speed sensor/tone ring front axle left	5	Sensor defective Open connection Sensor impedance out of normal operating range	<ul style="list-style-type: none"> – Check sensor wiring harness and connection for damage/interruptions. – Replace the sensor if necessary.
		7	Tone ring damaged or corroded	<ul style="list-style-type: none"> – Check for damaged or missing teeth on tone ring. – Verify the tone ring is not corroded or contaminated.
		8	Air gap too large Tone ring damaged or corroded	<ul style="list-style-type: none"> – Check for the correct sensor setting (air gap 0.2 to 1.7 mm). – Check the bearing clearance and tone ring run out. – Eliminate the cause of the increased air gap and correct the sensor setting. – Check the tone ring for damage (missing teeth and corrosion); replace if necessary. – Check the sensor for correct installation and bushing/clip for damage.
		9	Air gap too large Tone ring damaged or corroded Noise on sensor output signal	<ul style="list-style-type: none"> – Check for the correct sensor setting (air gap 0.2 to 1.7 mm). – Check the bearing clearance and tone ring run out. – Eliminate the cause of the increased air gap and correct the sensor setting. – Check the tone ring for damage (missing teeth and corrosion); replace if necessary. – Check the sensor for correct installation and bushing/clip for damage.
		10	Noise on sensor output signal	<ul style="list-style-type: none"> – Check for the correct sensor setting (air gap 0.2 to 1.7 mm). – Check the bearing clearance and tone ring run out. – Eliminate the cause of the increased air gap and correct the sensor setting. – Check the tone ring for damage (missing teeth and corrosion); replace if necessary. – Check the sensor for correct installation and bushing/clip for damage.
		11	Sensor signal noisy, brake chatter	<ul style="list-style-type: none"> – Check for the correct sensor setting (air gap 0.2 to 1.7 mm). – Check the bearing clearance and tone ring run out. – Eliminate the cause of the increased air gap and correct the sensor setting. – Check the tone ring for damage (missing teeth and corrosion); replace if necessary. – Check the sensor for correct installation and bushing/clip for damage.
		12	Noise on sensor output signal	<ul style="list-style-type: none"> – Check the correct sensor setting (air gap 0.2 to 1.7 mm). – Check the bearing clearance and tone ring run out. – Eliminate the cause of the increased air gap and correct the sensor setting. – Check the tone ring for damage (missing teeth and corrosion); replace if necessary. – Check the sensor for correct installation and bushing/clip for damage.

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SPN	Component	FMI	Fault Description	Repair
791	Wheel speed sensor/tone ring rear axle left	1	Air gap too large Tone ring damaged or corroded	<ul style="list-style-type: none"> – Check for the correct sensor setting (air gap 0.2 to 1.7 mm) – Check the bearing clearance and tone ring run out. Eliminate the cause of the increased air gap and correct the sensor setting. – Check the tone ring for damage (missing teeth and corrosion); replace if necessary.
		2	Tire mismatch	<ul style="list-style-type: none"> – Check for tire size mismatch. – Check for correct number of tone ring teeth. – Verify that the ECU is programmed correctly for vehicle.
		5	Sensor defective Open connection Sensor impedance out of normal operating range	<ul style="list-style-type: none"> – Check the sensor wiring harness and connection for damage/interruptions. – Replace sensor if necessary.
		7	Tone ring damaged or corroded	<ul style="list-style-type: none"> – Check for damaged or missing teeth on tone ring. – Verify the tone ring is not corroded or contaminated.
		8	Air gap too large Tone ring damaged or corroded	<ul style="list-style-type: none"> – Check for the correct sensor setting (air gap 0.2 to 1.7 mm). – Check the bearing clearance and tone ring run out. Eliminate the cause of the increased air gap and correct the sensor setting. – Check the tone ring for damage (missing teeth and corrosion); replace if necessary. – Check the sensor for correct installation and bushing/clip for damage.
		9	Air gap too large Tone ring damaged or corroded Noise on sensor output signal	<ul style="list-style-type: none"> – Check for the correct sensor setting (air gap 0.2 to 1.7 mm). – Check bearing clearance and tone ring run out. Eliminate cause for increased air gap and correct sensor setting. – Check the tone ring for damage (missing teeth and corrosion); replace if necessary. – Check the sensor for correct installation and bushing/clip for damage.
		10	Noise on sensor output signal	<ul style="list-style-type: none"> – Check for the correct sensor setting (air gap 0.2 to 1.7 mm). – Check the bearing clearance and tone ring run out. Eliminate the cause of the increased air gap and correct the sensor setting. – Check the tone ring for damage (missing teeth and corrosion); replace if necessary. – Check the sensor for correct installation and bushing/clip for damage.
		11	Sensor signal noisy, brake chatter	<ul style="list-style-type: none"> – Check for the correct sensor setting (air gap 0.2 to 1.7 mm). – Check the bearing clearance and tone ring run out. Eliminate the cause of the increased air gap and correct the sensor setting. – Check the tone ring for damage (missing teeth and corrosion); replace if necessary. – Check the sensor for correct installation and bushing/clip for damage.

