



TM



***Leeds Transit***

®

Instructor: Colin Hooper.  
Welcome to Leeds Transit CE Bus Full Power  
Brakes Training Course!



# Course Goal



- Given the information presented in the Leeds Transit Bus Hydraulic Full Power Brake System training course, the necessary service information and tools, technicians will be able to understand the design, operation and carry out preventative maintenance of the IC Corporation Bus Hydraulic Full Power Brake System.
- Pre Course Questions





# Pre-Course Questions



- During Maintenance , what hydraulic fluid pressure is available at the caliper piston with the ignition off?
- What Volume of Hydraulic fluid from the master cylinder is used to operate a single brake caliper?
- How does the vehicle operator switch off the Automatic Traction Control?
- How does a technician switch off the Automatic Traction Control?
- When the Automatic Traction Control warning light is illuminated in the instrument cluster, is the ATC functioning or malfunctioning?
- What is the maximum speed of the CE Bus where the parking brake is allowed to function?
- When a system malfunction occurs on a CE bus, it is only the parking brake that bring the vehicle to a halt. TRUE FALSE





# Pre-Course Questions



- During Maintenance , what hydraulic fluid pressure is available at the caliper piston with the ignition off? **OVER 2000psi**
- What Volume of Hydraulic fluid from the master cylinder is used to operate a single brake caliper?
- How does the vehicle operator switch off the Automatic Traction Control?
- How does a technician switch off the Automatic Traction Control?
- When the Automatic Traction Control warning light is illuminated in the instrument cluster, is the ATC functioning or malfunctioning?
- What is the maximum speed of the CE Bus where the parking brake is allowed to function?
- When a system malfunction occurs on a CE bus, it is only the parking brake that bring the vehicle to a halt. TRUE FALSE





# Pre-Course Questions



- During Maintenance , what hydraulic fluid pressure is available at the caliper piston with the ignition off? **OVER 2000psi**
- What Volume of Hydraulic fluid from the master cylinder is used to operate a single brake caliper? **NONE**
- How does the vehicle operator switch off the Automatic Traction Control?
- How does a technician switch off the Automatic Traction Control?
- When the Automatic Traction Control warning light is illuminated in the instrument cluster, is the ATC functioning or malfunctioning?
- What is the maximum speed of the CE Bus where the parking brake is allowed to function?
- When a system malfunction occurs on a CE bus, it is only the parking brake that bring the vehicle to a halt. TRUE FALSE





# Pre-Course Questions



- During Maintenance , what hydraulic fluid pressure is available at the caliper piston with the ignition off? **OVER 2000psi**
- What Volume of Hydraulic fluid from the master cylinder is used to operate a single brake caliper? **NONE**
- How does the vehicle operator switch off the Automatic Traction Control? **DRIVER CANNOT SWITCH OFF ATC**
- How does a technician switch off the Automatic Traction Control?
- When the Automatic Traction Control warning light is illuminated in the instrument cluster, is the ATC functioning or malfunctioning?
- What is the maximum speed of the CE Bus where the parking brake is allowed to function?
- When a system malfunction occurs on a CE bus, it is only the parking brake that bring the vehicle to a halt. TRUE FALSE





# Pre-Course Questions



- During Maintenance , what hydraulic fluid pressure is available at the caliper piston with the ignition off? **OVER 2000psi**
- What Volume of Hydraulic fluid from the master cylinder is used to operate a single brake caliper? **NONE**
- How does the vehicle operator switch off the Automatic Traction Control? **DRIVER CANNOT SWITCH OFF ATC**
- How does a technician switch off the Automatic Traction Control? **TOOLBOX**
- When the Automatic Traction Control warning light is illuminated in the instrument cluster, is the ATC functioning or malfunctioning?
- What is the maximum speed of the CE Bus where the parking brake is allowed to function?
- When a system malfunction occurs on a CE bus, it is only the parking brake that bring the vehicle to a halt. **TRUE FALSE**





# Pre-Course Questions



- During Maintenance , what hydraulic fluid pressure is available at the caliper piston with the ignition off? **OVER 2000psi**
- What Volume of Hydraulic fluid from the master cylinder is used to operate a single brake caliper? **NONE**
- How does the vehicle operator switch off the Automatic Traction Control? **DRIVER CANNOT SWITCH OFF ATC**
- How does a technician switch off the Automatic Traction Control? **TOOLBOX**
- When the Automatic Traction Control warning light is illuminated in the instrument cluster, is the ATC functioning or malfunctioning?
- What is the maximum speed of the CE Bus where the parking brake is allowed to function?
- When a system malfunction occurs on a CE bus, it is only the parking brake that bring the vehicle to a halt. TRUE FALSE







# Pre-Course Questions



- During Maintenance , what hydraulic fluid pressure is available at the caliper piston with the ignition off? **OVER 2000psi**
- What Volume of Hydraulic fluid from the master cylinder is used to operate a single brake caliper? **NONE**
- How does the vehicle operator switch off the Automatic Traction Control? **DRIVER CANNOT SWITCH OFF ATC**
- How does a technician switch off the Automatic Traction Control? **TOOLBOX**
- When the Automatic Traction Control warning light is illuminated in the instrument cluster, is the ATC functioning or malfunctioning?
- What is the maximum speed of the CE Bus where the parking brake is allowed to function? **2 Miles per Hour**
- When a system malfunction occurs on a CE bus, it is only the parking brake that bring the vehicle to a halt. TRUE FALSE





# Pre-Course Questions



- During Maintenance , what hydraulic fluid pressure is available at the caliper piston with the ignition off? **OVER 2000psi**
- What Volume of Hydraulic fluid from the master cylinder is used to operate a single brake caliper? **NONE**
- How does the vehicle operator switch off the Automatic Traction Control? **DRIVER CANNOT SWITCH OFF ATC**
- How does a technician switch off the Automatic Traction Control? **TOOLBOX**
- When the Automatic Traction Control warning light is illuminated in the instrument cluster, is the ATC functioning or malfunctioning?
- What is the maximum speed of the CE Bus where the parking brake is allowed to function? **2 Miles per Hour**
- When a system malfunction occurs on a CE bus, it is only the parking brake that brings the vehicle to a halt. TRUE FALSE





# Course Objective



Upon successful completion of this training course, you will be able to:

- Identify the components and Describe the normal operation of the Hydraulic Full Power Brake System.
- Identify the components and Describe the normal operation of the Spring Applied/Hydraulic Release Powered Parking Brake System.
- Identify and Describe the normal operation the Full Power Brake System instrument cluster warning lights.





## Course Objectives (cont.)



- Operate WABCO Toolbox® Software to:
  - Identify Full Power Brake System faults and obtain preliminary repair instructions.
  - View Full Power Brake System operating conditions.
- Be aware of updated preventative maintenance issues.





# Module 1: System Components and Operation

**Before we carry on, let's just remind ourselves of some basic Hydraulic theory and system operations.**

Title 1, 16:00 Minutes





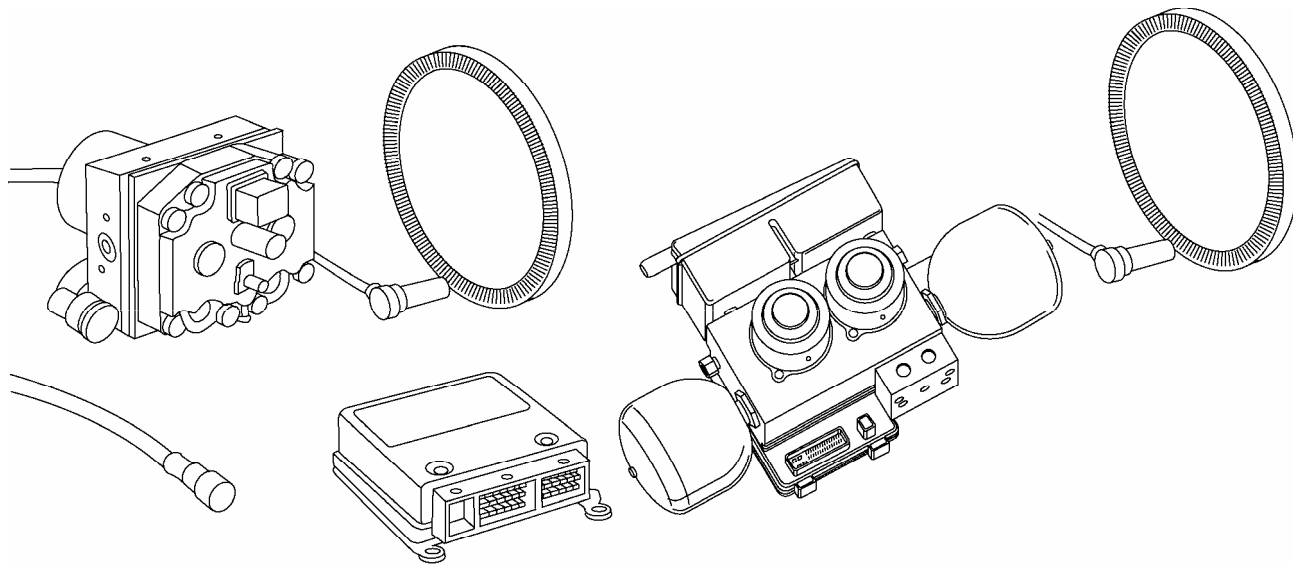
# Module 1: Contents *Leeds Transit*

Hydraulic Full Power Brakes System Introduction  
Hydraulic Full Power Brakes System Features and Benefits  
Hydraulic Full Power Brakes System Components  
Component Locations  
Hydraulic Schematic  
Primary and Secondary Circuits  
Master Cylinder  
Hydraulic Compact Unit  
Anti-Lock Brakes (ABS) and Automatic Traction Control (ATC)  
ABS and ATC Operating Modes  
Review Questions





# Hydraulic Full Power Brake System Introduction



HB000

**Current Hydraulic ABS**

**Next Generation Hydraulic Full Power Brake with ABS and ATC**





# Comparison to an Air Brake System

- The Full Power Brake System is a hydraulic brake system that works like an air brake system:
  - Brake fluid is stored in nitrogen charged accumulators.
  - Pump Motors maintain the supply of fluid in the accumulators.
- In comparison to air brakes:
  - accumulators = air tanks
  - pump motors = air compressor







# Hydraulic Full Power Brake System Features and Benefits

- Shorter stopping distances
- Powered Parking Brake System
- Electronic Brake Force Distribution
- Anti-Lock Brake System (ABS) standard
- Traction Control standard





# Hydraulic Full Power Brakes System Components

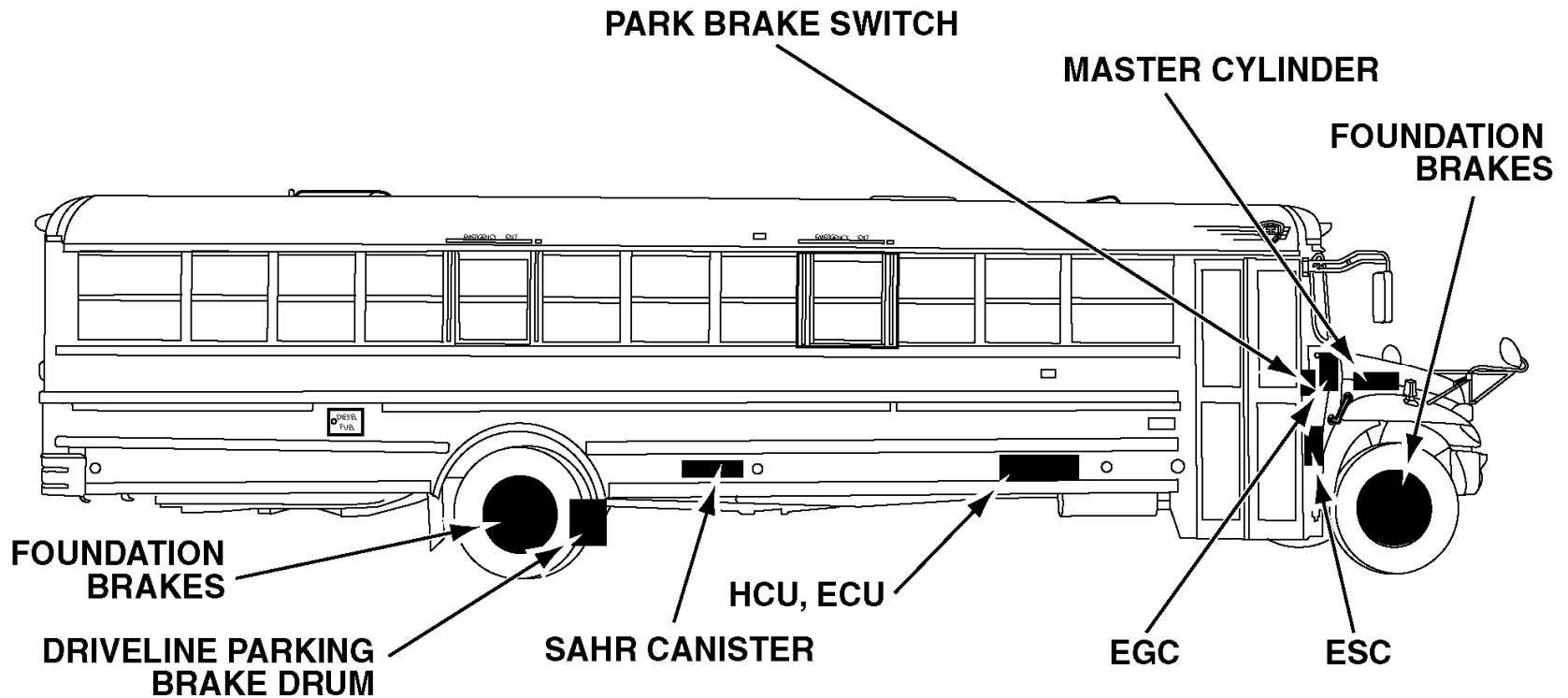
The following components are part of the Hydraulic Full Power Brake System:

- Dual-circuit brake fluid reservoir located on outside dash panel with level switch
- Hydraulic Compact Unit (HCU), which contains hydraulic valves and modulators. The HCU is located on the inside left frame rail.
- Electronic Control Unit (ECU), which contains the electronic hardware necessary to control the system. The ECU is bolted to the HCU.
- Two independent electric motors and pumps. Pump motors are each fused by a battery-powered 30A Maxi-Fuse located on the outside dash panel.
- Two independent accumulators with pressure transducers
- Dual-circuit master cylinder located beneath the brake fluid reservoir
- Diagnosable stop lamp switch located in master cylinder
- Spring Applied/Hydraulic Release Powered Park Brake Canister
- Wheel speed sensors
- Park Brake





# Component Locations

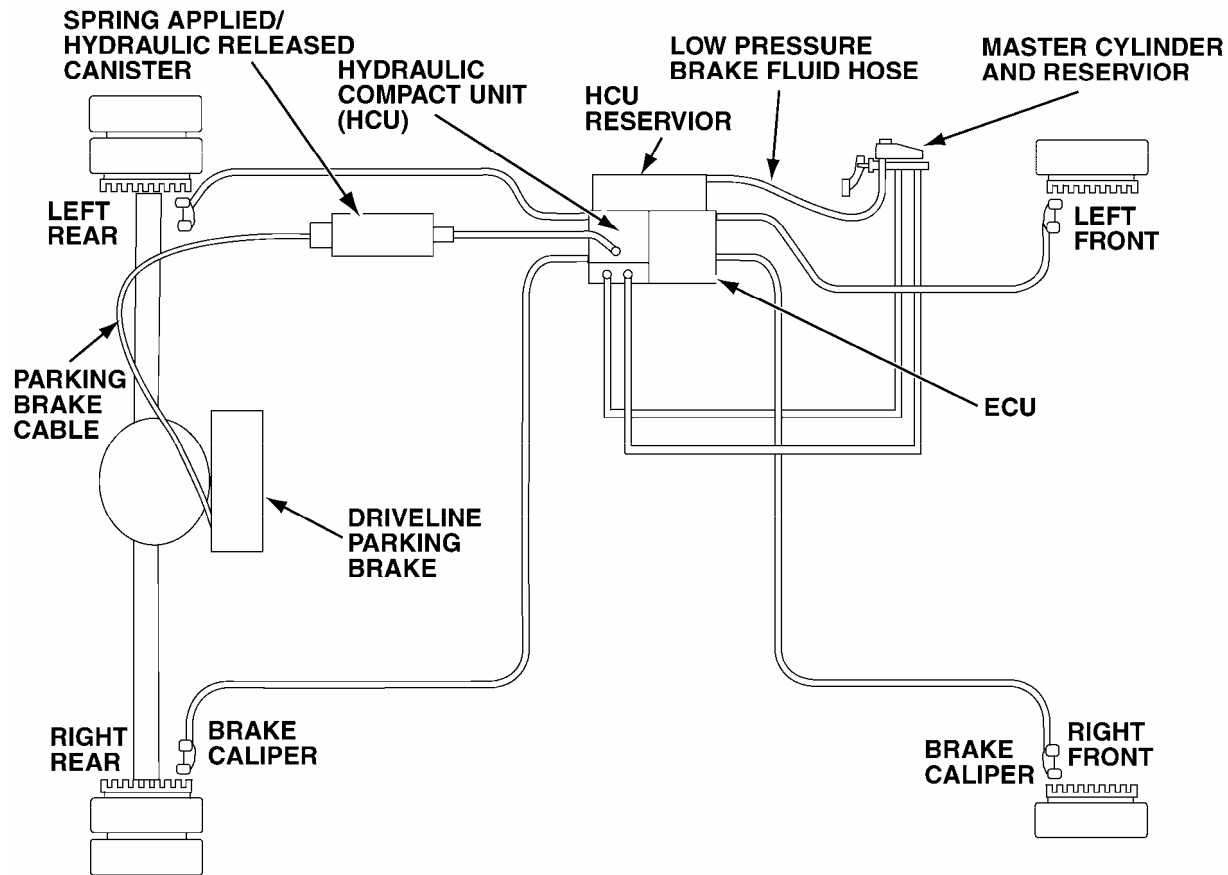


HB002



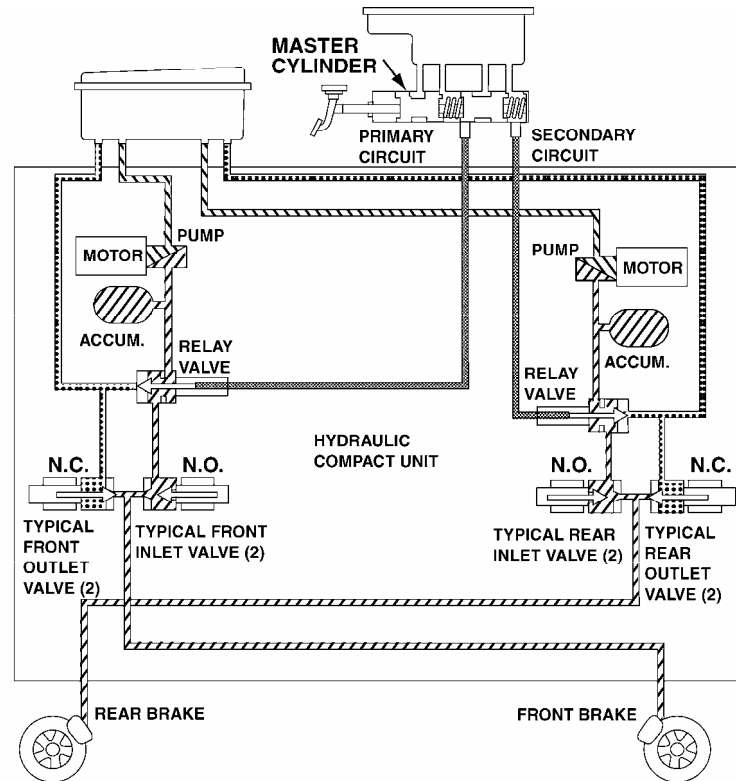




# Hydraulic Schematic







# Primary and Secondary Circuits



 MASTER CYLINDER PILOT SIGNAL  
 (PRESSURE-BRAKES APPLIED)  
 HIGH PRESSURE BRAKE FLUID

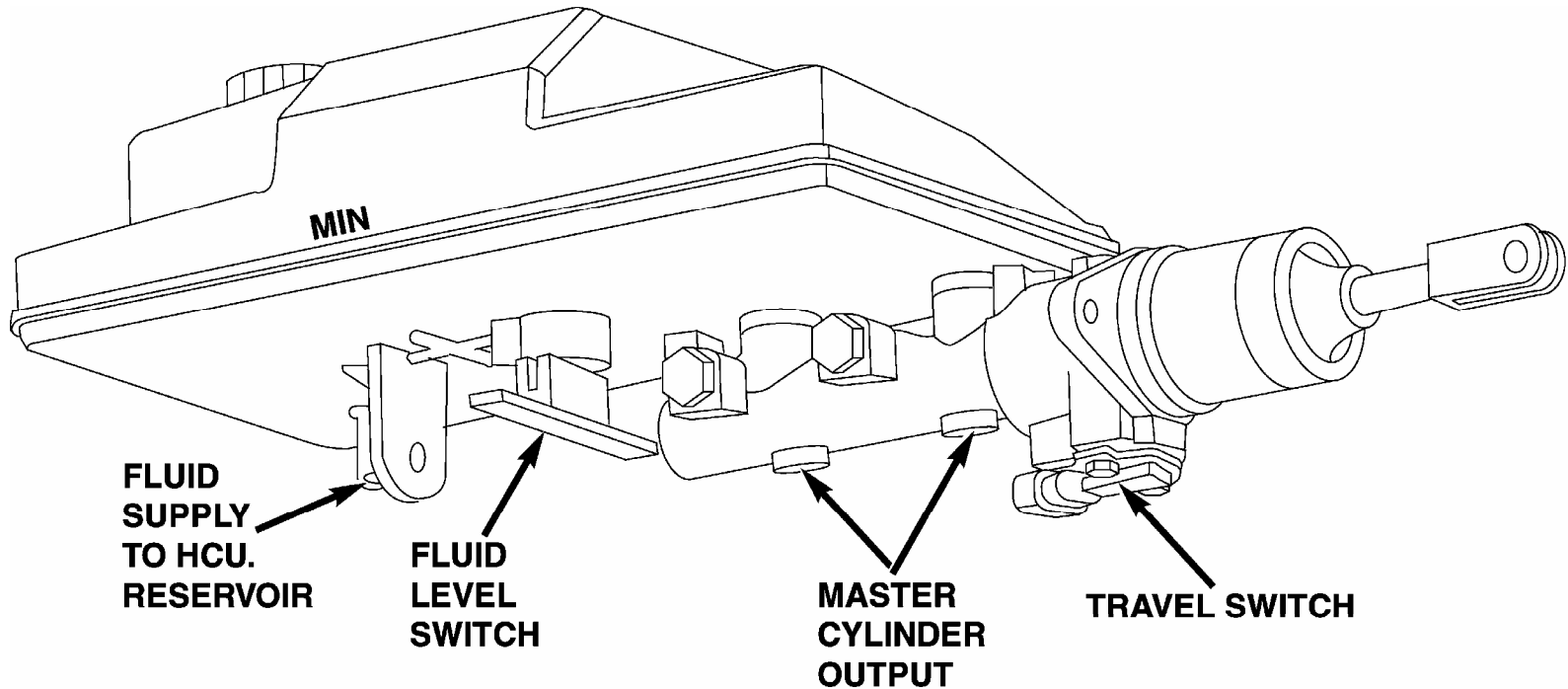
 UNPRESSURIZED SUPPLY FROM RESERVOIR  
 UNPRESSURIZED RETURN TO RESERVOIR

HB009





# Master Cylinder Assembly

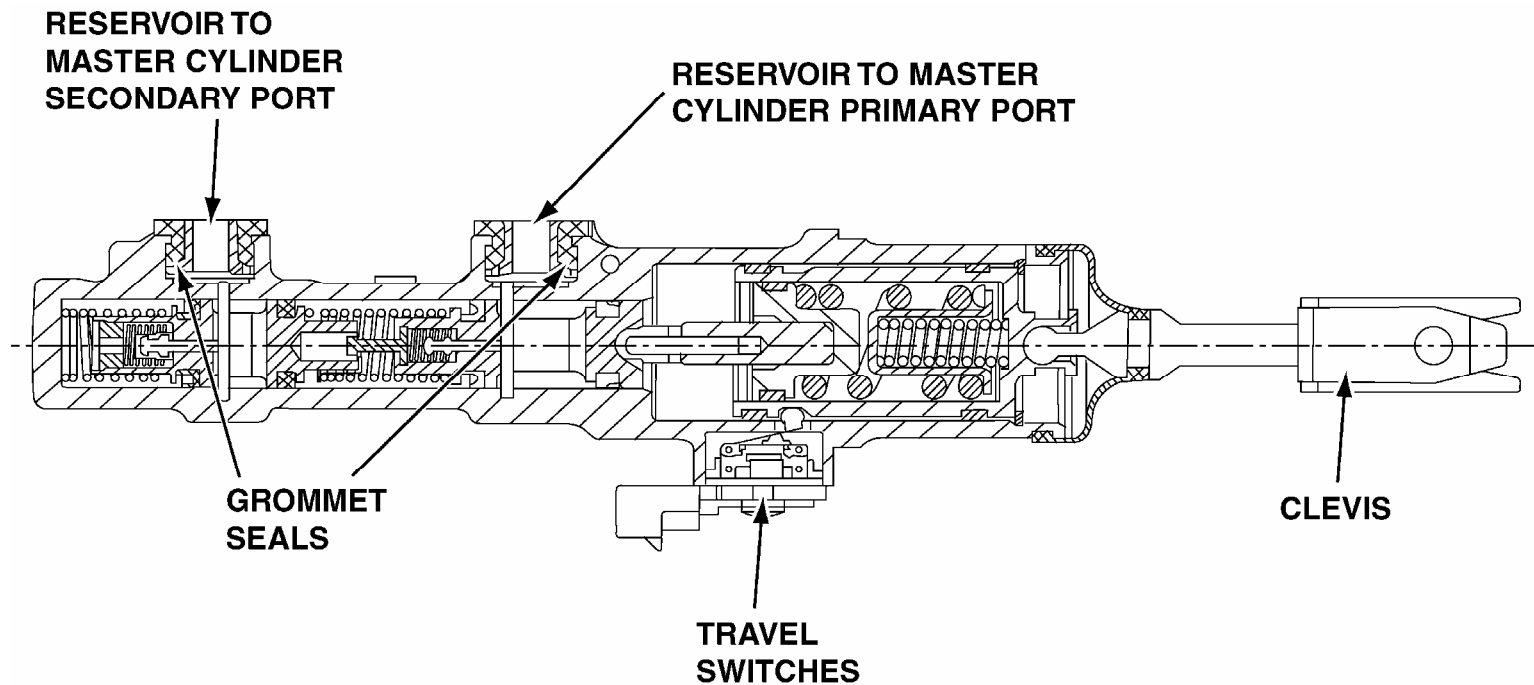


HB005



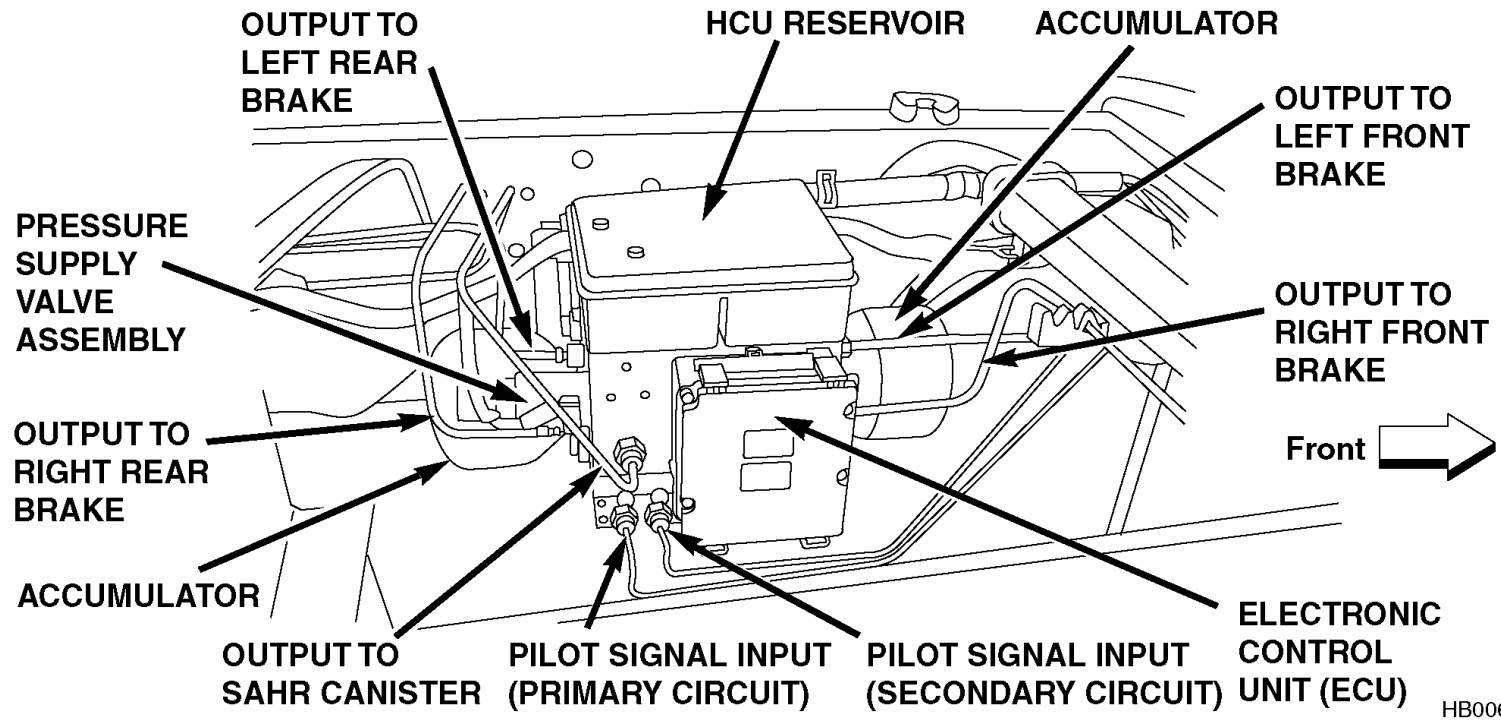


