



Service Data

SD-08-12000

Electronic Air Control (EAC) System - Integrated with Bendix® EC-80™ Electronic Control Unit (ECU)

INTRODUCTION

The Electronic Air Control (EAC) system is a set of software functions that are integrated into a special version of the Bendix® EC-80™ Electronic Control Unit (ECU).

The EAC system adds new and improved features supporting the Bendix® AD-HFi™ air dryer including J1939 messaging, Diagnostic Trouble Codes (DTCs), advanced functionality, and governor control.

Beyond basic governor control, the EAC system has advanced features to optimize air system pressure control and conserve energy. Also, the EAC system has advanced purge operations to protect the air system against moisture.

IMPORTANT

Bendix®-brand Electronic Control Units (ECUs) are not designed to store data for purposes of accident reconstruction, and Bendix® ACom® Diagnostic Software is not intended to retrieve data for purposes of accident reconstruction. Bendix makes no representations as to the accuracy of data or video retrieved and interpreted from ECUs for purposes of accident reconstruction. Bendix does not offer accident reconstruction services or interpretation of stored data. Bendix ECUs are not protected from fire, loss of power, impact damage, or other conditions that may be sustained in a crash situation and may cause data to be unavailable or irretrievable.

DESCRIPTION

ELECTRONIC AIR CONTROL (EAC) SYSTEM

The Bendix EAC system adds intelligent electronic air control of the air compressor governor. The EAC system provides the basic governor operation to maintain safe air pressure levels and provides advanced features, along with air system diagnostic and prognostic information.

The EAC system communicates on the vehicle J1939 CAN bus and receives vehicle information including primary and secondary air pressures, engine speed, torque, and other vehicle operational conditions. The EAC system also transmits compressor state, diagnostic, and prognostic information, including cartridge lifetime prediction, on the vehicle CAN bus.

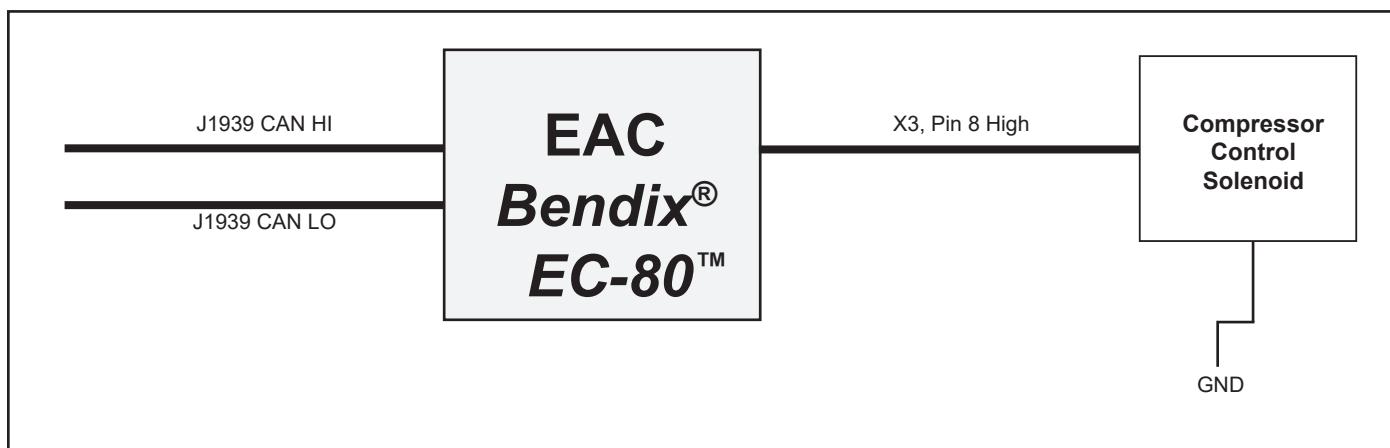


Figure 1 – EAC System Diagram

GENERAL SAFETY GUIDELINES

! WARNING! PLEASE READ AND FOLLOW THESE INSTRUCTIONS !

