

Technical Bulletin



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Subject: **Bendix® 600-volt Electric Screw Module 1 (ESM1)**

OVERVIEW

The Bendix® Electric Screw Module 1 (ESM1) is an electric air compressor that generates and supplies compressed air for a commercial vehicle air brake system. The major components that constitute the ESM1 assembly are the high-voltage electric motor (E-motor) (with an integrated inverter and CAN interface) and the oil-injected rotary screw compressor. Using electrical energy from the batteries of the Electric Vehicle (EV), the electric motor drives the compressor using a flange coupling connection between the two (2) sub-components to produce compressed air. See *Figure 1*.

The ESM1 is a high-voltage, liquid-cooled device, and requires coolant from the vehicle's cooling circuit during operation. The coolant runs in series – first through the motor and then through the heat exchanger on the compressor. The compressor has a self-contained oil system and does not require oil fed from the vehicle during operation. The ESM1 is required to be physically protected from wind and road splash using an enclosure box and/or thermal insulation for proper thermal management of the device.

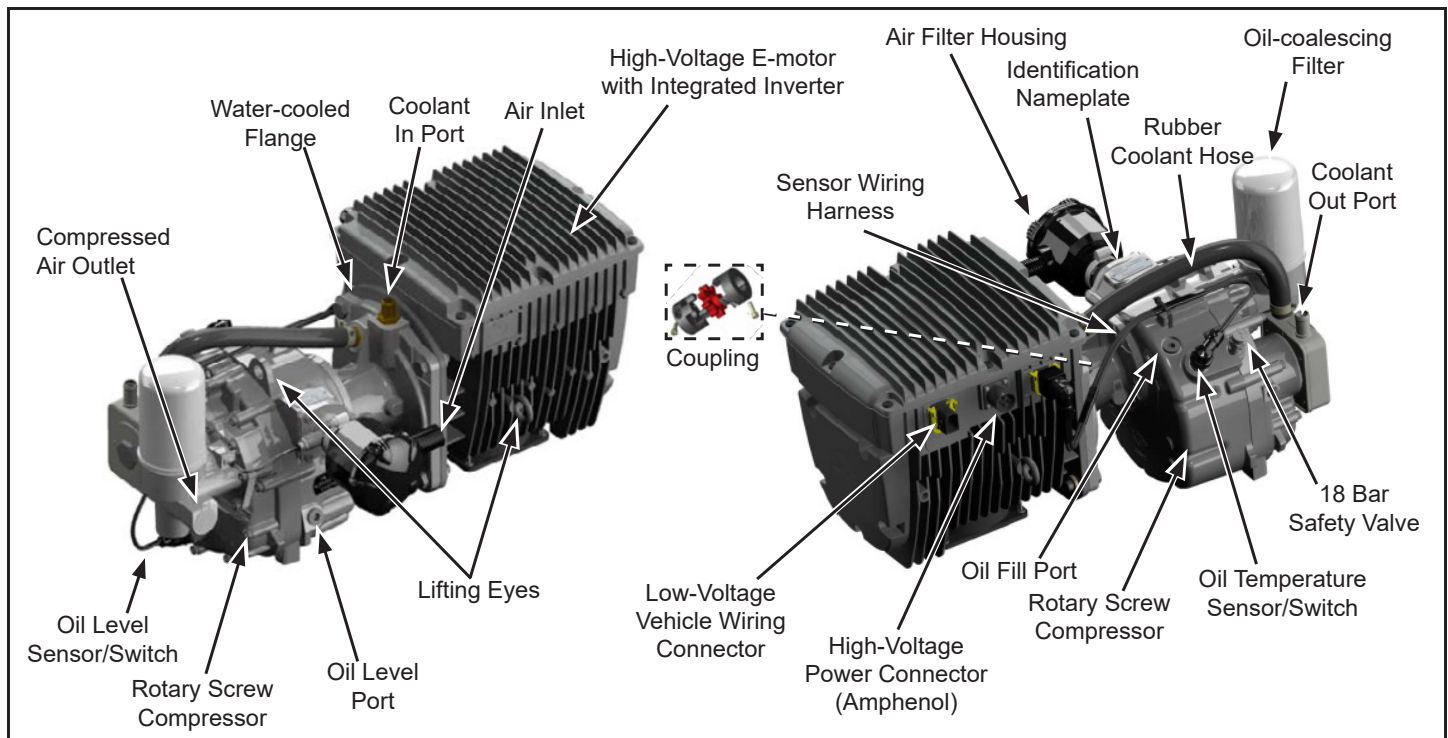


Figure 1 – Electric Screw Module 1 (ESM1) Components



WARNING

Service of the high-voltage system on this vehicle is restricted to qualified personnel. The required qualifications vary by region. Always observe local laws and legislative directives regarding electric vehicle service. Failure to follow this instruction may result in serious personal injury or death.

 **WARNING**

Persons with active implants must not work on the high-voltage system. The high-voltage system generates electric and magnetic fields. Fatal or serious physical injury can ensue from malfunctioning active implants (e.g., heart pacemaker, insulin pumps). Failure to follow these instructions may result in serious personal injury or death.

 **WARNING**

To prevent the risk of high-voltage shock, always precisely follow all warnings and service instructions including instructions to depower the system. The high-voltage system utilizes high-voltage cables to its components and modules. The high-voltage cables and wiring are identified by orange harness tape or orange wire covering. All high-voltage components are marked with high-voltage warning labels with a high-voltage symbol. Failure to follow these instructions may result in serious personal injury or death.

 **WARNING**

Disconnect the 12 V (or 24 V) battery before servicing the direct current to alternating current (DC-AC) inverter or alternating current (AC) power point to prevent the risk of high-voltage shock. Failure to follow this instruction may result in serious personal injury.