# Master Cylinder





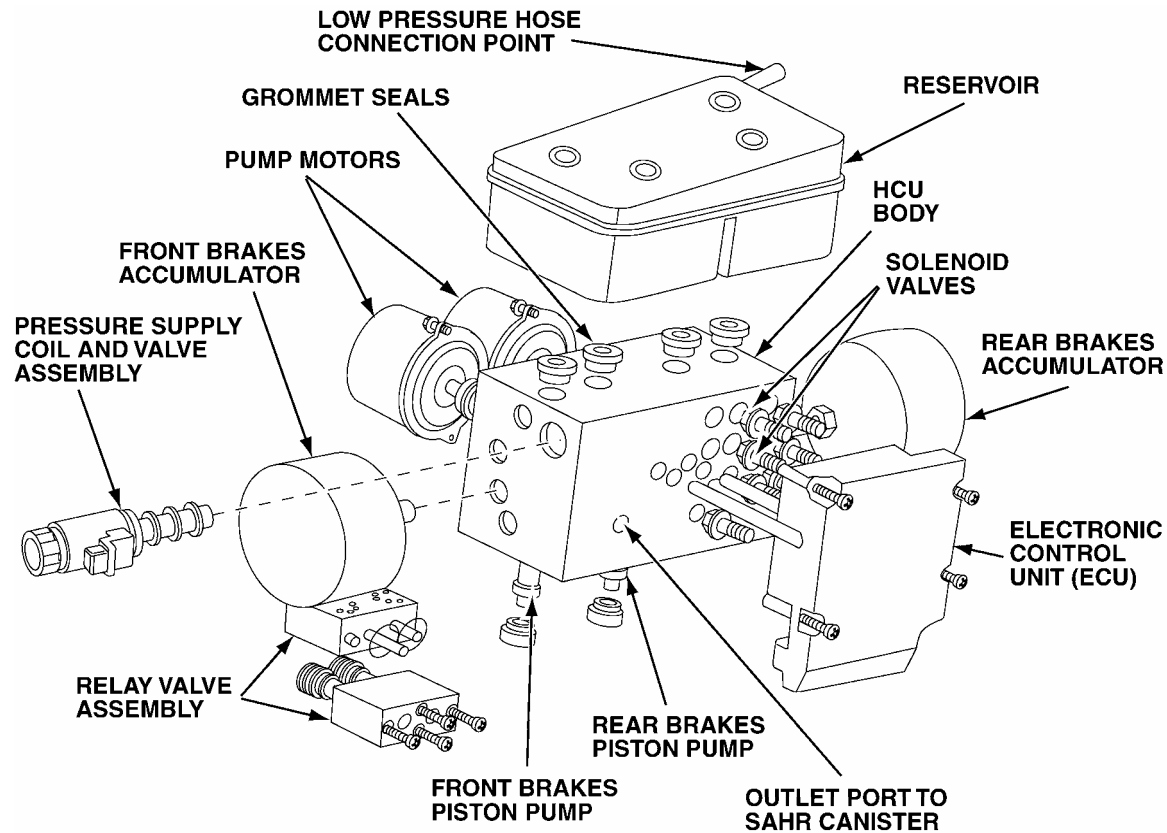
# Hydraulic Compact Unit Location







# Hydraulic Compact Unit

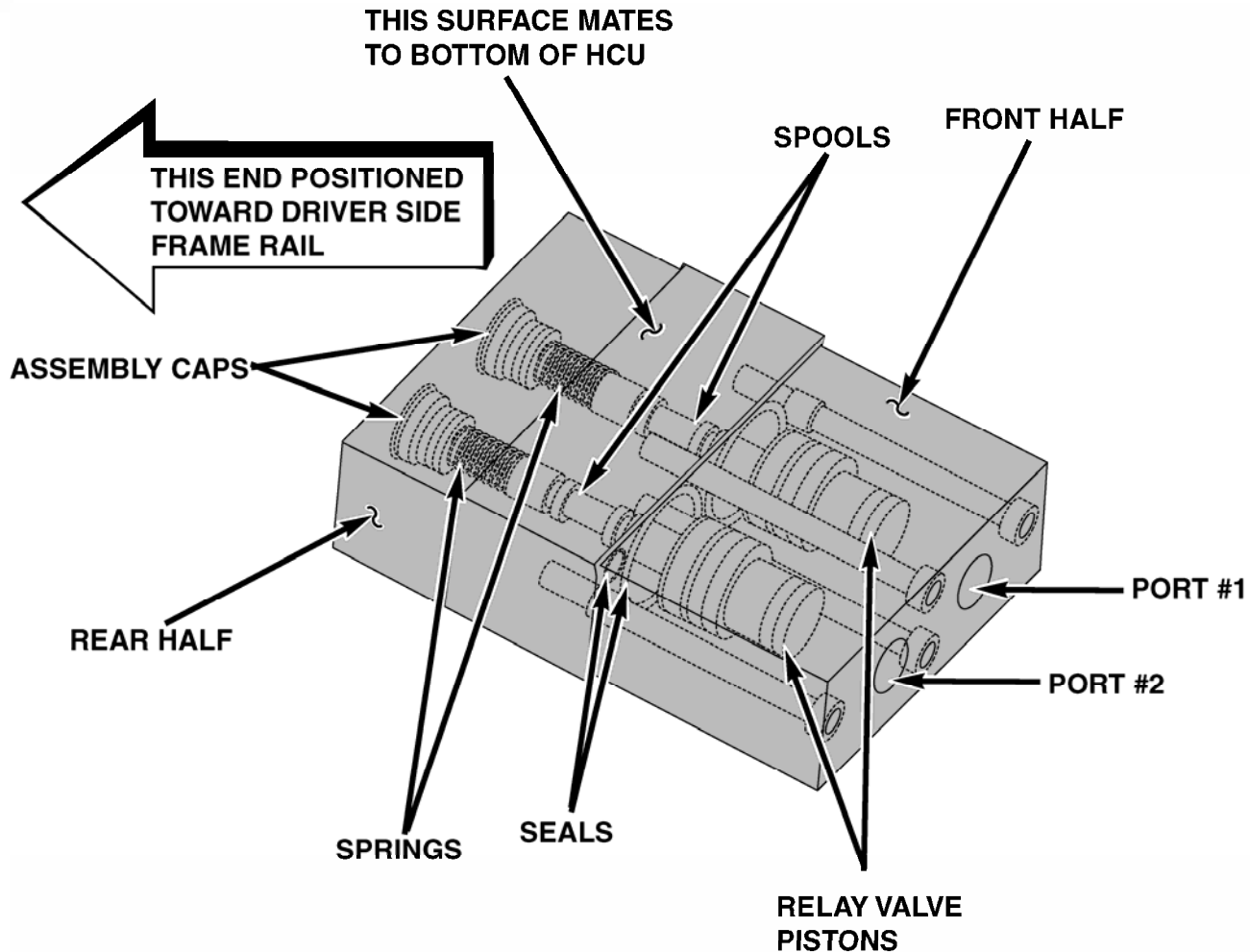


HB007



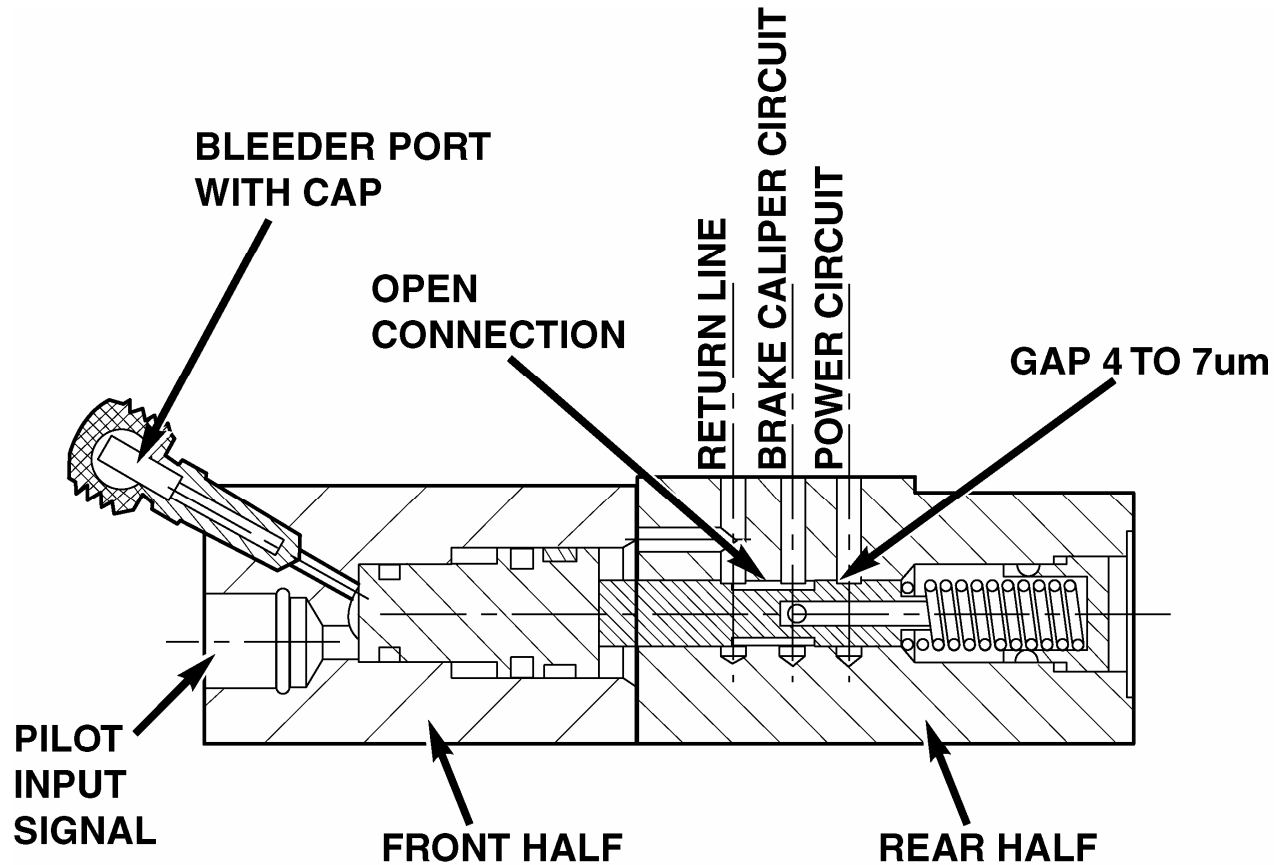


# Relay Valve Assembly





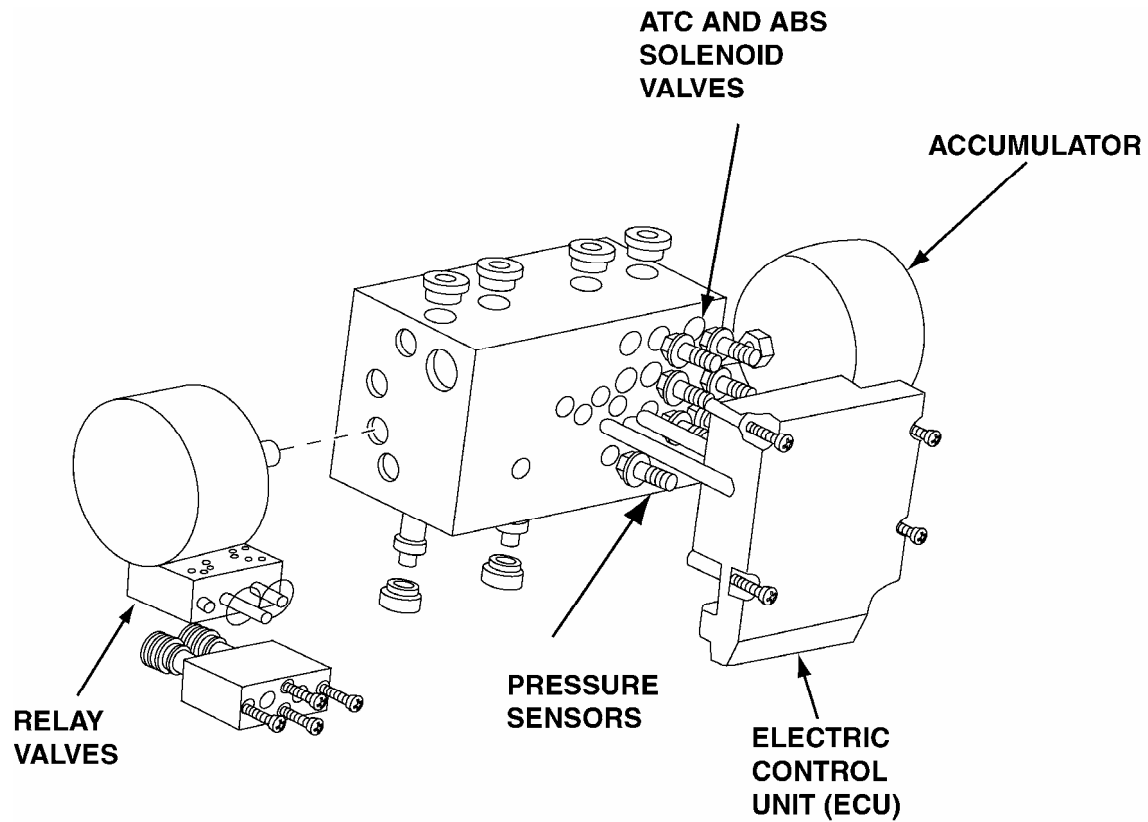
# Relay Valve Assembly Cross Section



HB040

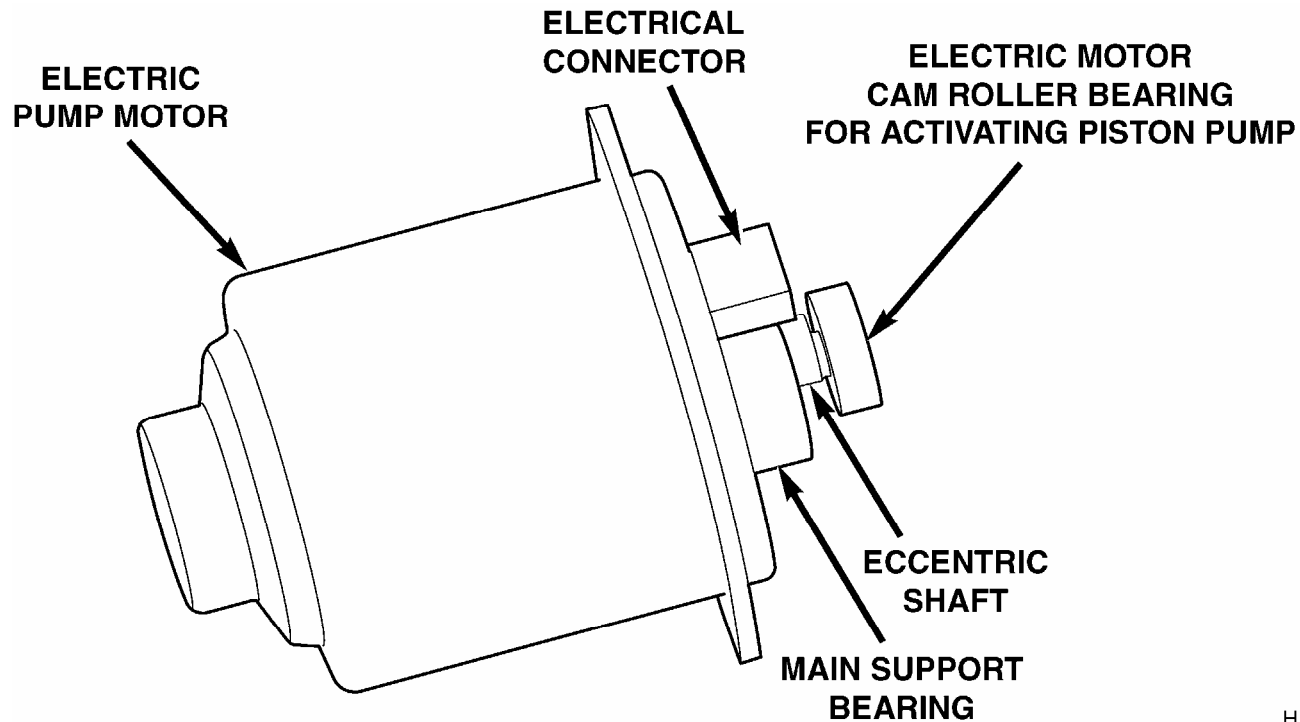


# Electronic Control Unit





# Pump Motor

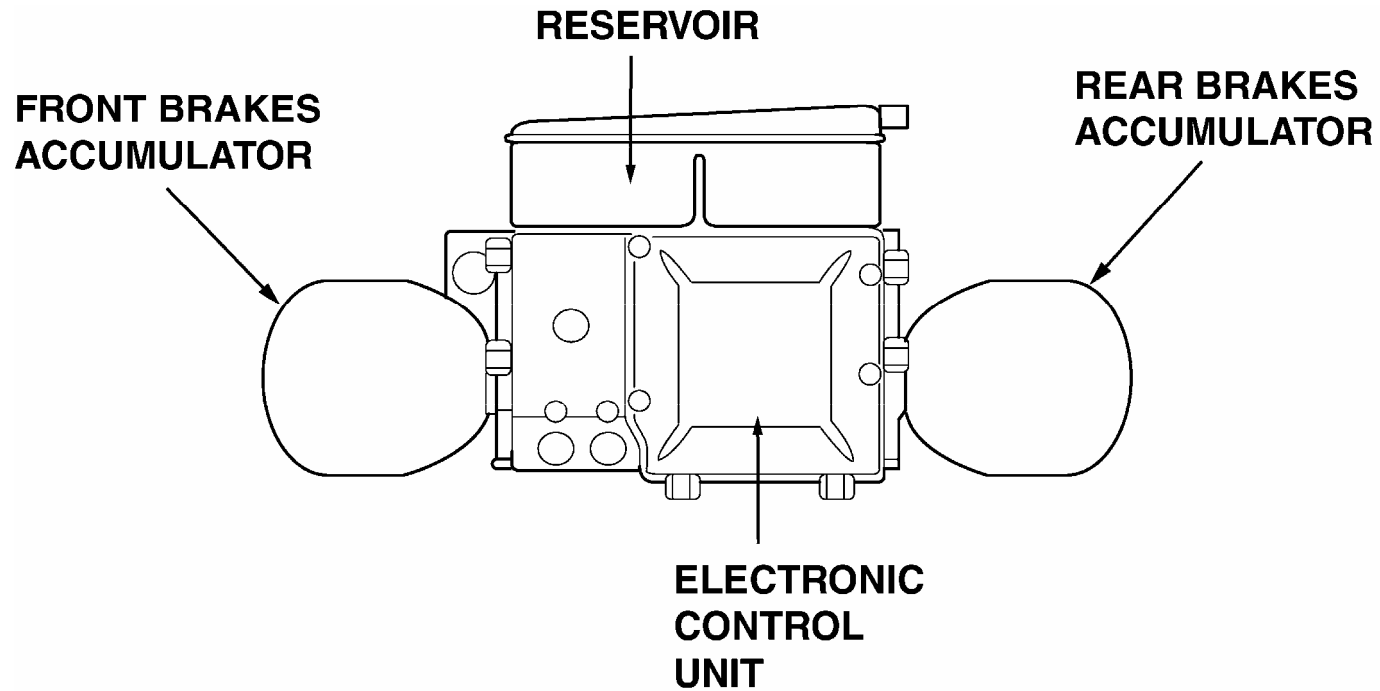


HB034





# Accumulator Locations



HB052





# Anti-Lock Brakes and Automatic Traction Control

- ABS OPERATION
  - ABS Module (ECU) senses when wheels are about to lock up.
  - Sensors are positioned at each wheel end.
  - ECU compares wheel speeds.
  - To prevent lock up, ECU uses solenoid valves to decrease and then increase brake pressure at affected wheel.
  - Process repeated several times per second.
  - Allows driver to maintain control of vehicle.
  - System reverts to foundation brakes if malfunction occurs.





# Anti-Lock Brakes and Automatic Traction Control

- ATC OPERATION

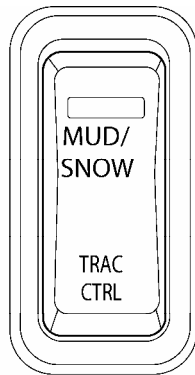
- ATC system prevents wheel slippage or traction loss during vehicle acceleration.
- Monitors wheel speed to detect spin.
- ECU uses solenoid valves to apply brake pressure to spinning wheel, transferring torque to non-slipping wheel.