TO AVOID PERSONAL INJURY OR DEATH:

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

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

SYSTEM COMPONENTS

The Electronic Air Control (EAC) system is a set of software functions that are integrated into a special version of the Bendix® EC-80™ Electronic Control Unit (ECU).

- **Electronic Control Unit (ECU):** The ECU controlling the EAC system will be referred to as the EAC (EC-80 integrated) ECU. The EAC system is controlled by the integrated functionality located within the EC-80 ECU which receives air system pressure information from the vehicle J1939 CAN bus and controls the air compressor governor to maintain safe air pressure levels. The EAC (EC-80 integrated) ECU monitors the air system pressure. The unit energizes and de-energizes the compressor solenoid governor to

unload and load the vehicle air compressor. The EAC (EC-80 integrated) ECU also receives engine speed, torque, and vehicle speed from the engine Electronic Control Module (ECM) to provide advanced features. The brake EAC system advises the driver of any malfunctions. Diagnostic Trouble Codes (DTC) can be displayed via Bendix® ACom® Diagnostic Software to evaluate system status.

- **Compressor Solenoid Governor:** The compressor solenoid governor is controlled by the ECU to load and unload the air compressor.

- **Air Dryer (Bendix® AD-HFi™ SP Air Dryer and Bendix® AD-HFi™ EP Air Dryer):** The Electronic Air Control (EAC) system supports either the AD-HFi SP air dryer (200 cubic inch, standard purge tank) or AD-HFi EP air dryer (300 cubic inch extended purge tank). The vehicle EAC system has been parameterized at the factory and therefore designed for use with either an SP- or EP-size purge reservoir. If the air dryer is replaced, use the OE service part to ensure proper operation.
- **Air Compressor:** The EAC system is configured with the original equipment compressor only and therefore, any replacement compressor must be the same make and model.
- **EAC (Bendix® EC-80™ integrated) Electronic Control Unit (ECU) Variant:** The EAC (EC-80 integrated) ECU is supported by EC-80 Advanced only.
- **X3, Pin 8 Compressor Control Output from ABS8:** The EAC system drives the compressor solenoid governor through connector X3, Pin 8. When the EAC system energizes the compressor solenoid governor with positive voltage, the compressor will be unloaded and therefore, as a result, not building air pressure. When the EAC system de-energizes the solenoid governor, the compressor will be loaded and building air pressure.

ELECTRONIC AIR CONTROL (EAC) SYSTEM DESCRIPTION WITH BASIC GOVERNOR AND ADVANCED FEATURES

The EAC system provides basic governor control and advanced air system control features.

BASIC GOVERNOR CONTROL

The EAC system provides basic governor control and loads/unloads the compressor to maintain a safe air system pressure level. When the air pressure drops below the cut-in pressure threshold, the EAC system will load the compressor; when the air pressure is greater than the cut-out pressure threshold, the EAC system will unload the compressor and purge the air dryer desiccant to remove moisture.

ADVANCED FEATURES

The EAC system provides advanced air system control features.

- **Energy Savings:** The EAC system may exploit certain engine monitoring situations by allowing the compressor to engage and charge the system, taking advantage of otherwise wasted energy. This feature may result in slight overcharging of the service system, not to exceed 140 psi.
- **Performance Enhancements:** The EAC system may operate slightly different than a traditional pneumatic charging system. Because the EAC system can monitor the air system and vehicle use, it may not always load and unload the compressor at the same pressures. Additionally, the EAC system is also capable of monitoring the health of the air dryer cartridge using available vehicle data. If the EAC system determines that excessive water is accumulating in the air dryer cartridge, it may unload the compressor and initiate a purge. This may happen at a system pressure level lower than expected. After the interrupted charge is complete, the system will automatically continue to charge as normal and will purge again when maximum pressure is reached.
- **Cartridge Lifetime Prediction (CLP):** This feature monitors the vehicle usage conditions and provides an estimate of the health and remaining life. It also provides DTCs when the estimated life falls below certain threshold levels. Bendix® ACom® Diagnostic Software supports the resetting of the CLP to 100% remaining after servicing and replacing the cartridge.
- **Diagnostics:** The EAC system includes several different diagnostic features that can provide DTCs when abnormal system usage is suspected. This may include excessive compressor usage or excessive moisture build-up in the desiccant cartridge or system.