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SPN	Component	FMI	Fault Description	Repair
791	Wheel speed sensor/tone ring rear axle left	12	Noise on sensor output signal	<ul style="list-style-type: none"> – Check for the correct sensor setting (air gap 0.2 to 1.7 mm) – Check the bearing clearance and tone ring run out. Eliminate the cause of the increased air gap and correct the sensor setting. – Check the tone ring for damage (missing teeth and corrosion); replace if necessary. – Check the sensor for correct installation and bushing/clip for damage.
792	Wheel speed sensor/tone ring rear axle right	1	Air gap too large Tone ring damaged or corroded	<ul style="list-style-type: none"> – Check for the correct sensor setting (air gap 0.2 to 1.7 mm). – Check the bearing clearance and tone ring run out. Eliminate the cause of the increased air gap and correct the sensor setting. – Check the tone ring for damage (missing teeth and corrosion); replace if necessary.
		2	Tire mismatch	<ul style="list-style-type: none"> – Check for tire size mismatch. – Check for correct number of tone ring teeth. – Verify that ECU is programmed correctly for vehicle.
		5	Sensor defective Open connection Sensor impedance out of normal operating range	<ul style="list-style-type: none"> – Check the sensor wiring harness and connection for damage/interruptions. – Replace the sensor if necessary.
		7	Tone ring damaged or corroded	<ul style="list-style-type: none"> – Check for damaged or missing teeth on tone ring. – Verify the tone ring is not corroded or contaminated.
		8	Air gap too large Tone ring damaged or corroded	<ul style="list-style-type: none"> – Check for the correct sensor setting (air gap 0.2 to 1.7 mm). – Check the bearing clearance and tone ring run out. Eliminate the cause of the increased air gap and correct the sensor setting. – Check the tone ring for damage (missing teeth and corrosion); replace if necessary. – Check the sensor for correct installation and bushing/clip for damage.
		9	Air gap too large Tone ring damaged or corroded Noise on sensor output signal	<ul style="list-style-type: none"> – Check for the correct sensor setting (air gap 0.2 to 1.7 mm). – Check the bearing clearance and tone ring run out. Eliminate the cause of the increased air gap and correct the sensor setting. – Check the tone ring for damage (missing teeth and corrosion); replace if necessary. – Check the sensor for correct installation and bushing/clip for damage.
		10	Noise on sensor output signal	<ul style="list-style-type: none"> – Check for the correct sensor setting (air gap 0.2 to 1.7 mm). – Check the bearing clearance and tone ring run out. Eliminate the cause of the increased air gap and correct the sensor setting. – Check the tone ring for damage (missing teeth and corrosion); replace if necessary. – Check the sensor for correct installation and bushing/clip for damage.