- If both wheels slipping, engine ECU will reduce torque to help slipping wheels recover.







# Conditions that affect ATC



HBO51

- Both Rear Wheels Spinning
  - Reduced engine torque
- ATC Switch in Disable Position
  - Deep Snow Mode





# Review Questions



1. Instead of intensifying the pressure exerted on the master cylinder piston, the Hydraulic Full Power Brake System uses Hydraulic Accumulators to provide the energy necessary to actuate the 4-wheel disc brake calipers.
2. Where is the HCU located? **Inside Left Frame Rail**
3. The pressure from the master cylinder only acts as a pilot pressure and is not directly plumbed to the calipers.  
(Circle one)      **TRUE**      FALSE
4. What is the purpose of the two pressure sensing switches in the HCU? **Inside Left Frame Rail Monitor the pressure in the front and rear brake circuits, and turn the pump motors ON and OFF.**
5. What is the purpose of the relay valve located at the bottom of the HCU? **Receives pilot signal from the Master Cylinder, controls the application of high pressure brake fluid from the accumulators to the brake calipers.**







# Module 2: Spring Applied/Hydraulic Release Powered Parking Brake System

## **Objectives:**

Upon successful completion of this lesson, you will be able to identify the components and describe the operation of the Spring Applied/Hydraulic Release Powered Parking Brake System.





# Module 2: Contents



Spring Applied/Hydraulic Release Powered Parking  
Brake System Overview

Spring Applied/Hydraulic Release Canister  
Pressure Supply Valve Coil and Valve Assembly

Parking Brake Switch

Parking Brake Cable

Parking Brake Interlink Function

Automatic Parking Brake Apply

Releasing the Parking Brake

Faults that cause parking brake to stay applied

Review Questions





# Spring Applied/Hydraulic Release Powered Parking Brake System Overview

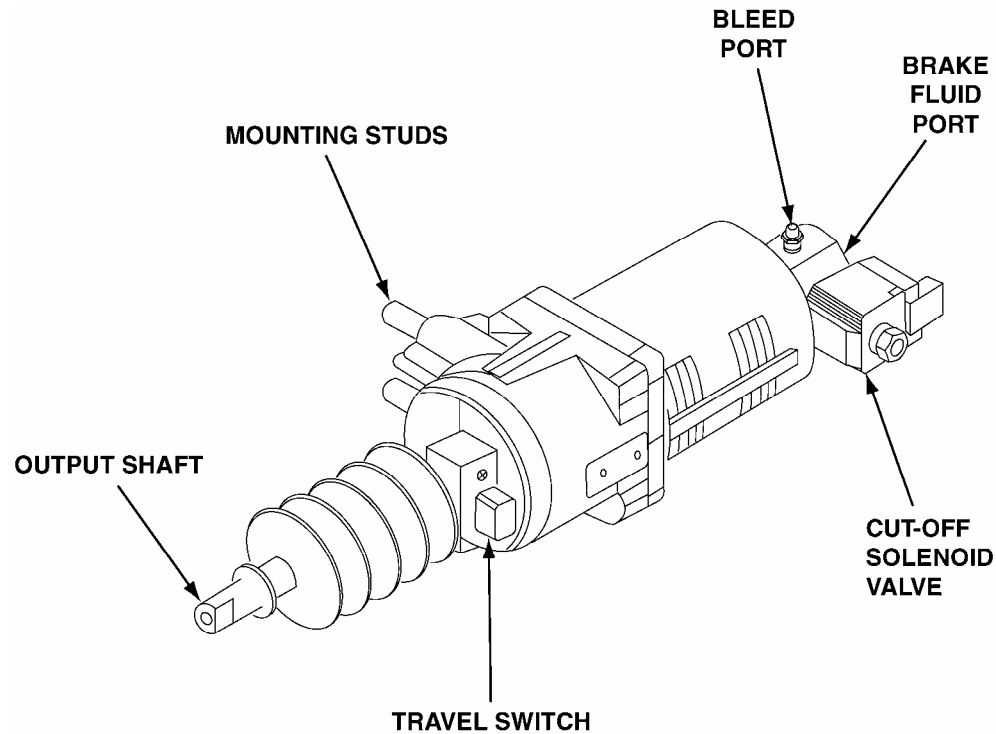
The Spring Applied/Hydraulic Release Powered Parking Brake System uses hydraulic pressure from the HCU to release the parking brake. The Spring Applied/Hydraulic Release Parking Brake System is made up of the following components:

- Spring Applied/Hydraulic Release Canister
- Pressure Supply Valve Coil and Valve Assembly
- Parking Brake Cable
- Parking Brake Switch
- Parking Brake Drum Assembly





# Spring Applied/Hydraulic Release Canister

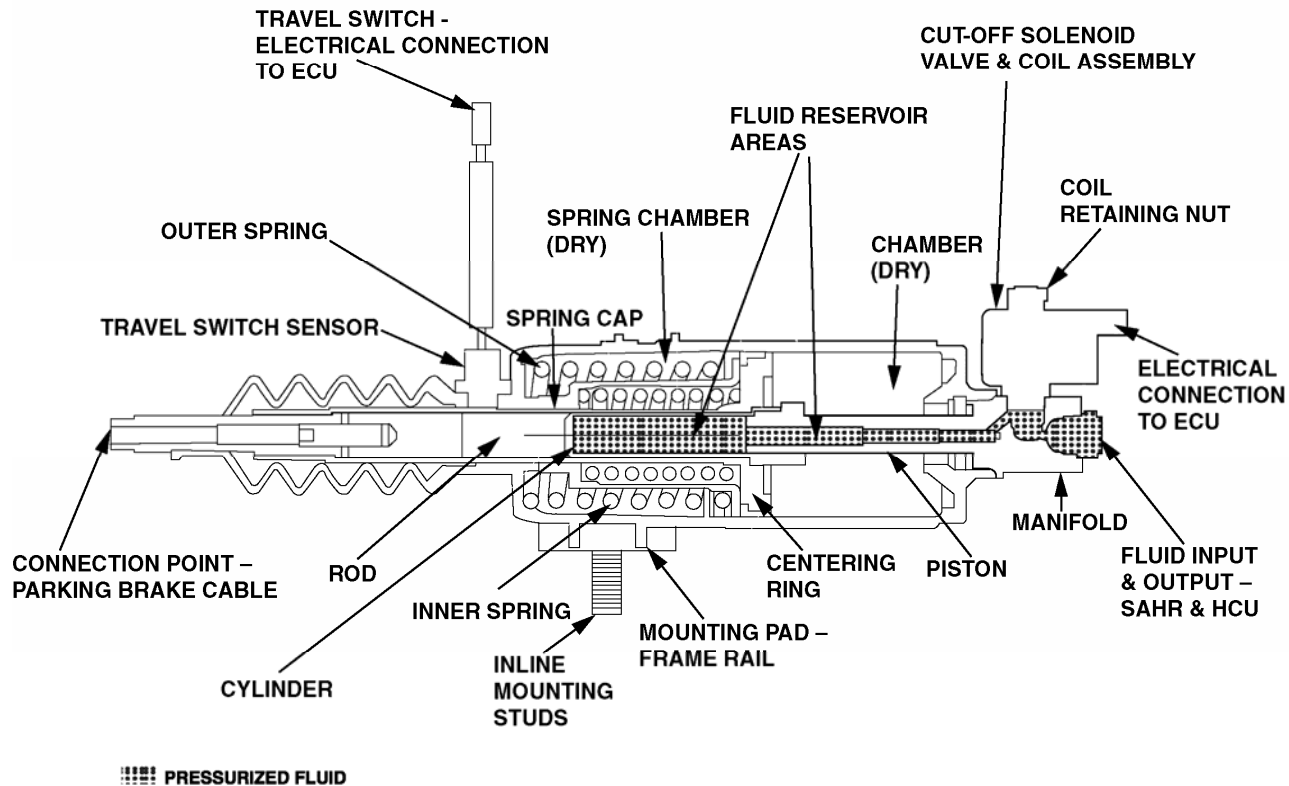


HB038





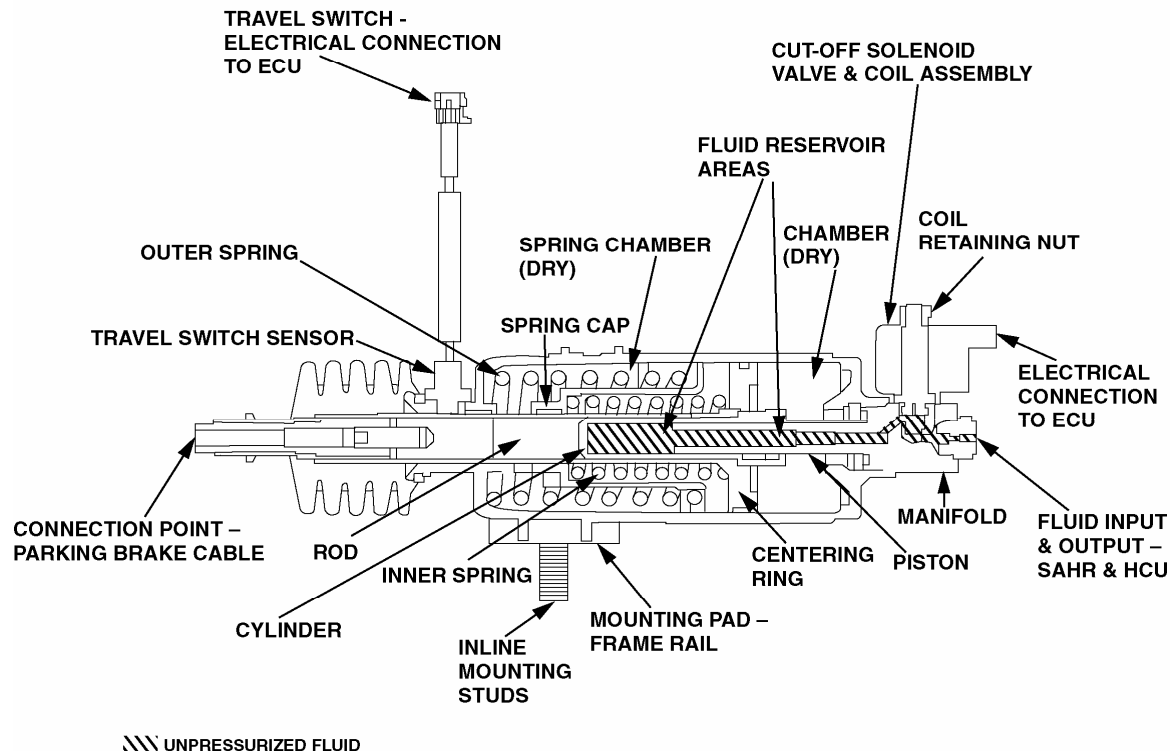
# Spring Applied/Hydraulic Release Powered Parking Brake Released Position