 **WARNING**

Extreme heat, such as paint-drying ovens, will cause damage of the high-voltage battery. The high-voltage battery must be removed before using paint-drying ovens longer than 45 minutes or with temperatures above 140°F (60°C). Failure to follow this instruction may result in damaging the high-voltage battery, which could cause serious personal injury or death in a fire or explosion.

 **WARNING**

FOR VEHICLES EQUIPPED WITH A SERVICE DISCONNECT PLUG: Never install the service disconnect plug when a high-voltage service cover is removed. Always install the cover prior to connecting the service disconnect plug. The cover prevents inadvertent contact with the high voltage, which is present at several points under the cover. Failure to follow these instructions may result in serious personal injury or death.

 **WARNING**

Work on high-voltage components during live-voltage conditions requires an additional person present to ensure safety. This person must be a qualified High-Voltage Technician equipped with a rescue hook and able to provide first aid in case of electrical shock. Failure to follow these instructions is a violation of European legislation safety regulations and may result in serious personal injury or death.

 **CAUTION**

The Bendix® Electric Screw Module 1 (ESM1) is a high-voltage device. Beware of electric shock. Service for the ESM1 must be performed only by qualified technicians. The ESM1 has a high-voltage motor, and the motor should not be opened or dismantled for repair. The ESM1 has air under high pressure within the rotary screw compressor, and care must be taken when servicing the compressor to avoid sudden air pressure loss and/or hot oil expulsion, which could result in injury or death.

 **IMPORTANT**

The ESM1 has one (1) integral lifting eye on the compressor (18-mm diameter) and two (2) side M8 tapped holes on the motor that allow lifting eyes to be screwed onto the device. Care should be taken to not tilt the ESM1 more than 45° during handling and installation to prevent oil spill.

MAINTENANCE

Maintenance must be performed every 1,500 operating hours (operating hours are defined as when the compressor is running) or at least once a year.

- Change the oil (Chevron® Cetus® PAO 46 or Castrol® Alphasyn T46 only)
- Replace the oil-coalescing filter
- Replace the air filter
- Visually check the compressor to track any potential issues (leakages, shocks, etc.)

AIR AND COOLANT CONNECTIONS

See Figure 2 for the air and coolant connections for the Bendix® Electric Screw Module 1 (ESM1).