TROUBLESHOOTING

The Electronic Air Control (EAC) system normally operates in the basic governor mode as described above loading at cut-in and unloading (and regeneration) at cut-out air pressures. If there are fault conditions and/or vehicle or solenoid governor interface problems, normal operation and advanced features may be disrupted. In this case, check for the following abnormal conditions:

CONSTANT AIR BUILD: In certain fault conditions (i.e. the solenoid is not working properly or the air dryer is not properly connected), the EAC fail safe operation is to constantly load the compressor building air pressure. This condition will exist if there are compressor solenoid governor connection problems or missing or invalid vehicle CAN messages or signals.

- **Check the compressor solenoid governor:** The EAC system controls the compressor with a pneumatic solenoid. Check the connection from the Bendix® EC-80™, connector X3, Pin 8 to the solenoid (this is the high side or positive voltage to Pin 1 of the two-pin solenoid connector). Also, check the chassis ground connection to Pin 2 of the two-pin solenoid connector. When the primary or secondary air pressure is below cut-in, Pin 1 to the solenoid should be low or ground potential voltage to load the compressor. When the primary and secondary air pressures are above cut-out, Pin 1 to the solenoid should be high or positive potential voltage to unload the compressor.
- **Tank pressure:** If the primary and secondary tank pressure difference is more than 14 psi, the compressor may enter a state of constant air build.
- **Invalid primary or secondary pressure signal on CAN:** The primary and secondary pressure signals are sent to the EAC controller over CAN, originating from the vehicle system pressure sensors. During normal operation and when the service system is above cut-in pressure, these two (2) pressure signals should be approximately equal. If the pressure signals differ by more than one (1) bar (14.7 psi), the EAC system can no longer trust the signal information and may default to constant build of air. Check the values of these signals per the vehicle manufacturer's recommendation and replace if necessary.

- **Check the Vehicle J1939 CAN Connection and Baud Rate:** The EAC system requires vehicle CAN messages and signal information that controls the compressor. Check the vehicle J1939 CAN bus connections to the EAC system. Vehicle J1939 CAN_H should be connected to EAC X1, Pin 8, and CAN_L should be connected to EAC X1, Pin 7. The EC-80 is factory-programmed to operate at baud rate 250kB (standard) and 500 kB (optional). Check to ensure the vehicle CAN and EC-80 baud rates match.

UNEXPECTED DIFFERENCE IN CUT-IN AND CUT-OUT: The EAC system has advanced features that will temporarily adjust the normal cut-in and cut-out pressure thresholds.

- **Overrun (OVR):** When the vehicle is going downhill, for example, the OVR feature will temporarily raise the cut-in and cut-out pressures. *Refer to the OVR section within the EAC System Description with Basic Governor and Advanced Features.*
- **Overtake (OVT):** When there is high engine torque demand, the OVT feature will temporarily lower the cut-in and cut-out pressures. *Refer to the OVT section within the EAC System Description with Basic Governor and Advanced Features.*

EAC FAIL SAFE, DEFAULT OPERATION: Under certain operating conditions, the EAC system will go into the EAC fail safe default operation: Continuous Load, Building Air. These conditions are:

- **Loss of CAN:** No CAN communication.
- **Loss of AIR1 Message:** CAN communication is present, but there is no AIR1 message pressure information.
- **Pressure Implausibility:** The difference between primary and secondary pressure is beyond a threshold parameter.