# Spring Applied/Hydraulic Release Powered Parking Brake Applied Position

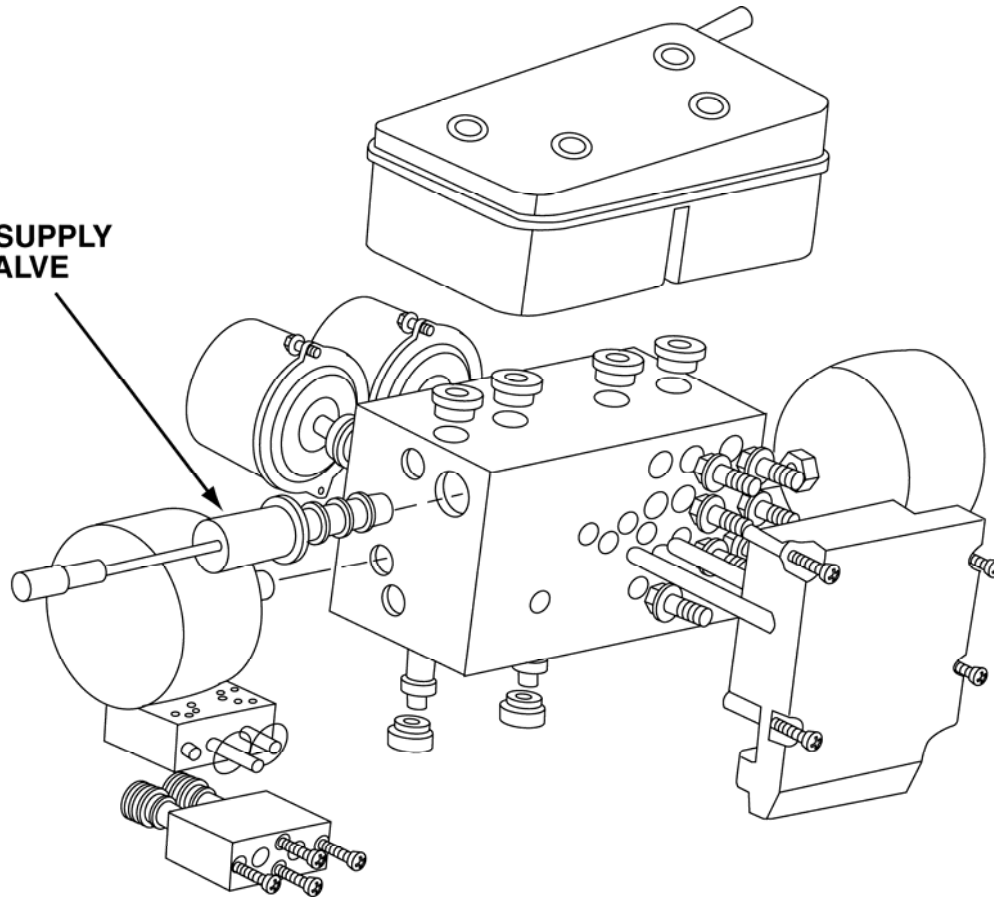


HB017\_A



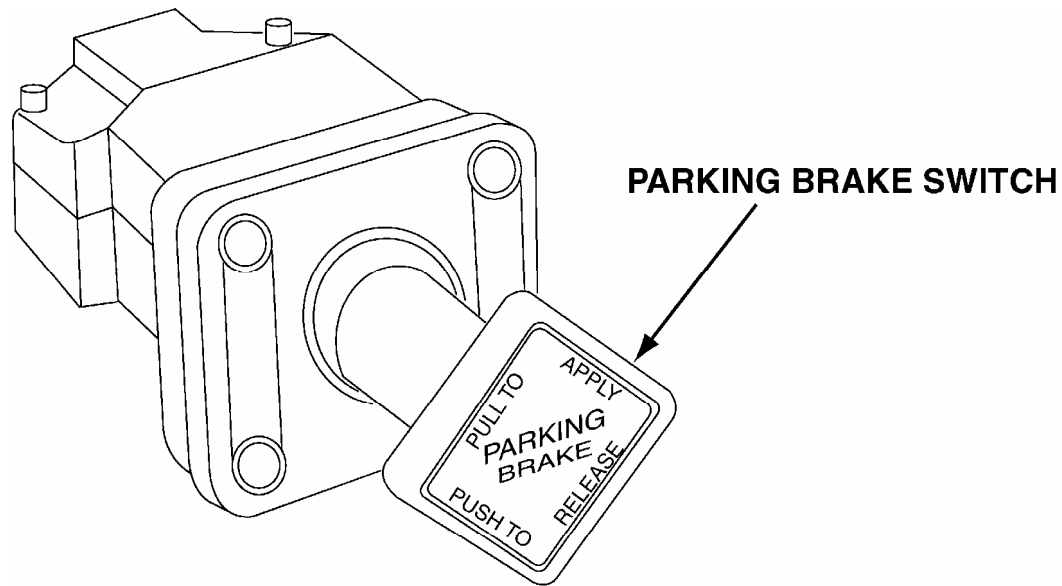
# Pressure Supply Valve Coil and Valve Assembly

**PRESSURE SUPPLY  
COIL AND VALVE  
ASSEMBLY**





# Parking Brake Switch

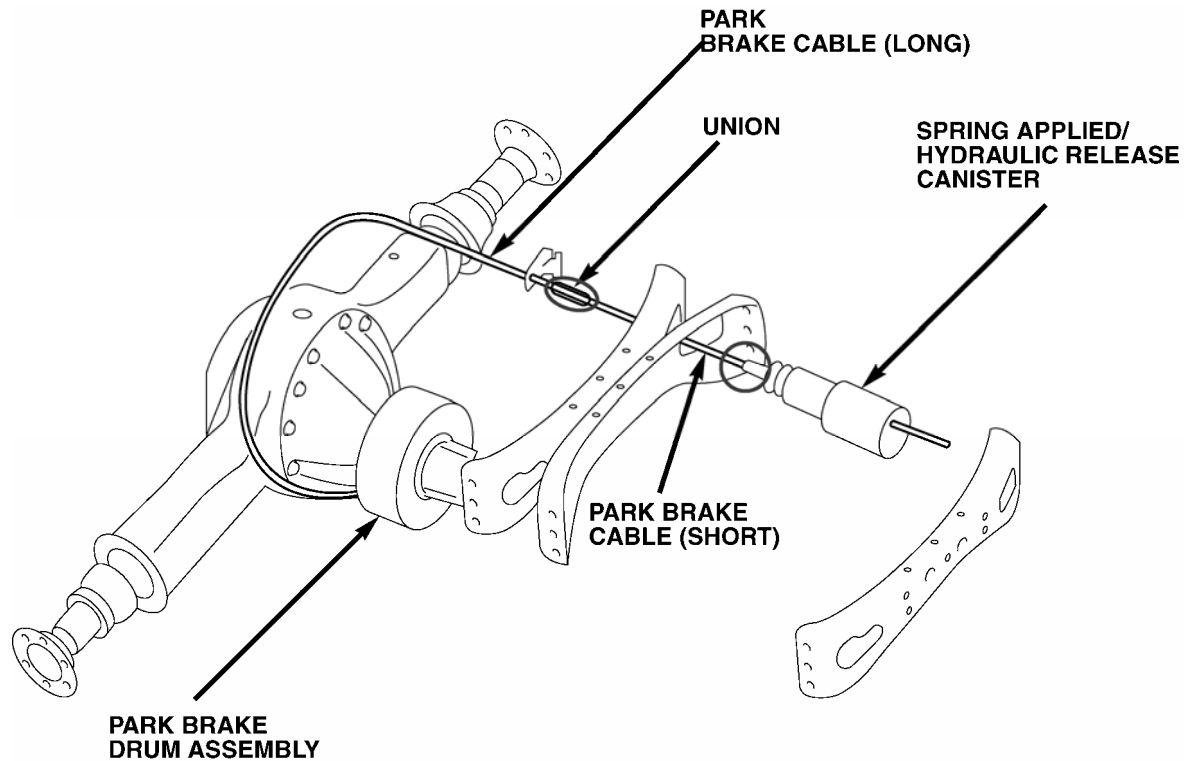


HB042





# Parking Brake Cable



HBO39\_A





# Parking Brake Interlink Function

- The Full Power Brake System has been engineered to include special safety features. These features are referred to as the Parking Brake Interlink. For instance, if the parking brake switch is pulled during vehicle operation, the system reacts by using a programmed algorithm in the ABS to apply the foundation brakes, stopping the vehicle quickly and under control. There is no sudden brake application.





# Automatic Parking Brake Apply



The parking brake applies automatically if any of the following fault conditions are met.

- Loss of pressure in the primary brake circuit.
- Complete loss of system electrical power, i.e., no power from either the battery or alternator.
- Erroneous electrical signal (such as a false brake signal).
- Park brake hydraulic circuit failure, for example something in the fluid circuit that prevents pressurization of the Spring Applied/Hydraulic Release canister.
- Double fault (cutoff valve fault, followed by a PSV fault).





# Releasing the Parking Brake

The following conditions must be met to release the parking brake:

- The key must be in the ignition position (ON).
- The brake pedal must be pressed.
- If equipped, the wheelchair lift must be properly stowed.
- The transmission selector must be out of the PB mode.





# Faults that will Cause Parking Brake to Stay Applied

The following faults must be corrected before the parking brake can be released:

- An electrical circuit fault regarding the parking brake switch.
- Loss of pressure in the primary circuit.
- Defective pressure supply valve (PSV).
- Active faults present (historic faults have no effect).
- Battery voltage less than 9 VDC.









# Module 3: Instrument Cluster Warning Lights

## **Objectives:**

Upon successful completion of this lesson, you will be able to identify and describe the operation of the Full Power Brake System instrument cluster warning lights.





# Module 3: Contents



Instrument Cluster Warning Light Operation  
Brake Pressure Warning (Red)  
Fluid Level Warning (Red)  
ABS Warning (Amber)  
Park Brake (Red)  
Service Park Brake (Red)  
Traction Control Indicator Light (Green)  
Review Questions







# Brake Pressure Warning (Red)



- **Solid On:** Low pressure detected. Accompanied by an audible alarm if not in Light Check at Start Up.
- **Flashing:** Full System Failure. Low pressure detected. Accompanied by Audible Alarm.

# BRAKE PRESSURE





# Fluid Level Warning (Red)

- **Solid On:** Low brake fluid level detected by sensor in master cylinder reservoir.
- **Off:** System Fluid Levels OK.

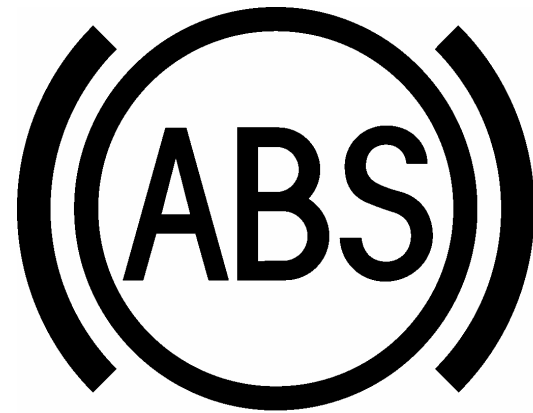
**BRAKE  
FLUID**





# ABS Warning (Amber)

- **Solid On:** System is not receiving power. Communications between ECU and ESC have been lost. ABS fault has been detected.
- **Off:** System is OK.