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SPN	Component	FMI	Fault Description	Repair
792	Wheel speed sensor/tone ring rear axle right	11	Sensor signal noisy, brake chatter	<ul style="list-style-type: none"> – Check for the correct sensor setting (air gap 0.2 to 1.7 mm). – Check bearing clearance and tone ring run out. Eliminate cause for increased air gap and correct sensor setting. – Check the tone ring for damage (missing teeth and corrosion); replace if necessary. – Check the sensor for correct installation and bushing/clip for damage.
		12	Noise on sensor output signal	<ul style="list-style-type: none"> – Check for the correct sensor setting (air gap 0.2 to 1.7 mm). – Check the bearing clearance and tone ring run out. Eliminate the cause of the increased air gap and correct the sensor setting. – Check the tone ring for damage (missing teeth and corrosion); replace if necessary. – Check the sensor for correct installation and the bushing/clip for damage.
117	Pressure sensor front circuit	11	Internal sensor failure	<ul style="list-style-type: none"> – Reset the ECU by cycling the ignition or by using the reset option in the TOOLBOX™ Software. – If the fault persists, check the ABS ECU powers and grounds. – After checking powers and grounds, if the fault still persists, it may indicate the unit has failed.
576	ATC off road switch	7	ATC off road switch defective	<ul style="list-style-type: none"> – Check the wiring between the ATC switch and ABS ECU. – If the fault persists, replace the ATC switch.
631	System configuration/installation	2	ESC parameter failure	<ul style="list-style-type: none"> – Reset the ECU by cycling the ignition or by using the reset option in the TOOLBOX™ Software – Retry the programming that was being attempted/reload parameters.
639	J1939 vehicle CAN data interface	1	J1939 data interface disturbed or message timeout	<ul style="list-style-type: none"> – If the ABS ECU is the only vehicle ECU not communicating, verify the J1939 wiring between the ABS ECU and the J1939 backbone. – Resistance should be 60 ohms between J1939 high and low. – Key on, check the voltage to ground at the ECU harness connector J1939 pins, and verify the high side has 2.5 to 5 volts and the low side has 2.49 volts or less. The readings will fluctuate but should be in range and should never be the same. The total of both readings together should be approximately 5 volts.
		3		
		5		
		6		
		7		
		9		
		10		
		11		
		14		
810	J1939 based speed signal input	13	WABCO CAN data interface disturbed or message timeout	<ul style="list-style-type: none"> – Verify that the engine ECU is communicating on J1939. – Verify that ABS ECU is configured correctly for vehicle application.

Appendix I

SPN	Component	FMI	Fault Description	Repair
1807	Steering angle sensor	4	The steering wheel angle signal is not available after ignition on.	<ul style="list-style-type: none"> – Check CAN wiring between ABS ECU and SAS for interruptions and short circuits. – Check for corroded or damaged wiring between SAS and ESC module. – Contact the WABCO Customer Care Center at 855-228-3203 to check the parameter setting of the ECU and SAS compatibility.
		7	The calculated steering ratio of the vehicle is not plausible.	<ul style="list-style-type: none"> – Check for correct mounting of the SAS and ESC module. – If work has been performed on the vehicle which affects the steering system or front end alignment, perform SAS calibration and ESC initialization.
		8	Steering angle sensor calibration failed	<ul style="list-style-type: none"> – Verify the SAS is correctly mounted. – Perform SAS calibration and ESC initialization.
		9	Data communication fault with ESC module	<ul style="list-style-type: none"> – Check the harness between ABS ECU and SAS. – Check the parameter setting of ABS ECU. – Check SAS operation if the fault persists.
		12	Steering angle sensor internal error communicated	<ul style="list-style-type: none"> – Check CAN wiring between ABS ECU and SAS for interruptions and short circuits. – Check for corroded or damaged wiring between the SAS and ESC module. – Check SAS operation if the fault persists.
		13	Steering angle sensor calibration required	<ul style="list-style-type: none"> – Follow the SAS calibration procedure defined in the maintenance manual.
		14	Steering angle sensor internal error communicated	<ul style="list-style-type: none"> – Check the installation and condition of the SAS and steering system.
520210	ESC Module	1	ESC initialization required	<ul style="list-style-type: none"> – Follow the ESC initialization (End of Line) calibration.
		2	ESC module incompatible with ABS ECU	<ul style="list-style-type: none"> – Verify the correct ABS ECU and ESC module with OEM.
		5	Loss of CAN communication between ABS ECU and ESC module	<ul style="list-style-type: none"> – Check CAN wiring between ABS ECU and ESC module for interruptions and short circuits. – Check CAN wiring between ABS ECU and SAS for interruptions and short circuits. – Check for corroded or damaged wiring between the ECU, SAS and ESC module.
		7	ESC module mounting incorrect	<ul style="list-style-type: none"> – Verify the ESC module is securely mounted, leveled and in the correct location. Contact the WABCO Customer Care Center at 855-228-3203 to ensure the ESC module is in accordance with ABS ECU parameters.
		9	Loss of CAN communication between ABS ECU, SAS and ESC module	<ul style="list-style-type: none"> – Check CAN wiring between ABS ECU and ESC module for interruptions and short circuits. – Check CAN wiring between ABS ECU and SAS for interruptions and short circuits. – Check for corroded or damaged wiring between the ECU, SAS and ESC module.