ELECTRONIC AIR CONTROL (EAC) SYSTEM DEFAULT OPERATION AND SERVICE SHOP INSTRUCTIONS

- **Loaded Mode:** The EAC system stays in loaded mode, continuously building air; the Pressure Relief Valve (PRV) will activate at overpressure.
- **Cartridge Monitoring:** The EAC system continues to track air dryer cartridge health and will report associated Diagnostic Trouble Codes (DTCs).
- **Service Shop:** The service shop should be aware that if vehicle conditions put the EAC system into continuous load operation, the PRV can be compromised and the air dryer cartridge can become saturated. In this case, the service person should replace the PRV. The service person should also check for EAC system mid- and high-level wetness DTCs. If a high-level DTC exists, the air dryer cartridge should be replaced. *Refer to SD-08-12046, Bendix® AD-HF® and AD-HFi™ Service Data Sheet, on b2bendix.com.*

EAC SYSTEM DIAGNOSTIC SUPPORT

DTC DETECTION

The EAC system contains self-testing diagnostic circuitry that continuously checks for proper operation and external compressor solenoid governor and wiring.

DTC DESCRIPTION AND REPAIR INFORMATION

The EAC (Bendix® EC-80™ integrated) Electronic Control Unit (ECU) DTCs are supported with Bendix® ACom® Diagnostic Software. *Refer to Table 1.*

Depending on the version of Bendix® ACom® Diagnostic Software, it will display the EAC (EC-80 Integrated) ECU on its roll call and other relevant screens as either "*Bendix EC-80 EAC*" or "*Electronic Air Control (EC-80 integrated)*."

ELECTRONIC AIR CONTROL (EAC) (BENDIX® EC-80™ INTEGRATED) ELECTRONIC CONTROL UNIT (ECU) DIAGNOSTIC TROUBLE CODES (DTCS) AND SERVICE INFORMATION

SPN	FMI	DTC/Lookup Code	Description	Service Shop Information
629	12		Controller operational defect.	Replace the Antilock Braking System (ABS) Electronic Control Unit (ECU).
8621	13		Electronic Air Control (EAC) memory error.	Replace or reprogram the ABS ECU.
1351	3	32-3	Bendix® AD-HFi™ Air Dryer solenoid voltage above normal, or shorted to high source.	Inspect the AD-HFi air dryer solenoid Pin 1 for short to voltage source. See <i>Figure 2</i> .
1351	4	32-4	AD-HFi air dryer solenoid voltage below normal, or shorted to low source.	Inspect the AD-HFi solenoid Pin 1 for short to ground potential. See <i>Figure 2</i> .
1351	5	32-1	AD-HFi solenoid current below normal or open circuit.	Inspect the AD-HFi air dryer solenoid Pin 1 and Pin 2, wiring for open or disconnected solenoid. See <i>Figure 2</i> .
521614	2	34-4	EAC system pressure mis-match between primary and secondary circuit.	The difference between the primary and secondary pressures is greater than 14 psi. Inspect the air system pressure sensors for accuracy and inspect the pneumatic lines for damaged or kinked hoses.
521613	2	33-4	System pressure too high.	The solenoid status and pressure information is available. The compressor is in the unloaded state, but the pressure has been determined to be too high. Inspect the air system for damage and for blockages. Inspect the pressure sensor accuracy and plumbing.
521610	15	30-1	Cartridge remaining life low.	Pre-alert. 85% cartridge lifetime consumed and 15% cartridge lifetime remaining. Schedule cartridge replacement.