# Park Brake (Red)



- **Solid On:** Parking Brake Applied.
- **Off:** Parking Brake Released.

**PARK**







# Service Park Brake (Red)

- **Solid On:** problem with parking brake circuit has been detected. May include Spring Applied/ Hydraulic Release travel switch, cut off coil or supply coil.
- **Off:** System has not detected any faults.

**SERVICE**  
**(P)**





# Traction Control Indicator Light (Green)

- **Solid On:** Fault has been detected in ATC Circuits or traction control is enabled and the vehicle is experiencing an ATC event.
- **Flashing:** System is disabled.
- **Off:** When this light is OFF, the following conditions are present:
  - A. No fault has been detected in the ATC circuits.
  - B. The vehicle is not experiencing an ATC event.
  - C. The ATC dash switch is positioned in the Enable mode, also referred to as the Normal mode.

# TRAC CTRL





# Review Questions



- 1.™ Describe a level 1 brake pressure warning:  
**Low pressure condition if 1 of the 2 brake circuits is failing.**
2. Describe a level 2 brake pressure warning:  
**Both primary and secondary brake circuits are experiencing a fault.**
3. List 3 conditions that can cause the ABS warning light to illuminate:  
**System not receiving power, Communication between the ECU and ESC is lost, Experiencing an ABS event.**
4. Which FPB instrument cluster light is used to indicate status of a component only? Hint, this is the only light that is not used to indicate a system fault.  
**Park Brake Position Light**
5. List at least 4 conditions that can cause the service parking brake warning light to illuminate:  
**ECU determined a problem with the Powered Park Brake system, Over travel, Under travel, no travel of the parking brake cable; If the ECU detects a voltage or current problem.**





# Module 4: Basic Troubleshooting



## Objectives:

Upon successful completion of this lesson, you will be able to describe the Full Power Brake System faults that cause warning lights to illuminate. Also you will be able to identify how Full Power Brake System fault messages are transmitted to the electronic gauge cluster. Finally you will be able to operate WABCO (minimum Level 5.0) TOOLBOX® Software to identify Full Power Brake System faults and obtain preliminary repair instructions. View Full Power Brake System operating conditions. Perform Full Power Brake System component functional tests. Program a Full Power Brake System ECU.

 Title 3. 10:00 Minutes



# Module 4: Contents



Full Power Brake System Fault Detection  
Brake Pressure Warning Light  
Fluid Level Warning Light  
ABS Warning Light  
Service Park Brake Warning Light  
Traction Control Warning Light  
Introduction to the WABCO TOOLBOX®  
Review Questions





# Full Power Brake System Fault Detection



Full Power Brake System faults are indicated by five warning lights located at the top and center of the Electronic Gauge Cluster.

1. Brake Pressure
2. Fluid Level
3. ABS
4. Service Park Brake
5. Automatic Traction Control (ATC)





# Brake Pressure Warning Light

The warning light illuminates when there is a problem with the operating pressure of the brake system. Specifically, a fault is detected by the ECU when pressure falls below 1550 psi. The normal operating range is 1880 to 2300 psi for both the primary and secondary brake circuits. The signal path for communicating this fault is:

1. Full Power Brakes ECU
2. J1939 Data Link
3. Electrical System Controller
4. J1939 Data Link
5. Electronic Gauge Cluster





# Fluid Level Warning Light

When the brake fluid in the Master Cylinder reservoir falls below the MINIMUM mark, the ECU logs a fault and the fluid level warning light illuminates. The signal path for communicating this fault is:

1. Fluid Level Switch
2. Full Power Brakes ECU
3. J1939 Data Link
4. Electrical System Controller
5. J1939 Data Link
6. Electronic Gauge Cluster







# ABS Warning Light



Since the ECU is constantly monitoring the wheel speed sensors, ABS solenoid valves, and the ABS light, any problem in the performance of these components logs a fault in the ECU and illuminates the ABS warning light. Some situations that could cause a fault in the ABS system are:

- Full Power Brake system is not receiving electrical power.
- Wheel speed sensors are positioned too far from the tone ring, as indicated by a change in the amplitude of the signal being sent to the ECU. In addition, non-approved wheel speed sensor can log an ABS fault because the sensor operates with a different amplitude and frequency. Another reason would be if no signal at all is being sent to the ECU.
- ABS solenoid valves that are not functioning properly.
- ECU has determined that the voltage and current draw across the solenoid valves are out of range.
- Communications between the ECU and the ESC has been lost.

The signal path for communicating an ABS fault is:

1. Full Power Brakes ECU
2. J1939 Data Link
3. Electrical System Controller
4. J1939 Data Link
5. Electronic Gauge Cluster





# Service Park Brake Warning Light



The service park brake warning light illuminates when the ECU has detected a fault in the circuits that serve the Spring Applied/Hydraulic Release system. Some problems that could be occurring within the circuits of the Spring Applied/Hydraulic Release system are:

- The travel switch at the rear of the Spring Applied/Hydraulic Release canister indicates either an under travel, over travel, or no travel condition of the parking brake cable that connects the Spring Applied/Hydraulic Release canister to the rear axle parking brake drum. The signal path for communicating this fault is:
  1. Travel Switch
  2. Full Power Brakes ECU
  3. J1939 Data Link
  4. Electrical System Controller
  5. J1939 Data Link
  6. Electronic Gauge Cluster





# Service Park Brake Warning Light (cont.)



The coil that controls the pressure supply valve at the rear of the Hydraulic Compact Unit, and the coil that controls the cutoff valve mounted at the front of the Spring Applied/Hydraulic Release canister, is shorted or open. Any abnormal voltages supplied to these coils can also set a fault. The signal path for communicating the faults associated with either of these two devices is:

1. Full Power Brakes ECU
2. J1939 Data Link
3. Electrical System Controller
4. J1939 Data Link
5. Electronic Gauge Cluster.





# Traction Control Warning Light



The Trac Cntrl warning light illuminates when the ECU has detected a fault in the traction control system circuits. Specifically, the ECU monitors for any potential problems at the:

- Rear wheel speed sensors
- ATC solenoids
- ABS solenoids that serve the rear brakes
- Power circuits to the solenoids
- J1939 Data Link

The signal path for communicating this fault is:

1. Full Power Brakes ECU
2. J1939 Data Link
3. Electrical System Controller
4. J1939 Data Link
5. Electronic Gauge Cluster.





# Introduction to the WABCO TOOLBOX®

PC-based diagnostic system used to:

- Retrieve system faults
- Report operating conditions
- Test individual components
- Program ECU after replacement

Displays both diagnostic and repair  
information on one screen





# Operating Conditions

Typical operating condition information displayed:

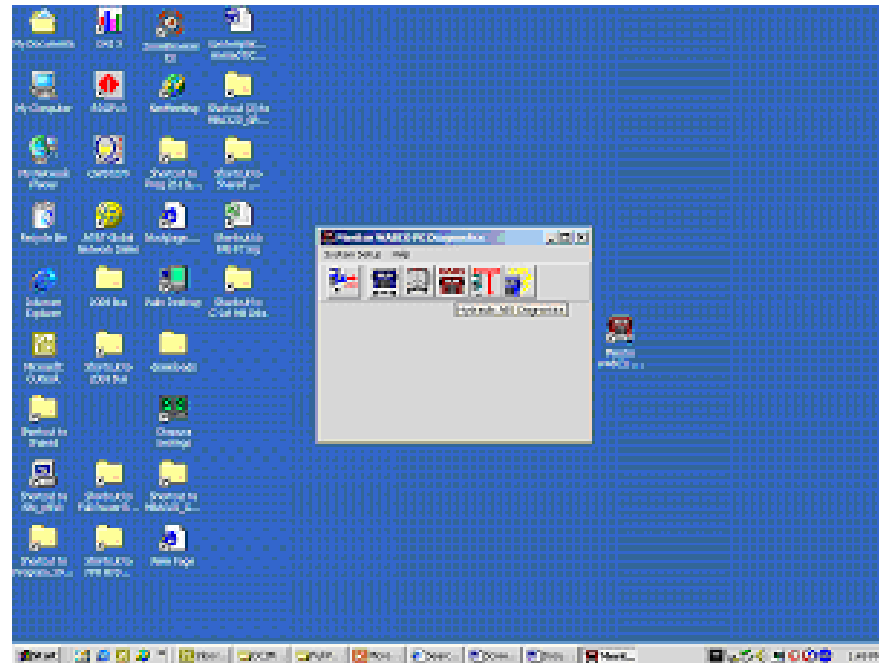
- Number of ignition cycles
- Quantity of ABS/traction control events
- Powered park brake applications
- Pump motor run time
- Severity of foundation braking events

Information can be cleared back to a “zero” setting.





# Meritor WABCO PC Diagnostics Window





# Faults



Meritor WABCO HPB

Tractor ECU Display Component Tests Help

EXIT [ABS] [Bar Graph] [Light Bulb] [ATC] [ATC] [Warning Icon]

ECU Information		Wheel Sensor	
ECU Type	<input type="text"/>	RPM	MPH
Part Number	<input type="text"/>	Left Front	<input type="text"/>
Manufacture Date	<input type="text"/>	Right Front	<input type="text"/>
Serial Number	<input type="text"/>	Left 2nd	<input type="text"/>
Software Rev.	<input type="text"/>	Right 2nd	<input type="text"/>

Faults	Learned Component	Road Speed
<input type="checkbox"/> Existing <input type="checkbox"/> Stored	<input type="checkbox"/> Retarder Relay	<input type="text"/> (mph)

Control Status	Switches	Voltages
ABS Brake <input type="text"/>	ATC <input type="text"/>	Battery <input type="text"/>
ABS Retarder <input type="text"/>	Foot Brake <input type="text"/>	Ignition <input type="text"/>
ATC Brake <input type="text"/>	Parking Brake <input type="text"/>	<b>Lamps</b>
ATC Engine <input type="text"/>	Low Brake Fluid <input type="text"/>	ABS <input type="text"/> ATC <input type="text"/> Brake <input type="text"/>
Parking Brake Actuator <input type="text"/>	<b>Pressure (psi)</b>	
PB Monitor Switch <input type="text"/>	Front Axle <input type="text"/>	
	Rear Axle <input type="text"/>	

RP1210A Error: 128II

03/17/2004 10:41 AM







# Actuate Outputs



The screenshot displays the 'Monitor WABCO HPB' software interface. The window title is 'Monitor WABCO HPB' and it includes a menu bar with 'Tractor ECU', 'Display', 'Component Tests', and 'Help'. Below the menu bar is a toolbar with various icons representing different vehicle systems.

**ECU Information**

ECU Type	HPB (12V)
Part Number	0049060562
Manufacture Date	02/20/2000
Serial Number	00000226
Software Rev.	HEAA0011

**Wheel Sensor**

	RPM	MPH
Left Front	0	0
Right Front	0	0
Left 2nd	0	0
Right 2nd	0	0

**Faults**

None Existing **Yes** Stored

**Learned Component**

Retarder Relay

**Road Speed**

0 (mph)

**Control Status**

ABS Brake	Off
ABS Retarder	N/A
ATC Brake	
ATC Engine	
Parking Brake Actuator	Active
PB Monitor Switch	Applied

**Switches**

ATC	
Foot Brake	On
Parking Brake	On
Brake Fluid	Low

**Pressures (psi)**

Front Axle	1715
Rear Axle	1932

**Voltages**

Battery	11.20
Ignition	11.18

**Lamps**

ABS	ATC	Brake
Off	Off	N/A

ATC Disabled 8/20/03 12:10 PM





# Operation Conditions



HB022





# Fault Information Window

**Fault Information** [X]

**Faults:**

NUM	FAULT NAME	TYPE	TIMES	SID	FMI
1	Parking Brake System - Overtravel	Inactive	1	61	13
2	J1939 Communication Message time-out	Inactive	4	248	9
3	Right Front Sensor - Air gap too large	Inactive	1	2	1
4	Parking Brake System - Could not be applied	Inactive	1	61	3

**Repair Instructions:**

Spring Applied Hydraulic Release overtravel detected. Check Spring Applied Hydraulic Release brake lining.