Appendix I

SPN	Component	FMI	Fault Description	Repair
520210	ESC Module	10	ESC system detects a plausibility issue while driving	<ul style="list-style-type: none"> – Verify the SAS and ESC module are correctly mounted, leveled and in the correct location. Contact the WABCO Customer Care Center at 855-228-3203 to ensure the ESC module and SAS is in accordance with ABS ECU parameters.
		12	ESC module has communicated internal failure	<ul style="list-style-type: none"> – Check CAN wiring between ABS ECU, ESC module and SAS for interruptions and short circuits. – Check for corroded or damaged wiring between the ECU, SAS and ESC module. – Check for stray single power wires on or near ESC module. – Check for damaged or incorrectly mounted SAS. – Verify the ESC module is securely mounted, leveled and in correct location. – Verify the ABS ECU and ESC has been correctly calibrated. Follow ESC initialization (End of Line) calibration.
		13	ESC configuration error	<ul style="list-style-type: none"> – Verify the correct ABS ECU and ESC module with OEM.
		14	ESC initialization required	<ul style="list-style-type: none"> – Follow the ESC initialization (End of Line) calibration.
520211	ESC System	2	ESC system configuration error	<ul style="list-style-type: none"> – Verify the correct ABS ECU and ESC module with OEM.

7 Appendix II

7.1 Aftermarket Programming

Aftermarket programming is a method of servicing the WABCO SmartTrac™ hydraulic ABS unit. The process can be completed in the following steps.

1. Acquire a programmable replacement SmartTrac™ hydraulic ABS module through Meritor's aftermarket distribution channel or refer to Meritor PartsXpress (www.MeritorPartsXpress.com).
2. Install the replacement ABS module into the vehicle following the instructions in Section 3 of this manual.

Alternatively, the ECU can be programmed off vehicle using aftermarket Bench Programming Unit, part number 400 850 960 0 and SmartTrac™ hydraulic EPI bench test cable, part number 400 851 117 4. Use the directions that follow in Section 7.2 for aftermarket programming procedures with the unit connected via the cable (400 851 117 4). For more information regarding the aftermarket Bench Programming Unit, refer to WABCO SP-18016.

3. Acquire a configuration file from <http://wabco.snapon.com>. You will need the VIN, part number being replaced, new programmable part number and serial number to download the configuration file.
4. Upload the configuration file into the new programmable SmartTrac™ hydraulic ABS module using WABCO's TOOLBOX™ Software Aftermarket Programming application and an RP1210 diagnostic adapter. See Minimum Requirements for Aftermarket Programming before continuing.



NOTE: Aftermarket programming does not change the ABS-based safety system functionality installed in the vehicle.

7.2 Minimum Requirements for Aftermarket Programming

Before ordering a programmable SmartTrac™ hydraulic ABS module, ensure you meet all of the requirements to program the ECU on the vehicle.