Table 1 – Troubleshooting Table

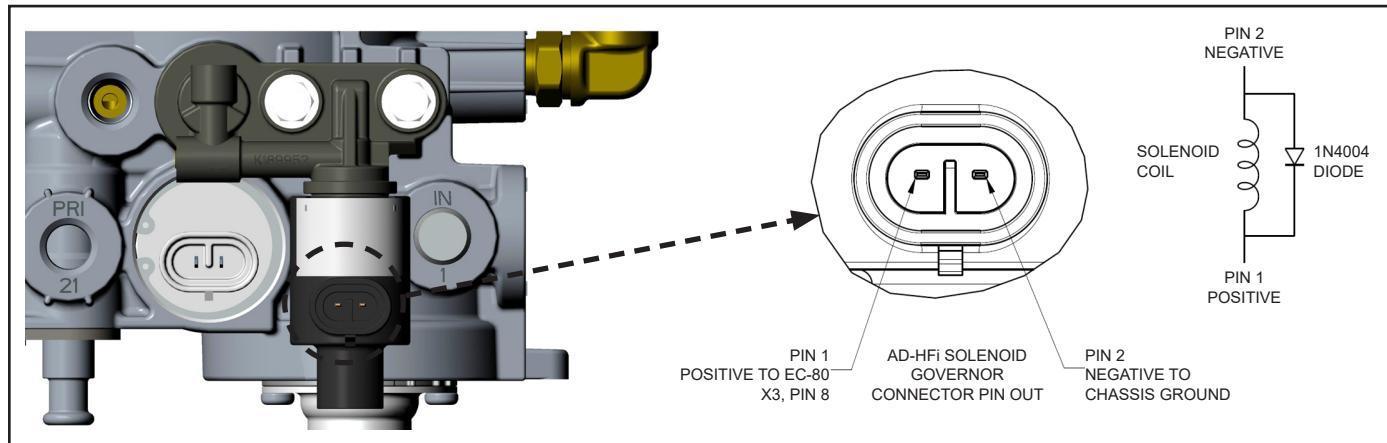


Figure 2 – Solenoid Governor Pin Out

SPN	FMI	DTC/Lookup Code	Description	Service Shop Information
521610	16	30-2	Cartridge life expired.	Nominal alert. 100% cartridge lifetime consumed and 0% cartridge lifetime remaining. Immediate cartridge replacement is recommended (refer to <i>SD-08-12046, Bendix® AD-HF® and AD-HFi™ Service Data Sheet, on b2bendix.com</i>).
521610	0	30-3	Cartridge life beyond expired.	Over-worn alert. 150% cartridge lifetime consumed. Replace immediately and inspect for possible water in the air system.
521611u	15		Excessive air compressor run time. Potential water in air tanks.	Over time, the air dryer may not have removed the proper amount of moisture in the air due to insufficient regeneration. Inspect the air system for leaks. Review the vehicle application for high air usage which will be indicated by a high-loaded compressor duty cycle. Review the purge frequency for insufficient regeneration. Check the reservoirs for water via drain valves. If no water is in the reservoirs, check the air system for function (charge and purge cycle) and confirm the safety valve is not popping off. If the safety valve is popping off, replace it (refer to <i>SD-08-12046, Bendix® AD-HF® and AD-HFi™ Service Data Sheet, on b2bendix.com</i>).
521611	16	31-2	Excessive air compressor run time. Likely water in air tanks.	Over time, the air dryer may not have removed the proper amount of moisture in the air due to insufficient regeneration. Inspect the air system for leaks. Review the vehicle application for high air usage which will be indicated by a high-loaded compressor duty cycle. Review the purge frequency for insufficient regeneration. Check the reservoirs for water via drain valves. If no water is in the reservoirs, check the air system for function (charge and purge cycle) and confirm the safety valve is not popping off. If the safety valve is popping off, replace it (refer to <i>SD-08-12046, Bendix® AD-HF® and AD-HFi™ Service Data Sheet, on b2bendix.com</i>).