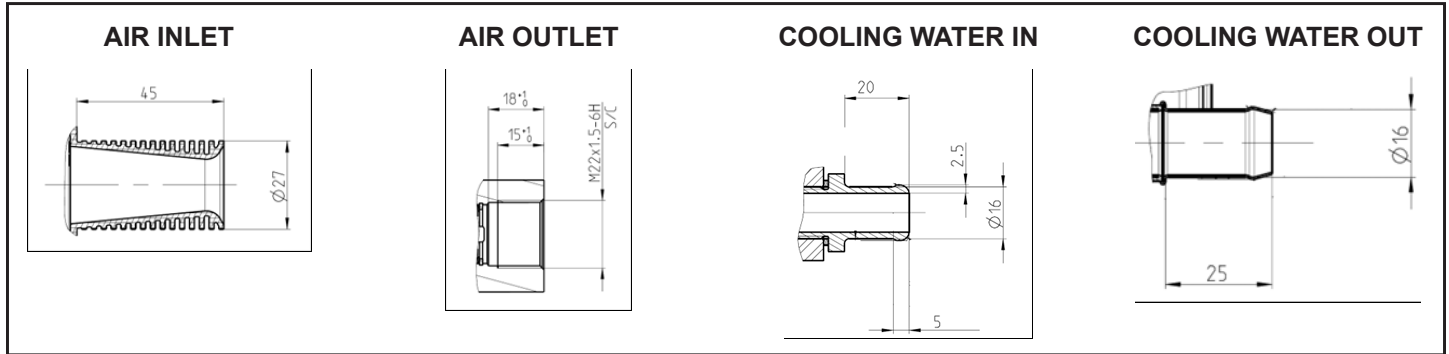


Figure 2 – Air and Coolant Connections

ELECTRICAL CONNECTION

See Figure 3 for the low- and high-voltage connections for the Bendix® Electric Screw Module 1 (ESM1).