1. Aftermarket programming requires J1939 communication to the ECU. Any J1939 RP1210 diagnostic adapter such as Nexiq USB Link-2 or Noregon can be used for programming. Aftermarket programming will not be possible without the correct hardware.
2. Aftermarket programming of the SmartTrac™ hydraulic ABS module requires the minimum version of TOOLBOX™ 12.7 Software. The version of TOOLBOX™ Software being used can be found at the top of the TOOLBOX™ Software window.

If you do not have the latest TOOLBOX™ Software, you can purchase it at <http://wabco.snapon.com>.

3. Aftermarket programming requires configuration files which can be downloaded without charge at: <https://wabco.snapon.com>.
If you meet all of the minimum requirements, proceed with the following Aftermarket Programming procedures.

7.3 Aftermarket Programming Procedures

Step 1: Acquire a programmable replacement SmartTrac™ hydraulic ABS module through Meritor's aftermarket distribution channel or refer to Meritor PartsXpress (www.MeritorPartsXpress.com).

If you need help identifying the correct replacement programmable ECU, contact Meritor Aftermarket Customer Care at: USA: 888-725-9355, Canada: 800-387-3889.

Programmable SmartTrac™ hydraulic ABS modules are clearly identified with a large orange sticker indicating it must be programmed and are also shipped with an instruction sheet explaining how to complete the service operation. Fig. 7.1.

Fig. 7.1



Step 2: Install the SmartTrac™ hydraulic ABS module into the vehicle following the procedures in Section 5.

When the replacement SmartTrac™ hydraulic ABS module is installed, the ABS lamp will be lit due to an active DTC (Diagnostic Trouble Code):

SID	SPM	FMI	Description
253	630	2	Calibration Memory – Wheel Parameter Incorrect



This DTC will clear after a configuration file has been successfully loaded into the SmartTrac™ hydraulic ABS module.

The ABS lamp will remain on until the vehicle has been driven above 4 mph (6 km/h).

Step 3: Acquire the required configuration file from <https://wabco.snapon.com>.

Begin by either creating an account or logging into an account created during a previous purchase from the site. Fig. 7.2.

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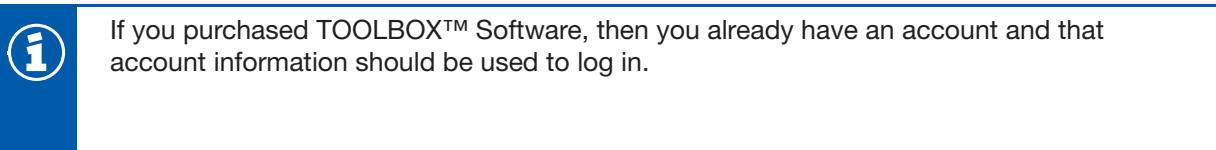


Fig. 7.2

The screenshot shows the WABCO login page. On the left, under 'Registered Users', there is a form with fields for 'Username*', 'Forgot Username?', 'Password*', 'Forgot Password?', and a 'Sign In' button. On the right, under 'New Users', it says 'You need to create a user account before you can place an order.' with a 'Create a new user account' button. At the top right, it says 'You are not logged in.' with a 'Logout' button. The URL in the address bar is 'http://www.wabco.com/LogIn.aspx'. A reference number '4013302a' is at the bottom right.

Click the Aftermarket Programming Configuration Files button at the top of the screen.

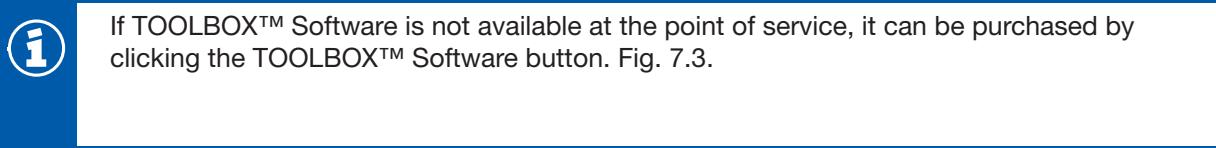


Fig. 7.3

The screenshot shows the WABCO software navigation menu. It includes links for Home, Catalog, Support, My Account, Reports, Cat. Admin., Contact, Default Catalog, and Logout. The 'TOOLBOX Software' link is highlighted. The URL in the address bar is 'http://www.wabco.com/Software.aspx'. A reference number '4013303a' is at the bottom right.