Table 1 – Troubleshooting Table

SPN	FMI	DTC/Lookup Code	Description	Service Shop Information
521611	0	31-1	Excessive air compressor run time. Likely water in air tanks and potential damage to desiccant cartridge.	<p>Over time, the air dryer may not have removed the proper amount of moisture in the air due to insufficient regeneration. Inspect the air system for leaks. Review the vehicle application for high air usage which will be indicated by a high-loaded compressor duty cycle. Review the purge frequency for insufficient regeneration. Check the reservoirs for water via drain valves.</p> <p>If no water is in the reservoirs, check the air system for function (charge and purge cycle) and confirm the safety valve is not popping off. If the safety valve is popping off, replace it (refer to <i>SD-08-12046, Bendix® AD-HF® and AD-HFi™ Service Data Sheet, on b2bendix.com</i>). Desiccant cartridge may need replaced due to excessive moisture (refer to <i>SD-08-12046 on b2bendix.com</i>). Reset wetness level via Bendix® ACom® Diagnostic Software.</p>
521612	0	32-3	Electronic Air Control (EAC) compressor duty cycle above normal operational range.	Over time, the loaded duty cycle of the compressor has been determined to be too high. Inspect the air system for leaks and the compressor for air delivery capacity.
521615	15	35-1	AIR1 message not being received.	EAC is not receiving vehicle air system pressure information. Air compressor constantly loaded. Inspect J1939 CAN bus communication for the presence of AIR1 message and pressure information.
521616	15	35-2	EAC AIR1 primary tank pressure signal missing.	EAC is not receiving primary tank pressure within the AIR1 message. Inspect J1939 CAN bus for the presence of AIR1 message and primary pressure signal information.
521617	15	35-3	EAC AIR1 secondary tank pressure signal missing.	EAC is not receiving secondary tank pressure within AIR1 message. Inspect J1939 CAN bus for the presence of the AIR1 message and secondary pressure signal information.

Table 1 - Troubleshooting Table

Diagnostic Trouble Code (DTC) Storage / Event History

The Electronic Air Control (EAC) system and Bendix® ACom® Diagnostic Software retain a record of all Diagnostic Trouble Codes (DTCs). This record is commonly referred to as "event history." When a DTC self heals or is manually cleared, the DTC code remains in event history as an inactive DTC.

Bendix Technical Assistance Team

For direct telephone technical support, the Bendix Tech Team is available at 1-800-AIR-BRAKE (1-800-247-2725), option 2, Monday through Thursday, 8:00 a.m. to 6:00 p.m. and Friday, 8:00 a.m. to 5:00 p.m. ET. Follow the instructions in the recorded message. The Bendix Tech Team can also be reached by email at techteam@bendix.com.

Bendix ACom Diagnostic Software

The EAC system is supported by ACom Diagnostic Software. Visit b2bendix.com for additional information and for downloads of the ACom Diagnostic Software.