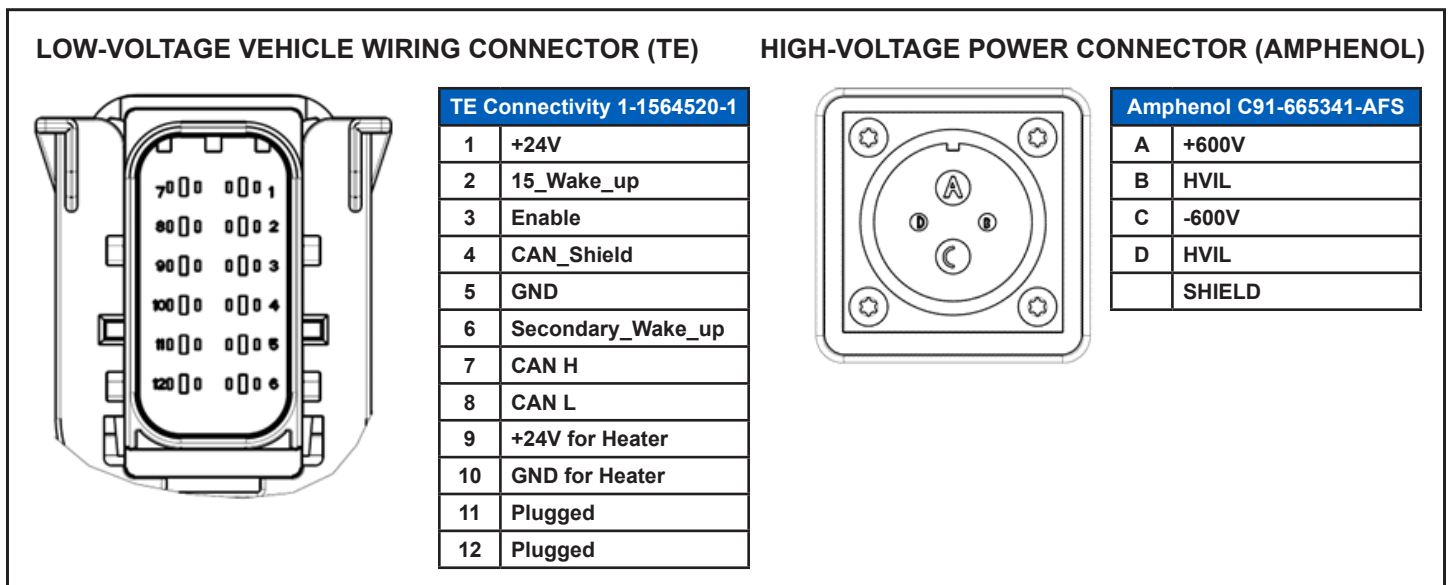


Figure 3 – Low- and High-Voltage Connections

DIAGNOSTIC TROUBLE CODES (DTCS)

Use Bendix® ACom® PRO™ Diagnostic Software to read any potential Diagnostic Trouble Codes (DTCs) on the Bendix® Electric Screw Module 1 (ESM1), and take the appropriate next steps. Refer to Table 1.

DTC CODE (DEC)	DM1 AMBER WARNING LAMP	DM1 RED WARNING LAMP	NAME	DESCRIPTION	DTC ACTION
257	No	Yes	eCompressor (ESM1) fault: Traction voltage critically low, motor stopped	DC traction high-voltage supply malfunction: Voltage lower than 420 V for 5 seconds, and the ESM1 is requested to run.	<ul style="list-style-type: none"> The voltage being supplied to the ESM1 is outside of the nominal range of 500-800 VDC. Contact the OEM for further troubleshooting on the ESM1 high-voltage power supply. If the voltage is found to be within the nominal range of 500-800 VDC, and the DTC persists, replace the ESM1 motor.
258	No	No	eCompressor (ESM1) fault: Traction voltage low, reduced speed	DC traction high-voltage supply malfunction: Voltage lower than 500 V for 5 seconds, and the ESM1 speed is below 81% of requested speed for 5 seconds.	<ul style="list-style-type: none"> The voltage being supplied to the ESM1 is outside of the nominal range of 500-800 VDC. Contact the OEM for further troubleshooting on the ESM1 high-voltage power supply. If the voltage is found to be within the nominal range of 500-800 VDC, and the DTC persists, replace the ESM1 motor.
259	No	No	eCompressor (ESM1) fault: Allowable current limit reached	Motor allowable current limit reached in high-voltage line.	<ul style="list-style-type: none"> Check the compressor air discharge line for potential blocks due to ice or other reasons, and clear any blockage if present. Ensure there is free air flow to the air dryer. If no blockage is found, check the oil level in the compressor through the side level port. CAUTION: Unscrewing the oil plug may result in air pressure loss or hot oil spurting. Ensure there is no air pressure within the compressor by unscrewing for a half turn and letting the system de-pressurize before unscrewing completely. Refill if oil is needed. If the previous steps do not resolve the Diagnostic Trouble Code (DTC), contact the OEM to verify that the allowable current limit for the unit is > 15A, as controlled by the vehicle controller. If the problem persists, the issue could be a damaged motor or a damaged compressor; replace the damaged component.
260	No	Yes	eCompressor (ESM1) fault: Traction voltage critically high, motor stopped	DC traction high-voltage supply malfunction: Greater than 800V for 0.5 seconds, and the ESM1 is requested to run.	<ul style="list-style-type: none"> The voltage being supplied to the ESM1 is outside of the nominal range of 500-800 VDC. Contact the OEM for further troubleshooting on the ESM1 high-voltage power supply. If the voltage is found to be within the nominal range of 500-800 VDC, and the DTC persists, replace the ESM1 motor.