Enter the part details for the vehicle being worked on and the part being replaced. Fig. 7.4.

- The VIN must include all 17 characters.
- The SmartTrac™ hydraulic ABS module part number being replaced must be entered.
- The new programmable SmartTrac™ hydraulic ABS module part number must be entered. Fig. 7.5.

Fig. 7.4

The screenshot shows the 'Part Details' form. It has four input fields: 'VIN*' (containing '1'), 'ECU Part Number Being Replaced*' (containing '10 Digits (400xxxxxxxx)'), 'New ECU Part Number*' (containing '10 Digits (400xxxxxxxx)'), and 'New ECU Serial Number*' (containing '6 Digits (xxxxxx)'). Below the fields is a checkbox for 'I have read the limitations above and confirm that this vehicle supports J1939 communications.' and a 'Calculate Price' button. A reference number '4013304a' is at the bottom right.

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Fig. 7.5



The next screen will show the configuration file details linked to the part number and VIN combination entered. Verify the VIN, part number and SmartTrac™ hydraulic ABS module functionality matches the SmartTrac™ hydraulic ABS module being replaced. If this information is correct, click the Add to shopping cart button. Fig. 7.6.

Fig. 7.6

After the configuration file has been added to the shopping cart, the shopping cart will be displayed as a pop up window for a few seconds. Fig 7.7.

Fig. 7.7

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Clicking on "Go To Shopping Cart" or "Check Out" symbol will take you to the contact details page that need to be filled out to process the order. Fig 7.8.

Fig. 7.8

The screenshot shows a web-based checkout interface. At the top, there are tabs for 'Home', 'Checkout', 'Contact Details' (which is selected), 'Address Book', 'Send Payment Method', and 'Place Order'. Below the tabs, a section titled 'Contact Details' contains a sub-section 'Select Contact Details for this Order'. It includes fields for 'Attention Of' (set to 'Guest'), 'Email Address' (set to 'Guest@mentorwabco.com'), and checkboxes for 'Email order confirmation?' and 'Email status updates?'. There is also a 'Phone Number' field containing '123-456-7890'. At the bottom right of the form area, the identifier '4013308a' is visible.

The first step in the checkout process is to verify contact information. The information will automatically populate based on login information; all fields can be edited. Click on "Bill To This Address" when contact info is filled out. Fig. 7.9.



Fig. 7.9

This screenshot shows the same 'Contact Details' page as Fig. 7.8. It includes the same fields for 'Attention Of', 'Email Address', and 'Phone Number'. Below these, there is a section titled 'Address Book' with two entries: 'Address 1' and 'Address 2'. Each entry displays an address (e.g., '2950 waterview, rochester hills, MI, 48309, UNITED STATES') and a yellow button labeled 'Bill to this address'. The identifier '4013309a' is located at the bottom right of the form area.

The final screen of the download process allows the details of the download to be reviewed before placing the order. If all of the information is correct, then check the box acknowledging the terms and conditions of the download and click Place Order. Fig. 7.10.

Fig. 7.10

This screenshot shows the 'Place Order' page. At the top, it displays 'Order Details' with a single item: 'Aftermarket Programming Configuration File' with a quantity of 1, unit price of \$0.00, and subtotal of \$0.00. Below this, there are sections for 'Freight' (N/A - Shipment not required) and 'Tax' (Estimated VAT/sales tax). A note states 'Total Amount \$0.00'. In the center, there is a field for a promotion code with an 'Apply' button. To the right, a 'Payment details' section shows 'No Charge'. At the bottom, there is a checkbox for accepting terms and conditions, a note about the不可撤销性 of the order, and a 'Place Order' button. The identifier '4013310a' is located at the bottom right of the form area.

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The order will be processed and a link to download the configuration file will be displayed. Click the hyperlink to download the configuration file. Fig. 7.11.