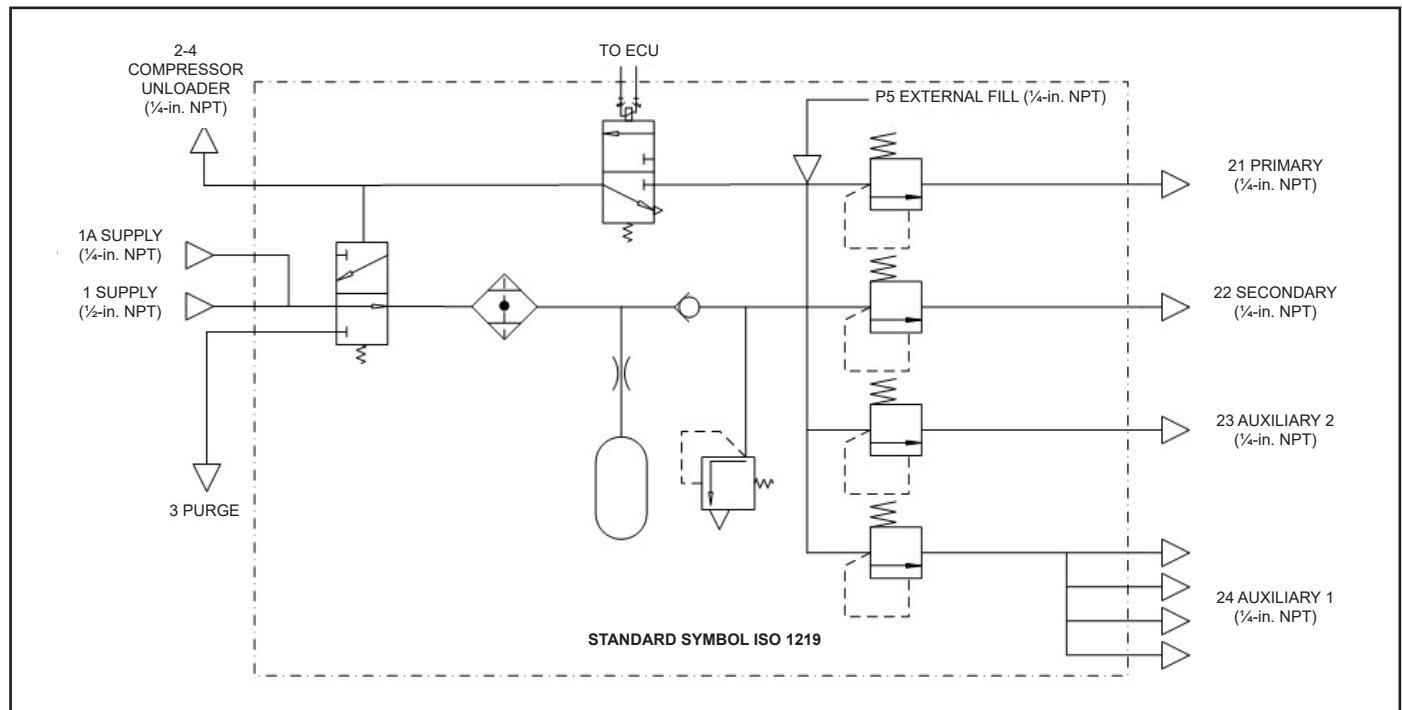


Figure 3 – Schematic

RELATED DOCUMENTATION

Bendix Specifications	
SD-08-12046	Bendix® AD-HF® and AD-HFi™ PuraGuard® Oil Coalescing Air Dryer Service Data Sheet
SD-13-4983	Bendix® EC-80™ ABS/ATC Controller Service Data Sheet
SD-13-4986	Bendix® ESP EC-80™ Controller Service Data Sheet
Society of Automotive Engineers (SAE) Documents	
SAE J1939-71	Vehicle Application Layer
Government Requirements	
FMVSS 121	U.S. Department of Transportation, National Highway Safety Administration Federal Motor Vehicle Safety Standard 571.121
Other Documentation	
RP-1210A	Technology Maintenance Council (TMC) Recommended Practice for Microsoft® Windows® communications APO

Table 2 – Related Documentation

ABBREVIATIONS AND DEFINITIONS

ABS	Antilock Braking System
AD-HFi EP	Air Dryer - High Flow Intelligent with Solenoid Governor, Extended Purge Tank
AD-HFi SP	Air Dryer - High Flow Intelligent with Solenoid Governor, Standard Purge Tank
ATC	Automatic Traction Control
BCVS	Bendix Commercial Vehicle Systems LLC
CAN	Controller Area Network
Cut-In	The lower air pressure threshold at which the compressor loads to build pressure
Cut-Out	The higher air pressure threshold at which the compressor unloads to stop building pressure
DTC	Diagnostic Trouble Code
EAC	Electronic Air Control
ECM	Electronic Control Module
ECU	Electronic Control Unit
GND	Electrical Ground Potential
SA	Source Address
PRV	Pressure Relief Valve

Table 3 – Abbreviations and Definitions