Table 1 – Diagnostic Trouble Codes (DTCs)

DTC CODE (DEC)	DM1 AMBER WARNING LAMP	DM1 RED WARNING LAMP	NAME	DESCRIPTION	DTC ACTION
261	No	Yes	eCompressor (ESM1) fault: Motor overload	Motor overload, failed to achieve >1400 RPM for 15 seconds continuously.	<ul style="list-style-type: none"> Check the compressor air discharge line for potential blocks due to ice or other reasons, and clear any blockage if present. Ensure there is free air flow to the air dryer. If no blockage is found, check the oil level in the compressor through the side level port. CAUTION: Unscrewing the oil plug may result in air pressure loss or hot oil spurting. Ensure there is no air pressure within the compressor by unscrewing for a half turn and letting the system de-pressurize before unscrewing completely. Refill if oil is needed. If the previous steps do not resolve the Diagnostic Trouble Code (DTC), the issue could be a damaged motor or a damaged compressor; replace the damaged component.
262	No	Yes	eCompressor (ESM1) fault: Motor internal fault	Motor internal fault - Power stage error.	<ul style="list-style-type: none"> Replace the ESM1 motor.
263	No	Yes	eCompressor (ESM1) fault: Motor internal fault	Motor internal fault - No connection with power unit.	<ul style="list-style-type: none"> Replace the ESM1 motor.
264	No	Yes	eCompressor (ESM1) fault: Compressor overheated	Compressor overheated.	<ul style="list-style-type: none"> Turn off the device and allow the ESM1 to cool down for approximately 60 minutes. Ensure that there is proper coolant supply to the ESM1. Coolant must be 50-50 ethylene glycol-water mixture at nominal temperature of 40°C (104°F) (should not go below 30°C [86°F] or above 65°C [149°F]), with flow rate of 10 l/min. Contact the OEM if the coolant flow or temperature is not within specification. Check the sensor wiring harness including connectors and pins on the ESM1; replace if faulty. Check the thermal switch on the ESM1; replace if faulty. Check the oil level in the compressor through the side level port. CAUTION: Unscrewing the oil plug may result in air pressure loss or hot oil spurting. Ensure there is no air pressure within the compressor by unscrewing for a half turn and letting the system de-pressurize before unscrewing completely. Refill if oil is needed. Check the compressor air discharge line for potential blocks due to ice or other reasons, and clear any blockage if present. Ensure there is free air flow to the air dryer. If the problem persists, replace the compressor.

Table 1 – Diagnostic Trouble Codes (DTCs)

DTC CODE (DEC)	DM1 AMBER WARNING LAMP	DM1 RED WARNING LAMP	NAME	DESCRIPTION	DTC ACTION
265	No	Yes	eCompressor (ESM1) fault: Motor overheated	Motor overheated.	<ul style="list-style-type: none"> Turn off the device and allow the ESM1 to cool down for approximately 60 minutes. Ensure that there is proper coolant supply to the ESM1. Coolant must be 50-50 ethylene glycol-water mixture at nominal temperature of 40°C (104°F) (should not go below 30°C [86°F] or above 65°C [149°F]), with flow rate of 10 l/min. Contact the OEM if the coolant flow or temperature is not within specification. Check that the fan on the motor is working; replace the motor if damaged. Check the compressor air discharge line for potential blocks due to ice or other reasons, and clear any blockage if present. Ensure there is free air flow to the air dryer. If the problem persists, replace the motor.
266	No	No	eCompressor (ESM1) fault: Motor outer fan fault	Motor outer fan fault.	<ul style="list-style-type: none"> Clean the outer fan on the motor, as debris can lead to reduced fan speed. If the previous step does not resolve the issue, replace the ESM1 motor.
267	No	No	eCompressor (ESM1) fault: Inner fan fault	Inner fan fault.	<ul style="list-style-type: none"> Replace the ESM1 motor.
268	Yes	No	eCompressor (ESM1) fault: Compressor oil level low	Compressor oil level low.	<ul style="list-style-type: none"> Check the oil level in the compressor through the side level port. CAUTION: Unscrewing the oil plug may result in air pressure loss or hot oil spurting. Ensure there is no air pressure within the compressor by unscrewing for a half turn and letting the system de-pressurize before unscrewing completely. Refill if oil is needed.
269	No	No	eCompressor (ESM1) fault: CAN communication error	CAN communication error.	<ul style="list-style-type: none"> Check the ESM1 vehicle harness, ensuring that there is good connection. Replace the harness if damaged. <p>OR</p> <ul style="list-style-type: none"> Check the eIAG air dryer and the vehicle Electronic Control Unit (ECU). Contact the OEM if the problem persists.