[Update] [Clear Faults] [Print] [Save] [Exit]

HB023





# Navigating Within the Toolbox

Operating Time (hours)	<input type="text" value="86"/>	
<b>Pump Motor Hours</b>		
Front Axle	<input type="text" value="0.00"/>	<input type="button" value="Clear Hours (Front)"/>
Rear Axle	<input type="text" value="0.00"/>	<input type="button" value="Clear Hours (Rear)"/>
<b>Brake Event Counters</b>		
Decel < 0.2g	<input type="text" value="260"/>	<input type="button" value="Clear Counters"/>
Decel < 0.2g - 0.5g	<input type="text" value="1"/>	
Decel > 0.5g	<input type="text" value="0"/>	
<b>Miscellaneous Counters</b>		
Parking Brake Events	<input type="text" value="42"/>	<input type="button" value="Clear Parking Brake Events"/>
ABS Events	<input type="text" value="0"/>	<input type="button" value="Clear ABS Events"/>
ATC Events	<input type="text" value="0"/>	<input type="button" value="Clear ATC Events"/>
Ignition Cycles	<input type="text" value="147"/>	<input type="button" value="Clear Ignition Cycles"/>
<input type="button" value="Close"/>		

HB025





# Review Questions



1. What is the normal operating range for the primary and secondary brake circuits?  
**1770 – 2320 psi**
2. A fault is detected by the ECU when brake circuit pressure falls below:  
**1550 psi**
3. Wabco TOOLBOX® software has the ability to identify system faults and display corresponding repair information.

(Circle one)

**TRUE**

FALSE

4. List at least vehicle 4 operating conditions that can be tracked by the Wabco TOOLBOX® software:

**Number of ignition cycles, Number of ABS events, Total run time of pump motors, Severity of foundation brake events**





# Module 5: Service Highlights

## **Objectives:**

Upon successful completion of this lesson, you will be able to identify serviceable and non-serviceable Full Power Brake System components and describe key service issues for Full Power Brake System components.





# General Warnings and Cautions



Pay attention to Service Information Warnings and Cautions regarding:

- Handling pre-charged HCU
- Depressurizing system before service (system pressure = 2,000 psi)
- Maintaining system cleanliness; do not use mineral oil for cleaning
- General brake fluid cautions
- Cover open electrical connections; plug open brake fluid ports





# Wheel Speed Sensor Adjustment and Testing



- Steering axle sensors are on inboard side of the knuckle.
- Fixed axle sensors are on inboard side of rear axle spindle.







# Wheel Speed Sensor Adjustment



- Install new sensor and push by hand until sensor contacts tooth wheel.
- Sensor will self-adjust during normal wheel rotation.
- During normal operation, gap must not exceed 0.04-inch.





# Sensor Resistance Test



- Sensor resistance must be between 500 and 2000 ohms.
- To measure sensor resistance at ECU, disconnect the ECU connector.
- To measure resistance at the sensor, disconnect the sensor chassis harness connector; check between the pins indicated in the appropriate service information.





# Wheel Speed Sensors Replacement



- Thoroughly clean area before replacing.
- Disconnect sensor at chassis wiring harness; twist/pull on sensor to remove from spring clip (DO NOT pull on cable).
- When installing a new sensor and/or spring clip, lubricate with approved Meritor-WABCO lubricant or equivalent.
- Clear ECU of any error codes when service is complete.

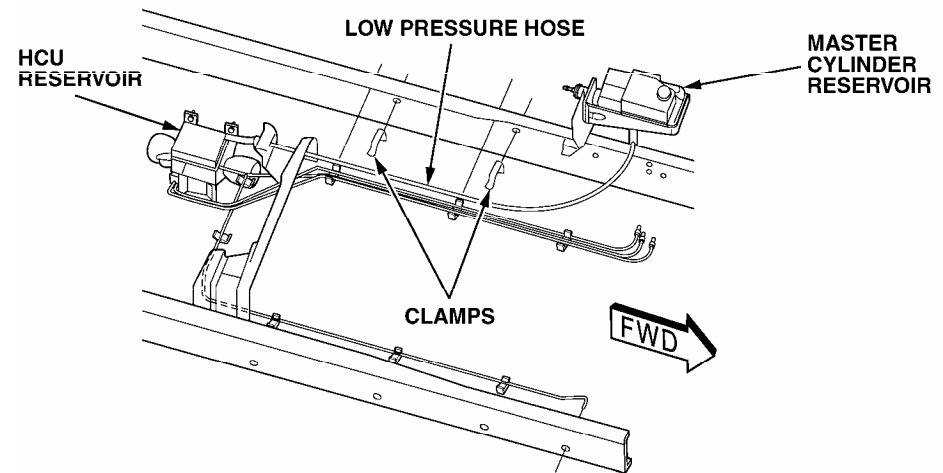




# Low Pressure Hose Replacement



- MUST be replaced with DOT 3-compatible hose.
- 30-amp pump motor fuses must be removed.
- Depressurize system prior to removal/ replacement.
- Keep new hose ends sealed until ready to connect.
- Carefully follow procedures for filling new accumulators.
- **WARNING:** If leakage is noticed after installation, system must be depressurized again before servicing leaks.



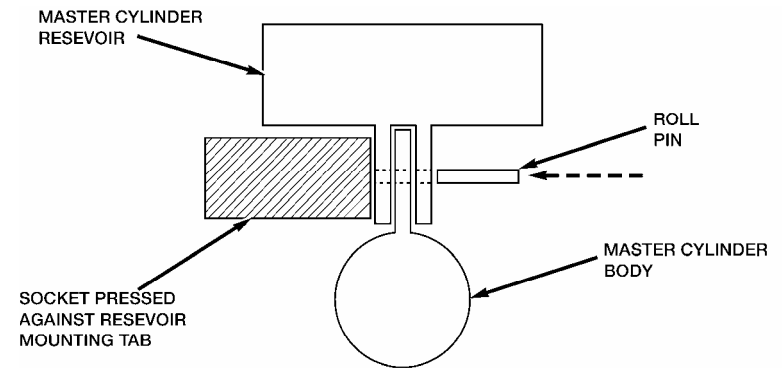
HB030





# Master Cylinder Reservoir Replacement

- During M/C service, do not depress brake pedal until told to do so.
- Depressurize system before servicing.
- Position a container to catch drained brake fluid under M/C.
- Protect mounting tabs from excessive deflection when installing roll pin (see diagram).
- Connect travel switch electrical connector when directed.
- Bleed system following service.



HB031





# Brake Travel Switch Replacement



- Depressurizing system is not required (travel switch/brake light switch can be replaced without opening system).
- Discard old switch seal after removal; replacement switch comes with a new seal.
- Check brake lamp operation following service.





# Fluid Level Switch Replacement



- Depressurizing system is not required (fluid level switch can be replaced without opening system).
- Switch body is held in place by locking tabs.





# Parking Brake Inspection and Adjustment

- Observe all warnings and cautions in the Service Information when working on parking brake.







# Warnings and Cautions



- Always set wheel chocks when servicing parking brake system.
- Use floor stands in addition to hydraulic or mechanical jacks to support vehicle.
- Work on brake components away from other service areas, and in accordance with OSHA regulations.
- Clean brake parts in the open air, and use an industrial vacuum with HEPA filter to remove dust.
- Do not allow brake parts to be contaminated with grease or oil.





# Parking Brake Inspection – Drum Removed

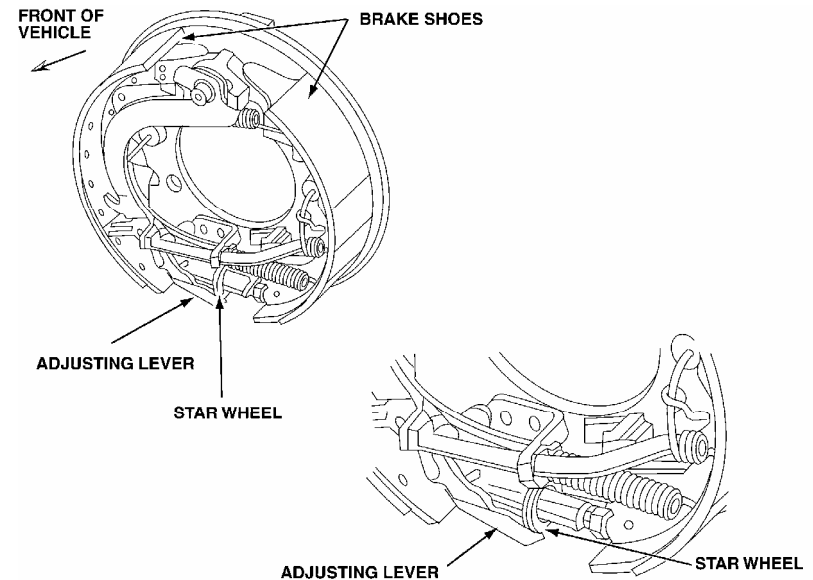
- Inspect brake shoes for uneven wear, wear beyond 0.762 mm (0.030 inch) above shoes, contamination or cracks; replace as necessary.
- Inspect brake lever and cam for excessive cracks, wear or bends.
- Inspect springs/hold-down pins, adjuster cable assembly, adjuster nut and screw.
- Check for burrs, chips or other damage to adjuster nut star wheel.
- Measure drum for uneven wear, and replace if necessary.





# Brake Shoe Adjustment – Drum Removed

- Move measuring tool up and down between shoe center points to ensure measurement is being made at the highest point. This will ensure against over-adjustment.
- Follow additional measurement procedures in Service Manual before seating shoes.



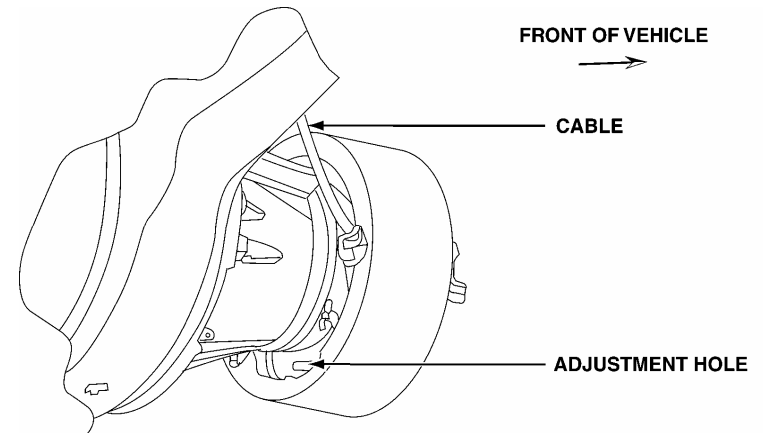
HB026





# Brake Shoe Adjustment – Drum Installed

- Raise and support rear axle (drive shaft must freely rotate for adjustments).
- Adjusting screw star wheel has a paint mark to aid in adjustment.



HB027





# Pressure Supply Valve (PSV) and Coil Service Highlights

- NOTE:** The PSV is available in kit form and includes a solenoid valve with three O-rings, a plastic nut with O-ring, and a coil.
- Using the EZ-Tech® service tool and the TOOLBOX® diagnostic software, clear any diagnostic codes that were detected by the ECU during this service procedure.
  - Remember to apply and then release the powered parking brake several times to verify proper operation and to observe for any additional fault codes.





# Spring Applied / Hydraulic Release Canister Replacement

When removing the Spring Applied/Hydraulic Release canister you must depressurize the brake system.

To depressurize the system:

- Depress the brake pedal at least 30 times.
- Use the EZ-TECH® and TOOLBOX® software to verify that pressure at both accumulators are at or near the 0 psi value.

**NOTE:** The replacement Spring Applied/Hydraulic Release canister is packaged as a complete assembly and includes all the necessary components, except the two mounting nuts and nylon bushings, which can be ordered separately through Service Parts.





## CE Braking System Areas Requiring Preventative Maintenance

- Corrosion on SAHR and HCU solenoids
- Electrical Connectors Loose and Corroded
- Excess 'Stress' on Harnesses
- Incorrectly Adjusted Parking Brake





Thank You!