Fig. 7.11



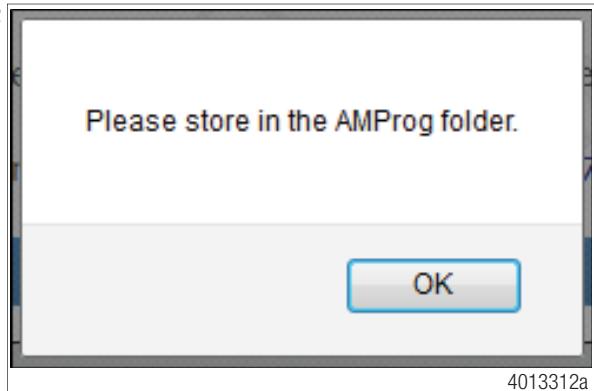
The file extension ".HY" is specifically for the SmartTrac™ hydraulic ABS module only. Ensure the file has this. No other file will be compatible.



IMPORTANT: The configuration file will be available in your account for seven days from purchase. The configuration file must be downloaded to a computer within that time.

The following message will be displayed regarding recommended file storage location. Press OK to continue with saving the file. Fig. 7.12.

Fig. 7.12

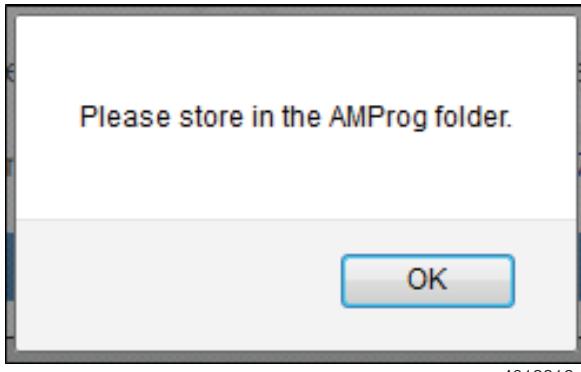


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Save the configuration file to a location that can be accessed while connected to the vehicle. The aftermarket programming application will allow the file selection from any location in your computer. (Not just the AMProg Folder.) Fig. 7.13.

Fig. 7.13



4013312a

Step 4: Load the configuration file into the SmartTrac™ hydraulic ABS module using WABCO's TOOLBOX™ Software Aftermarket Programming application.

Begin by verifying you have the latest version TOOLBOX™ Software. First locate the software version on the WABCO label on the SmartTrac™ hydraulic ABS module. An example of the cab ECU label is shown, and the ECU software version is circled. Fig. 7.14.

Fig. 7.14



Once you have verified you are using the correct version of TOOLBOX™ Software, connect to the vehicle using recommended J1939 RP1210 diagnostic adapter. Turn the ignition on, open TOOLBOX™, and click the aftermarket programming application to start programming the SmartTrac™ hydraulic ABS module. Fig. 7.15.



Wireless diagnostic adapters should not be used for aftermarket programming or any other WABCO programming operation.

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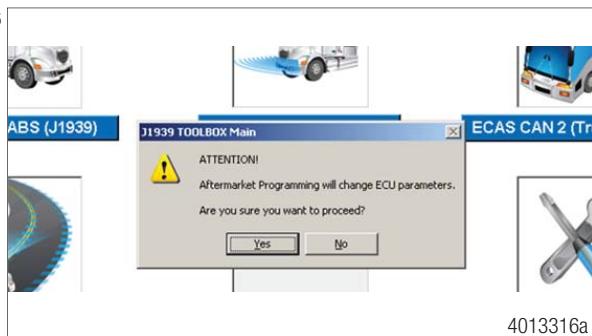
- i** It is recommended that aftermarket programming be completed with ignition on only. Do not cycle the key until the programming operation is complete. Verify the battery is fully charged prior to performing the programming operation; the vehicle should not be connected to a battery charger during programming. If the vehicle ignition is known to "time out" while using a key fob, use the vehicle key so the ignition will stay on during programming. Use WABCO's Bench Programming Unit and SmartTrac™ hydraulic EPI bench test cable for programming outside of the vehicle.
- i** For complete instructions for using TOOLBOX™ Software, refer to the TOOLBOX™ Quick Start Guide: OM1618.