Table 1 – Diagnostic Trouble Codes (DTCs)

DTC CODE (DEC)	DM1 AMBER WARNING LAMP	DM1 RED WARNING LAMP	NAME	DESCRIPTION	DTC ACTION
270 272 273	No	Yes	eCompressor (ESM1) fault: CAN communication error	CAN communication error.	<ul style="list-style-type: none"> Check the ESM1 vehicle harness and ensure that there is good connection. Replace the harness if damaged. OR <ul style="list-style-type: none"> Check the eIAG air dryer and the vehicle Electronic Control Unit (ECU). Contact the OEM if the problem persists.
271	Yes	No	eCompressor (ESM1) fault: CAN communication error	CAN communication error.	<ul style="list-style-type: none"> Check the ESM1 vehicle harness, ensuring that there is good connection. Replace the harness if damaged. OR <ul style="list-style-type: none"> Check the eIAG air dryer and the vehicle Electronic Control Unit (ECU). Contact the OEM if the problem persists.
274	No	No	eCompressor (ESM1) fault: Motor software internal fault	Motor software corrupted.	<ul style="list-style-type: none"> The software is corrupted. Replace the ESM1 motor.
275	No	No	eCompressor (ESM1) fault: CAN bus fault	CAN bus fault.	<ul style="list-style-type: none"> Check the ESM1 vehicle harness, ensuring that there is good connection. Replace the harness if damaged. OR <ul style="list-style-type: none"> Check the eIAG air dryer and the vehicle Electronic Control Unit (ECU). Contact the OEM if the problem persists.
276 277	Yes	No	eCompressor (ESM1) fault: Compressor oil level sensor fault	Compressor oil level sensor fault.	<ul style="list-style-type: none"> Check the sensor wiring harness including connectors and pins on the ESM1; replace if faulty. Perform a power reset by turning the vehicle ignition OFF for at least 60 seconds and verify there is no Diagnostic Trouble Code (DTC). If the previous action did not resolve the DTC, replace the oil level sensor.
278	No	No	eCompressor (ESM1) fault: e-motor internal temperature sensor failure	E-motor internal temperature sensor failure.	<ul style="list-style-type: none"> Replace the ESM1 motor.
279	No	No	eCompressor (ESM1) fault: Fan ON, power supply fault	The fans have been requested ON for at least 5 seconds. AND The fan supply is below 5 V.	<ul style="list-style-type: none"> The fan control failed. Replace the ESM1 motor to avoid overheating.
280	No	No	eCompressor (ESM1) fault: Fan OFF, power supply fault	The fans have been requested OFF for at least 5 seconds. AND The fan supply is above 22 V.	<ul style="list-style-type: none"> The fan control failed. Replace the ESM1 motor to avoid overheating.

Table 1 – Diagnostic Trouble Codes (DTCs)

DTC CODE (DEC)	DM1 AMBER WARNING LAMP	DM1 RED WARNING LAMP	NAME	DESCRIPTION	DTC ACTION
281	No	No	eCompressor (ESM1) fault: Motor torque high, reduced speed	Motor torque high, reduced speed.	<ul style="list-style-type: none"> Check the compressor air discharge line for potential blocks due to ice or other reasons, and clear any blockage if present. Ensure there is free air flow to the air dryer. If no blockage is found, check the oil level in the compressor through the side level port. CAUTION: Unscrewing the oil plug may result in air pressure loss or hot oil spurting. Ensure there is no air pressure within the compressor by unscrewing for a half turn and letting the system de-pressurize before unscrewing completely. Refill if oil is needed. If the previous steps do not resolve the Diagnostic Trouble Code (DTC), the issue could be a damaged motor or a damaged compressor; replace the damaged component.
282	Yes	No	eCompressor (ESM1) fault: Motor internal temperature sensor fault	Motor multiple internal temperature sensor failure.	<ul style="list-style-type: none"> Replace the ESM1 motor.

Table 1 – Diagnostic Trouble Codes (DTCs)

ADDITIONAL SUPPORT

For 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.