Fig. 7.15



A message will be displayed indicating that the SmartTrac™ hydraulic ABS module will be changed as a result of programming. Click "Yes" to continue with programming the SmartTrac™ hydraulic ABS module. Fig. 7.16.

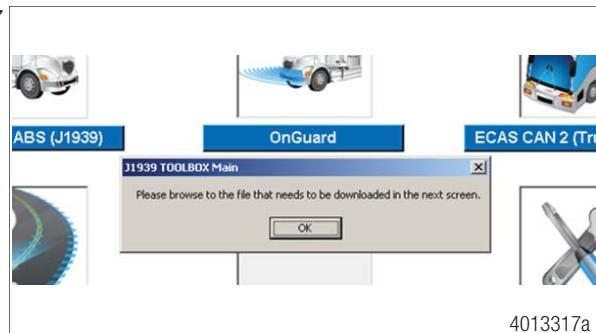
Fig. 7.16



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The Aftermarket Programming application will then locate the configuration file. Click OK to select the file. Fig. 7.17.

Fig. 7.17



Use the file selection box to locate the configuration file that matches the part number and VIN being serviced. Select the file by clicking on it, and then click Open. Fig. 7.18.

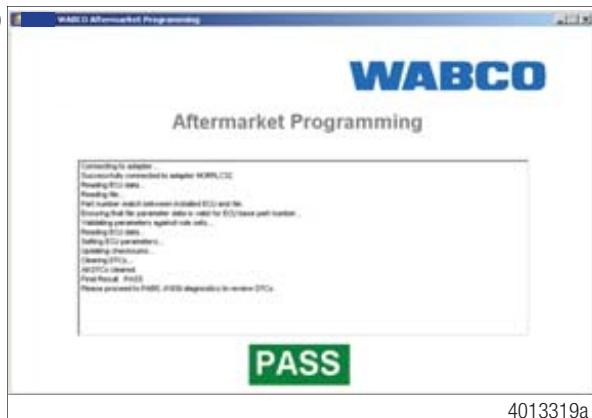
Fig. 7.18



The Aftermarket Programming application will automatically run from this point. The programming operation progress will be displayed in the dialogue box. Once the SmartTrac™ hydraulic ABS module programming is successfully completed, a green PASS indicator will appear at the bottom of the aftermarket programming application window. Fig. 7.19.

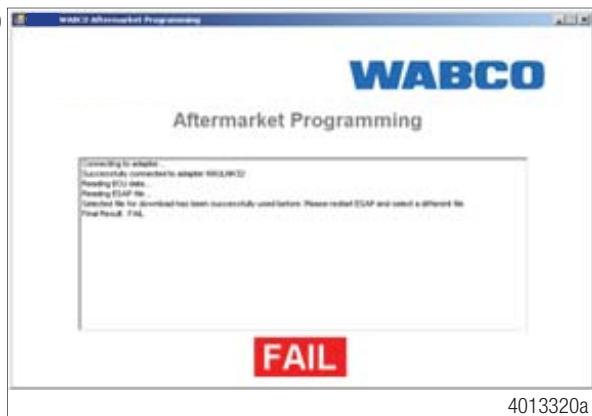
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Fig. 7.19



If the programming operation fails for any reason, a red FAIL indicator will appear at the bottom of the aftermarket programming application window. Within the text box, an error code will be displayed with instructions. If the programming operation cannot be completed, record the error code and contact the WABCO Customer Care Center at 855-228-3203. Fig. 7.20.

Fig. 7.20



ESC ECUs will require the ESC End of Line procedure to be completed following ECU replacement.

Information obtained in this manual was in effect at the time the publication was approved for printing and is subject to change without notice or liability. WABCO reserves the right to revise the information presented or to discontinue the production of parts described at any time.



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DIFFERENCE

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 2018, WABCO reported sales of over \$3.8 billion and has more than 16,000 employees in 40 countries. For more information, visit www.wabco-na.com.

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